Unemployment and property crime: evidence from Croatia

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Abstract

This paper studies the effect of unemployment on property crime in Croatia. The workhorse model of economics of crime is estimated on yearly panel data at the county level over the period 1998-2016. The results show that unemployment has a significant and positive effect on burglaries. The estimated elasticity is higher for female unemployment. The main effect of unemployment comes from lower crime quantiles for female unemployment, and from higher crime quantiles for male unemployment. The police force has the strongest negative effect on crime in areas with the highest crime rates. The typical identifying variation in unemployment is used to interpret the economic significance of the estimated effect. For a typical increase in unemployment, the number of burglaries is estimated to increase by 3.3 percent, which translates to over 750,000 euros in reported damages.

Keywords Unemployment · Property crime · Burglary · Robbery · Theft · Panel data · Fixed-effects

Introduction

Crime inflicts substantial damage to society. Unemployment is, along with other, well-known associated costs, also often mentioned as an antecedent to growing crime rates. During the prolonged seven-year recession (2009-2014), Croatia's GDP fell by 13 percent, with the number of unemployed reaching 345 thousand in 2013. In spite of the consistently high unemployment, which soared further during the crisis, no attempt has yet been made to empirically examine the effect of such adverse labor market conditions on crime rates. Croatia represents a perfect case study for examining the unemployment-crime (hereafter UC) relationship not only because of the severity and duration of the crisis but also because the crisis was reasonably

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exogenous. Croatia, as a small and open EU economy, effectively imported unfavourable economic conditions. Such a scenario enables clear identification of the UC relationship.

Several theories are dominant in the discussion of the factors and aetiology of crime and delinquent behaviour. Social control theory explains crime through weak social controls, weak parents' supervision and/or lack of bonds with significant family members, including parents [1]. On the contrary, social learning theory focuses on, instead of the absence of relationships, or relationships with deviant others [2]. Forming general strain theory, [2] recognizes three categories of strains: failure to achieve goals, removal of positive stimuli, and the presence of negative stimuli. Another frequently cited theory, especially in the economics of crime literature is a routine activity approach by [3]. In this view, criminal acts occur when likely offenders, suitable targets, and the absence of capable guardians converge in space and time [3]. Becker [4] formalizes criminal behaviour through the model of rational agents, who decide whether to commit a crime based on their expected returns from crime and from honest work. Becker's model fits well in the general strain theory. High unemployment, which is observed by [4] as decreased return on honest work, represents a significant strain for individuals. The more individuals are unemployed; the more people experience failure or anticipated failure to achieve their goals.

Given that seminal work by [4] on the rational choice theory behind crime gave researchers a powerful tool for the analysis of the UC relationship, it is not surprising that an avalanche of research was done, both theoretically and empirically to either confirm, explain, refute, or elucidate Becker's work. A large portion of this research was directed towards explaining the UC relationship. The lack of consensus in empirical research eventually resulted in [5] proposing the alternative path through which unemployment could affect crime. Cantor and Land [5] argued that the diminished engagement in social activities by the unemployed individuals results in a decreased probability that they will become either victims or perpetrators of crime. According to [6], the motivational effect is the main driver behind property crime, while the opportunity effect is relevant in the case of violent crime. Their findings are consistent with other studies finding a positive and significant effect of unemployment on property crimes ([6–11]; among others).

In Croatia, a former Yugoslav republic, the ravages of war were accompanied by the transition from self-governing socialism [12] to Western capitalism. Along with controversial privatization after the war, this resulted in growing unemployment from 240 thousands of unemployed in 1995 to striking 390 thousand in 2002. Šelih [13] notes that generally, transition countries' expectations were too high. They wanted to preserve the positive sides of the previous system, such as job security, or social and medical care. But, they also wanted to enjoy the benefits of the new system - political freedoms, efficient economy, higher standards of living, and private initiative [13]. [14] describes the slow and steady growth in crime rates from 1985 onwards in all former-Yugoslavia states[1].

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[1]There are several theories explaining the growth in crime rates in the transition from socialism to capitalism, which is outside the scope of this paper. For more details reader is advised to consult [14]

Surprisingly, the post-war period also failed to yield the much-desired stability. The volatility of economic conditions in the last 19 years is best depicted in Figure 1. Both, unemployment and total crime show substantial variation across the observed period. Just when the economy started growing (2003-2008), the global financial crisis struck and pushed the country almost back to pre-war levels of unemployment and GDP. The number of unemployed reached 345 thousand in 2013, which is not far from the record from 10 years before. The crisis in Croatia was deep and persistent with GDP contracting by 13 percent cumulatively between 2009 and 2014. It is not difficult to imagine how the difficult conditions represented in Fig. 1 could push people into crime after a certain threshold of strain is reached, as noted by [2].

The same period also saw substantial variations in the total crime rate. Total committed crimes in the observed period followed the reversed U-shaped curve, which is interesting as one would expect the largest crime rates right after the war. Instead, 1998 marked the minimum of total crimes with 56 thousand. Steady growth followed which peaked in 2004 with more than 85 thousands registered crimes followed by a decline in spite of the crisis. In 2014 there was almost the same number of recorded crimes as in 1998.

The variation in unemployment is similar to the one used by [15] for Sweden, albeit for the longer period, which presents a perfect environment for studying the effects on crime rates. So far, the empirical evidence on the UC relationship to date is still somewhat ambiguous. Over 30 years ago [16] summarized empirical evidence and showed that vast majority of results point to the positive effect of unemployment on property crimes, but emphasizing the conditional nature of this relationship and characterizing overall evidence from the literature as 'consensus of doubt'. In a later review by [17], it is noted that, while joblessness is not the overwhelming determinant

Fig. 1 Percentage change in total crimes and unemployment rate, 1998-2016. Source: Author's calculations based on data from Ministry of Interior and Croatian Employment Service

of crime, the two are indeed related. Since then, an avalanche of empirical studies was published, with most of them finding a positive and significant effect of unemployment on crime (notable examples include [6, 7, 9–11, 18–25]).

The present paper continues the line of empirical investigation of UC relationship for property crimes and contributes to the literature in several key areas. First, it offers first detailed empirical insight into the UC relationship in less developed, post-transition European country. Existing research focuses either on the United States data [6–11], or on other developed economies, such as Sweden [15, 26], Germany [27] or Spain [20, 21]. Second, it builds on the work by [28] and [29] by considering gender heterogeneity in estimating the UC relationship. The results show that this distinction is indeed relevant in the Croatian case. Third, to allow for non-linear UC relationship, quantile regression is estimated to see which quantiles of crime drive the average estimated effect. Finally, while some UC literature discusses the increase in damages associated with unemployment-induced crime [18], it rarely considers a credible counter-factual scenario, that is whether the hypothesized increase ever happens in reality. In the present paper, the approach by [30] is used to improve the interpretation of the results and give some basic back-of-the-envelope calculations of damages associated with a typical increase in unemployment.

The paper is structured as follows. Next section lists the related literature and estimations of UC relationship. The third section presents the data and empirical strategy used to estimate the UC relationship. The fourth section presents the main results of the conducted analysis. The next section discusses the main findings of the paper and the last section concludes.

Related literature on UC relationship

Early research focusing on the nexus between unemployment and crime was done using the time-series analysis [8, 31]. Britt [8] investigated the relationship for the youth population in the United States (US) and found support for the impact of opportunity effect of current unemployment on criminal activity and of prolonged unemployment on property crime. Hale and Sabbagh [31] show the time-series of crime from England and Wales in the period 1949-1987, arguing against the opportunity effect and approach presented by [5].

More recent work focused on the identification of the causal effect of unemployment on crime, and less on theory development and deliberation, which was a defining characteristic of earlier research. Raphael and Winter-Ebmer [11] and [10] both discussed the issue of endogeneity of the UC relationship and elected for IV to estimate the impact of unemployment on crime in the US. They find positive effects of unemployment on property crimes. Gould et al. [9] examined the degree to which changes in crime rates can be explained by changes in the labor market opportunities for those most likely to commit a crime — less-educated men. They found that crime rates are significantly determined by the wages and unemployment rates of less-educated males in the US. [6] also found support for a positive relationship between unemployment and property crimes on the county, state, and national level in the United States. [7] found that the benefit extensions of unemployment are linked

to higher property crime rates in the US. The interpretation is that the longer benefit durations are related to longer unemployment durations, which then lead to increased propensities for criminal activities.

The blossoming research into the UC relationship was almost exclusively focused on the US until the early 2000s. [27] used a rich dataset for Germany, but provided 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, supporting the opportunity perspective by [5]. Carmichael and Ward [32] used county-level data in Britain to investigate the relationship between male and youth unemployment and crime. They find a positive relationship between male unemployment and crime, regardless of age. Fougère et al. [33] found a significant impact of youth unemployment on crime for France on regional data in the period 1990-2000. Edmark [15] and [26] both provided evidence of the positive effects of unemployment and long-term unemployment on various categories of property and violent crimes in Sweden.

More recently, there were further attempts to analyze the UC relationship in southern European and Mediterranean countries. Saridakis and Spengler [25] provided evidence for deterrence of property crimes due to higher clear-up rates and the positive impact of unemployment on property crimes in Greece. They found no support for these relationships when violent crimes are used as dependent variables. [24] also analyzed the UC nexus in Greece. Exploiting the regional level panel data for the 1999-2013 period, he found the association between some crime categories, and only after the beginning of the crisis in 2009. Furthermore, his research showed that long-term unemployment is weakly related to total criminal activity during the crisis years, albeit positively. He also found a negative association between crimes against life and unemployment. [20] failed 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. [21] provided evidence for larger pertinence of socio-economic variables in comparison with unemployment for Spain. [18] presented 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. While there is an abundance of research on the UC relationship, in some regards, the literature is still lacking and ambiguous.

The present paper aims to tackle four particular deficiencies of existing research. First, since early contributions by [28] and [29], the UC studies generally neglected the distinction between male and female unemployment and potential differences in its effect on crime. [11] and [25] both include female unemployment only to explain the negative effect of unemployment on rape, without including it in the analysis of other crime categories. In this paper, the Becker-type model is estimated separately for both genders.

Second, aside from recent work by [23] and [34], the existing literature does not allow for different effects of unemployment for varying levels of crime in respective regions. [34] examine the effect of different socio-economic variables and policing on crime rates in England and Wales in the period 1992-2007. They find that policing has the most potent crime-reducing effect in low-crime areas and that the effect of

unemployment on crime is more substantial in high-crime areas. Also, they find that higher detection rates have a stronger effect on reducing crime in low-crime areas. [23] also examine the UC relationship on German district panel data in the period 2003-2009. They apply the quantile regression method to allow the identification of non-linear UC relationship, based on two arguments. First, in low-crime areas, there is more incentive to commit a crime when unemployment rises because one faces less effective prevention by potential victims. However, any potential detection in a low crime area implies a higher risk of social stigma. [23] provide empirical support of opportunity-based approach for property crimes, meaning that the effect of unemployment on crime is stronger in areas with comparatively low crime rates. However, they could not replicate these results when using fixed effects. As the results from two empirical studies differ, it is necessary to explore further the differences in unemployment effect as well as in policing effect in regions with different crime rates.

Third, existing studies rarely tried to use credible counter-factual scenario to interpret the estimated effect of unemployment on crime. In this paper, the approach by [30] is used to interpret the increase in monetary cost trough the typical identifying variation of unemployment.

Finally, the main downside of current empirical research is almost an exclusive focus on developed democracies, which is evident from both recent literature reviews [35, 36]. Some notable exceptions to this rule include [37] and [38] who explore the impact of economic hardship on crime in rural Tanzania and Madagascar respectively. Further, [39] provides tentative evidence of the connection between youth unemployment and crime in Nigeria. Countries of post-transitional Europe differ substantially from Western Europe in both economic development and the age of their democracy. However, they bear even less resemblance to rural Africa. Thus, the generalization of the results from the existing literature would inevitably be misleading.

As [40] argues, the UC relationship is generally ambiguous, and the effect of unemployment on crime probably varies across different legal systems and cultures. This paper aims to bridge this gap by providing empirical evidence on the UC relationship in Croatia. In particular, it offers insight into the effect of unemployment on total property crimes, burglaries, robberies, and thefts.

Model specification and data

The data are gathered for 20 Croatian counties in the period 1998-2016. 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 the Croatian Bureau of Statistics publications and 2001 and 2011 population censuses. A summary of the collected data is in Table 1.

Based on the theory and previous research ([15, 41] and others), but with certain limitations with regards to availableness of the data, several covariates are used. Clear-up rates for each category of a crime serve as a proxy for the probability of

Table 1 Summary statistics for crime rates and covariates

Statistic	N	Mean	St. Dev.	Min	Max
Aggregate property crimes	380	64.195	40.210	11.126	247.562
Burglary	380	33.614	21.707	5.452	141.789
Robbery	380	1.477	1.562	0.000	10.389
Theft	380	26.212	17.388	3.811	103.297
Unemployment	380	756.827	235.305	256.575	1,267.290
Male unemployment	380	341.327	114.249	89.669	603.329
Female unemployment	380	415.507	129.425	143.456	688.115
Aggregate property clear-up	380	0.413	0.112	0.148	0.814
Burglary clear-up	380	0.391	0.112	0.118	0.841
Robbery clear-up	377	0.642	0.254	0.000	3.000
Theft clear-up	380	0.426	0.136	0.136	0.848
Infant mortality	380	0.576	0.608	0.000	11.178
Divorces	380	10.857	3.366	2.979	25.691
Police officers	380	49.245	17.945	25.659	105.391
Drug abuse	380	15.466	12.598	1.567	78.538
Average income (HRK)	380	4,216.746	905.567	2,270.000	6,092.000
Tourism intensity	380	134,999.600	219,826.900	570.704	1,112,260.000

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

getting caught. Clear-up rates are defined as the share of solved crimes in total committed crimes in a given year. In Becker's model, when clear-up rates are higher, the incentive to commit a crime decreases. Another factor potentially deterring individuals from crime is the size of the police force. Thus, the number of police officers is included as control. When substantial swings in unemployment are present, it is possible that the decrease in unemployment is accompanied by an increase in the number of the employed police force and therefore a surge in crime reporting propensities and vice versa. More importantly, a larger police force could have a sufficient discouraging psychological impact on criminals even without the effective changes in reporting propensities (for a detailed discussion on the deterrent effect of police force see [35]).

The income level of the county is controlled for by including the average net wage. Again there are two possible connections between income and crime. In wealthier regions, there is more potential loot, and therefore more incentive to commit a crime. Contrarily, lower income implies a greater temptation to seek alternative ways to generate revenues and thus also have a positive effect on crime. Another control variable that is rarely used in the current literature is tourism intensity, defined here as the number of tourist overnight visits. Croatia is a popular tourist destination, especially in the coastal region which consists of seven counties. Recent literature showed that high tourism intensity could indeed be related to higher crime rates [42,

43]. Seven coastal regions and the Capital (Zagreb) have significantly more tourist visits than the other counties. Further, anecdotal evidence for Croatia suggests that higher tourism intensity is related to larger shadow-employment. If this is the case, than tourism intensity could play a role in the UC relationship, as unemployment could be smaller than the official statistics shows. Thus, tourism intensity should be included as a control. Drug abuse crimes are included as a covariate for obvious reasons. Infant mortality and divorces are also included as proxies for cultural treats and development of different regions.

To control for the unobserved heterogeneity while estimating the UC relationship, 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 the 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; the relationship between unemployment and crime. The inclusion of county fixed effects eliminates all variation in crime rates caused by time-invariant factors. The inclusion of year effects phases out the variation due to factors that cause year-to-year changes in crime rates common to all counties. The possibility that this relationship suffers from reverse causality is discussed extensively in the literature [10, 11, 18]. High crime rates in one area could have a negative influence on the establishment of new companies and consequently put a restraint on employment. However, in case of a small, open economy with around 4 million inhabitants, whose whole GDP amounts to 1.5 percent of Germany's and 0.3 percent of EU-28 GDP, it is highly plausible to assume that the fluctuations on the labor market are predominantly 'imported', and not caused by crime rates. Furthermore, Croatia doesn't have a history of either terrorist attacks, kidnappings or gang violence, and is generally considered a safe country. The argument that the marginal changes in crime rates in such a setting could cause shifts in unemployment is not very convincing. Figure 2 also serves as a heavy advocate of this reasoning. It shows the relationship between the growth rate of total crimes versus growth rates of different proxies of companies' performance. Panel (a) shows the average growth rates of the number of companies. It is clear that there is no systematic relationship between crime and the number of companies, which suggests that crime does not discourage new businesses. To exclude the possibility that this stems from the black economy circuit not recorded by the official unemployment statistics, crime rates are compared to to (b) companies' revenues, (c) total number of employed people in companies (including the ones classified as unpaid workers) and (d) investments in long-term assets by companies. Again, no systematic relationship is found. If anything, there is a slight positive correlation in panel (b) and (c). Thus, Figure 4 provides an illustrative argument that crime is not a deterrent factor for operation of businesses in Croatia.

Finally, to allow for the identification of non-linear UC relationship, after OLS estimation, quantile regression is used to answer another type of question. While OLS gives the size of the effect, quantile regression shows which part of the distribution drives the estimated effect. For example, it is possible that unemployment has a stronger effect on crime in low-crime regions and weaker effect in high crime regions
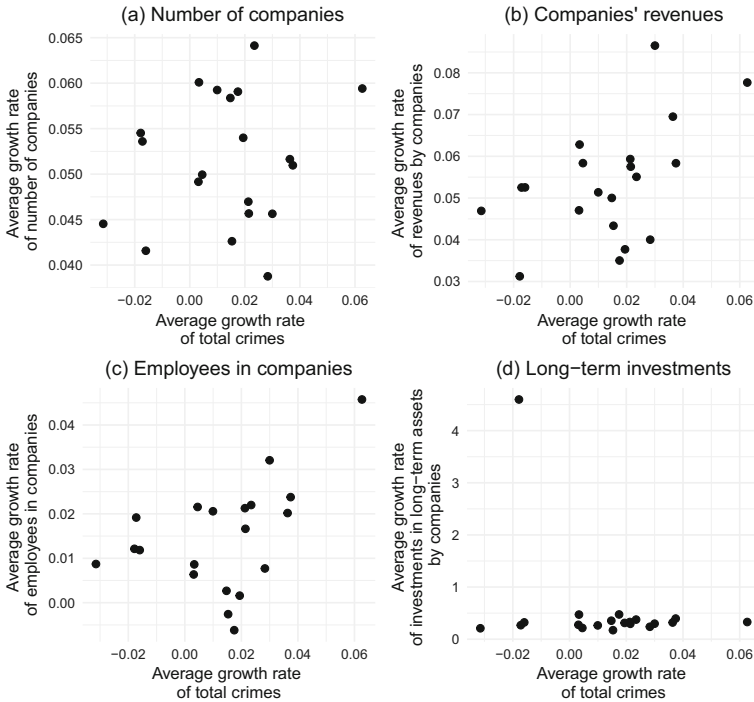
Fig. 2 Average growth of crime rates per 10,000 inhabitants vs. different proxies of companies' performance, 1998-2016. Source: Author's calculations based on data from Croatian Bureau of Statistics, Ministry of the Interior and Croatian Financial Agency

[23]. Similarly, as showed by [34], the effect of police force might differ between counties with different levels of crime.

Results

Baseline estimation

Results from our preferred baseline estimation, presented by equation (1) are in Table 2.[2] Unemployment does not affect aggregate property crimes but is related positively to more burglaries and fewer robberies, with no significant effect on thefts. At first, this result is at odds with most empirical research examining the UC relationship for property crimes. However, when taking into account that burglaries make up over 50 percent of all property crimes on average, the results are far less surprising. Interestingly, the effect on robberies is larger, negative and significant. The coefficient on thefts is also negative but is not significant.

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[2]Complete results for all specifications are given in the Appendix in tables A1-A4. Note that the columns from Table 2 reflect the columns 11 from tables A1 to A4 respectively.

Table 2 Unemployment and property crimes

	Dependent variable:			
	Property crimes	Burglary	Robbery	Theft
	(1)	(2)	(3)	(4)
Unemployment	0.044	0.297**	−0.628***	−0.206
	(0.140)	(0.147)	(0.198)	(0.180)
Clear-up rate	−0.181*	−0.004	−0.283	−0.308**
	(0.103)	(0.100)	(0.188)	(0.131)
Infant mortality	−0.017	−0.038*	−0.030	0.015
	(0.017)	(0.023)	(0.034)	(0.013)
Divorces	0.048	0.086	0.338**	0.022
	(0.059)	(0.080)	(0.142)	(0.063)
Police force	−0.500**	−0.716**	−0.224	−0.328
	(0.244)	(0.333)	(0.443)	(0.256)
Drug abuse	0.039	0.089	0.050	−0.025
	(0.058)	(0.065)	(0.069)	(0.059)
Income	1.539**	1.626**	1.558	1.389**
	(0.627)	(0.781)	(1.017)	(0.635)
Tourist overnights	0.150	0.223*	−0.062	0.071
	(0.098)	(0.123)	(0.105)	(0.089)
Observations	380	380	377	380
Adjusted R^2	0.905	0.865	0.797	0.895
Residual Std. Error (df = 334)	0.178	0.220	0.391 (dF = 331)	0.203

Notes: County clustered 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. Source: Author's calculations based on data from Croatian Bureau of Statistics, Croatian Employment Service and Ministry of the Interior.

Clear-up rates are deterrent factors for aggregate property crimes and theft, but the coefficients for burglary and robbery are not significant. A reasonable explanation would be that, because theft is defined as unlawful obtaining of a movable object *if the value of the stolen item is low*, it is easy to deter potential perpetrators from committing a theft in the first place. This result fits well into the basic model by [4] - the return on crime is low and increasing the probability of getting caught leads to a decrease in crime rate.

The police force is a strong deterrent factor for aggregate property crimes, which is mainly driven by burglaries. For each 1 percent increase in the number of police officers, there is a 0.72 percent decrease on average in the number of reported burglaries. This is comparable to the effect found in studies examining the deterrence effect of police on crime [44]. Studies since then have generally focused on IV due to the concern of simultaneity bias between the police force and crime. However,

according to [45] and emphasized by [35] there is no strong evidence of a relationship between lagged crime and the police force. This result is also relevant from a policy perspective as it suggests a direct way for policymakers to reduce crime. However, this might not be a pure deterrence effect. The elasticity of crime with regards to police may also reflect a role of incapacitation (see [35] for more details).

Average income is related to more property crimes, which suggests that wages are an important antecedent of the demand for crime. Tourism intensity is positively related to burglaries, as expected considering the influx of tourists during the peak of the season in July and August.[3]

Gender heterogeneity

Croatia is a patriarchal society where men earn substantially more than women and are more likely to be the main bread-winners of the household. Thus, the distinction between male and female unemployment could be even more relevant than noted previously [28, 29]. The models from Table 2 are re-estimated with female and male unemployment separately. The results remain virtually unchanged for all property crimes, except burglaries. The positive effect of unemployment on burglary is driven by female unemployment. The negative effect on robberies is the same, regardless of whether male, female or aggregate unemployment is used. Full results are presented in Table A5 in the Online Appendix.

Why is burglary mainly influenced by female unemployment? There are several possible and related explanations. First, when women become guardians in their home due to unemployment, burglars will hesitate less than when men guardians are present. Thus, when male unemployment rises, the number of potential offenders increases by the same amount as the number of capable guardians, which could explain why there is no effect. When female unemployment increases, the number of potential offenders increase, but the number of capable guardians remains unchanged. *Capable guardians* includes various deterrent factors, as defined by [3]. It is plausible that the female guardians are perceived by the offenders as less of a threat than their male counterparts.

Second, in a pronouncedly patriarchal society, men who lose their job tend to find another job relatively quicker than women. Looking at 2016 data, 56 percent of people who were unemployed for a year or longer were women. This share was well over 60 percent before 2010. Considering that long-term unemployment is more likely to push marginal cases into crime [46], crime could be the coping strategy of these households.

Note that in both explanations, the core of the argument is male offending but female victimization [29]. Thus, even when female unemployment is increasing, it is expected that the offenders will be males. Available data on the gender of offenders from 2010-2016 also supports this explanation — while the total number of property crime offenders decreased, the number of female offenders remained constant. In the

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[3]Just in 2016 more than 15.5 million tourists visited Croatia, which is 3.5 times the size of the population, and they recorded over 78 million overnight stays.

Table 3 Quantile regression results

	Quantile				
	0.05	0.25	0.5	0.75	0.95
Property crimes	0.087	−0.017	0.05	0.037	0.076
	(0.192)	(0.139)	(0.122)	(0.136)	(0.145)
Burglary	0.25	0.356***	0.375***	0.182	−0.28
	(0.203)	(0.136)	(0.131)	(0.172)	(0.206)
Robbery	−0.467	−0.404	−0.73***	−0.945***	−0.404
	(0.483)	(0.323)	(0.266)	(0.225)	(0.364)
Theft	−0.414*	−0.345	−0.162	−0.105	−0.002
	(0.238)	(0.218)	(0.156)	(0.184)	(0.226)

All control variables and fixed effects from Table 2 are included in all regressions. The standard errors are bootstrapped standard errors using the xy-pair method on 500 bootstrap replications; *significant at 10%, **significant at 5%, ***significant at 1%

same period, both male and female unemployment exhibited growth until 2013, and decline in the years that followed. The data supports the claim by [28] that women are just a small part of the known criminal population, regardless of their employment status. The same authors attribute this to learned female passivity, the exclusion of females from male-dominated criminal subcultures, and failure of society to teach girls the basic skills needed for crime [28].

Finally, in a patriarchal society, women are more vulnerable, and thus more likely to lose a job even when the crisis is less severe than the one between 2009-2014. Their partners may turn to crime as a response to household optimization to compensate for the lost income. Thus, female unemployment serves as a more refined measure of the economic cycle. As such, it also drives the main effect from unemployment to crime.

Quantile regression

To allow the identification of non-linear UC relationship, the quantile regression is applied as suggested by [23]. The results are shown in Table 3. The effect of unemployment is not significant for any level of aggregate property crime. The estimated effect of unemployment on burglaries is confirmed. The aggregate effect is coming from the lower and the middle part of the crime distribution. For robbery, the negative and significant effect is confirmed for middle and higher levels of crime, while theft is not significant in any but the lowest quantile. It could be that theft crimes are generally the lowest in scarcely populated localities. Each increase in unemployment in these areas leads to outward migration, which reduces the share of the population more prone to crime, as suggested by [22].

Exercise from Section 1 is repeated with quantile regression to summarise the results.[4] Several things are worth noting. There is no effect on aggregate property

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[4]Complete results for quantile regression by gender are given in Table A6 in the Online Appendix.

crimes, and there is a significant negative effect of the police force, which is increasing for higher crime quantiles. The effect on burglary is stemming from 0.5th, 0.25th and 0.05th quantile for female unemployment, and male unemployment is significant for 0.5th and 0.75th quantiles, albeit with smaller magnitudes. This result offers some assurance of the credibility of explanations for the significant coefficient on female unemployment offered above. When crime levels are lower, and tolerance to crime is higher, a change in unemployment and a lack of capable guardians could indeed offset an increase in burglaries. This can be viewed as a coping strategy of underprivileged households. Areas where the rate of burglary is higher, and tolerance to crime is lower; it is more difficult to push marginal individuals into crime. Therefore, only when the main household-breadwinners become unemployed, they might seek alternative sources of income. It can be seen that even the coefficients for male unemployment in these quantiles are substantially lower than the coefficients on female unemployment in lower quantiles.

Police force again exhibits the strongest negative effect in the highest quantiles, corroborating the hypothesis of lower tolerance. Tourism intensity is positively related to burglaries, as expected. The effect on robbery is again negative and significant for both male and female unemployment in 0.5th and 0.75th quantiles. Clear-up rates seem to be a significant deterrent factor for robberies in all but the highest crime quantile. The differences between burglary and robbery are illustrated quite well in these deterrent effects. Burglars seem to be deterred by the pure size of the police force, while robbers tend to react only to higher efficacy of police (larger number of solved crimes).

Interestingly, robberies are positively associated with the incidence of divorce, corroborating the results of [47] who find the correlation between family disruption and violent crimes. Quantile regression results for theft are also revealing. The average negative effect, which was not significant, becomes significant for both male and female unemployment in low-crime areas. Perhaps the low expected return from theft in combination with the lack of opportunities when unemployment is increased [5] is responsible for these peculiar results.

Robustness checks

While the variation caused by time and county fixed effects is eliminated, there is still a possibility of a confounded analysis. In particular, migration is potentially a significant shock-absorber. People might decide to seek sources of income by migrating instead of entering illegal activities, as noted in [22]. It is also possible that criminals relocate to more wealthier regions in search of better opportunities.

In Table A7 in the Online Appendix, these possibilities are controlled for by including either total yearly immigration to a county, total yearly emigration from a county, total net migration of a county, or immigration to a county from abroad to our baseline specifications from Table 2. No substantive changes in the results were found.

Finally, although the demographic structure of a county is generally time-invariant, a share of the population with tertiary education is included as an additional control in specifications a5, b5, and c5 respectively. Note that this data is from

population census and thus does not vary on a yearly basis.[5] Again, no substantive changes in the baseline results were found.

One additional potential source of bias could be the overestimation of unemployment by the official statistics as some people potentially work in the unofficial sector. However, the size of the estimations from the literature [48] suggest that the scope of shadow employment shouldn't play a substantive role in the UC relationship. Furthermore, county and year fixed effects should eliminate the majority of this unobserved variation.

Back-of-the-envelope calculations

To better understand the implications of the results, some basic back-of-the-envelope counter-factual calculations are provided by using the elasticity from the baseline specification. For a 1-percent increase in unemployment there is a 0.3-percent increase in burglaries, all other things being constant. In itself, it does not say a lot on the economic significance, or social magnitude of the effect.

For meaningful interpretation of the obtained coefficient, first the typical identifying variation is derived, as advised by [30]. This is done by regressing ln(unemployment) on all the control variables from the preferred specification to obtain the residuals. In this way ln(unemployment) is cleaned of the included fixed effects and the covariation with all other control variables. Thus, only the variation used for estimating the effect of unemployment on crime remains. The standard deviation of these residuals is the typical identifying variation of ln(unemployment). It amounts to about 0.1 log points for the studied sample, with the corresponding percentage variation at around 11 percent. The total variation of ln(unemployment) is 0.33 log points, which translates to a percentage variation of around 39 percent. Therefore, the total variation is over three times larger than the typical identifying variation. When using the counter-factual scenario to interpret the estimated effect of unemployment on crime, one should not use variation much larger than the typical identifying variation of 11 percent.

Considering the high volatility in the observed period, the change in unemployment of 11 percent was not unusual. Thus, the 11-percent increase in unemployment can be used as a meaningful counter-factual scenario. For such an increase in unemployment, the number of burglaries will increase by 3.3 percent. The average number of burglaries across all counties and years was 18,505, which means that typical variation in unemployment increases the average number of burglaries by 648. According to Ministry of Interior data, average estimated damage for burglary, again across all counties and years was 1,158 euros. Multiplying the counter-factual increase with the average damage gives that typical increase in unemployment leads to almost 750,000 euros increase in damages. These are just monetary damages, estimated by the Ministry of Interior. They are purged of a full set of tangible costs, and let alone the emotional pain of victims, decrease of social cohesion, trust, and other intangible

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[5]The value from 2001 census for the period 1998-2006, and the value from 2011 census for the latter period, is taken.

costs. Therefore, this estimate is just a lower bound of the total increase in damages to society as a whole. For example, taking into consideration the estimate from [49] for household burglary, this number rises to around 3.7 million euros, although household burglary is more narrow than burglaries investigated in this paper.

Discussion

Baseline estimation of UC relationship for different property crimes showed that unemployment has an inducing effect only on burglary. Although the direct comparison to previous literature is difficult due to the differences in specifications and measures of unemployment and crime, the estimated effect on burglaries in Croatia is not dissimilar to those estimated in [10, 15] and [18]. Regarding the gender heterogeneity, previous research focused either on determinants of female offending [50] or on female labor force participation as an important determinant of crime [29, 51]. In this paper, male and female unemployment are explicitly differentiated. Surprisingly, the results show that the positive average effect of unemployment on burglaries is mainly driven by female unemployment, even though the vast majority of offenders are males. Some tentative interpretations of this result include the unchanged number of capable guardians [3] when women enter into unemployment; higher prevalence of long-term unemployment among females; and generally higher vulnerability of women on the labor market.

Negative, significant, and robust effect of unemployment on robberies is found. Although some papers found a negative relationship between unemployment and violent crimes [11], robbery is still primarily motivated by economic gains, which is why this result was unexpected. To explore this puzzling result in more detail, the outliers and leverage of observations were analyzed. By removing the observations with higher leverage, the results stayed substantively the same. One speculative explanation could be that the majority of reported robberies are done in local stores, open spaces, and booths. These localities are at the same time in the first row for closures when a crisis comes. Thus, the negative effect of unemployment on robberies might actually be the effect on the "demand" for crime. Criminals have to invest a lot more effort to rob bigger stores with more personnel, let alone other objects with security such as banks. They are therefore discouraged from committing a robbery in the first place. Available data suggest that this might indeed be the case. The share of robberies in stores and open spaces in total robberies slightly decreased before the crisis and started increasing again after the crisis (Fig. 3). However, this interpretation is highly speculative, and further research on this topic is required.

Quantile regression results show that there is no escalating effect of unemployment in areas with higher crime incidence. Contrary to the findings of [23], who find a decreasing effect of unemployment in higher quantiles of crime, results show that the estimated average effect comes from the middle of the crime-incidence distribution. [23] interpret their results through *tolerance* towards crime. When crime 'supply' is low and consequently, tolerance to crime is high, the effect of unemployment is the largest, and decreasing parallel with increasing crime and declining tolerance. Present results are similar in that there is no escalating effect in the highest quantile; unlike
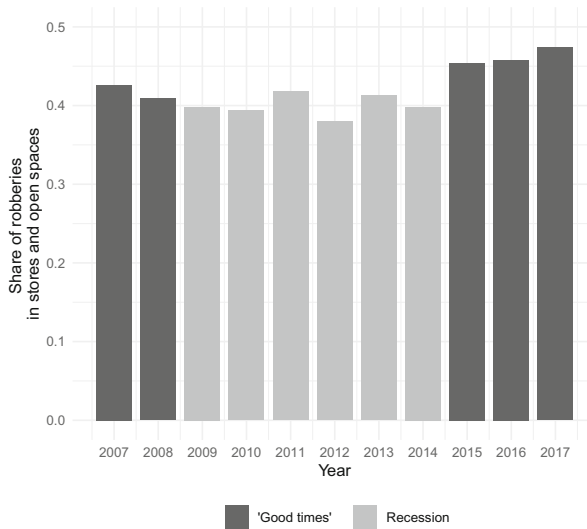
Fig. 3 Share of robberies in stores and open spaces in total robberies. Source: Author's calculations based on data from Ministry of Interior

in [34]. However, we find no effect in either tail of the distribution. As for the police force, the strongest negative effect is found in the highest crime quantiles. Escalating effect of the number of police officers suggests that the tolerance hypothesis by [23] holds, but is apparent in the effect of the police force, rather than unemployment. This negative effect can be explained through two potential channels. When crime is at higher levels, police might be more forceful in exercising their authority and thus deter potential criminals from crime. Contrarily, if criminal behavior is perceived as more 'normal' in high crime areas, this could have a negative impact on reporting propensities. In this case, the number of reported crimes would be reduced.

For meaningful interpretation of the estimated effect of unemployment on crime, the approach advised by [30] was used. Previous discussions of the economic significance of the estimated UC effect neglected the fact that total variation in unemployment is not the same as identifying variation used for estimation. This means that the effect will almost certainly be artificially inflated. For example, [15] explicitly discussed 'economic significance' of the effect by using total variation in the unemployment rate in the observed period. Altindag [18] only discusses the effect of 1 percentage point potential increase in unemployment without discussing the plausibility of this increase. [11] and [10] explain the decrease in crime rates in the 1990s through decreased unemployment through the same period. But, they fail to acknowledge that the decrease in unemployment for which they interpret the decline in crime is a total decrease and not the identifying variation. Mummolo and Peterson [30] give other examples of inflated results due to using total variation in the dependent variable as a credible counter-factual scenario.

Typical identifying variation of unemployment of 11 percent is associated with an increase in burglaries by 3.3 percent, which translates to over 600 burglaries per year

and over 750,000 euros in reported damages. This might not seem like much, but note that it represents just the lower bound of the effect as these damages include only the reported monetary damage. Furthermore, a possibility noted in [22] was realized in Croatia with substantial outward migration since the beginning of the crisis. In the absence of this possibility to migrate and work in Western Europe, it is possible that the estimated effect would be far stronger. Even more so because the leaving population is predominantly young one with the biggest risk of entering into crime [46].

Furthermore, according to results from [46], the complete costs of the recent crisis will only be evident in hindsight. During the crisis, 87,804 school-leavers aged 15-19, 47,152 school-leavers aged 20-24 entered the labor market. With substantial, long-lasting effects of recession estimated by [46], it is apparent that the static estimated effect of unemployment on burglaries is just a tip of the iceberg of associated costs of the recession in Croatia.

Conclusion

Unemployment represents significant negative strains on individuals and society. According to [2] failure or expectation of a failure to achieve goals can push people into crime and delinquent behavior. In economic terms, [4] discusses decreased expected returns from honest work as an incentive to commit a crime. In this paper, it is shown that unemployment indeed has a significant and non-trivial effect on burglaries. This effect is driven by female unemployment. Quantile regression results show that the areas with average crime rates are influenced the most by escalating unemployment.

The present research also shows the significant deterrent effect of a larger police force. Combined with the insight from quantile regression, one possible policy suggestion would be to focus police efforts on areas with higher unemployment and average crime rates, but also to consider employing more police officers in times of crisis. Discussion of other, individual-level measures is unfortunately limited with aggregate data and no information on the victims and perpetrators of burglaries.

This paper also has some limitations. First, it does not include the population age structure as control, while it is well known in the literature that age is an important determinant of crime. We partially circumvent this problem by employing county fixed-effects, because age structure does not vary substantially in such a short period. Different migrations measures, as well as the share of people with tertiary education, are included to test the robustness of the results. The effect of unemployment stays significant, as shown in Table A7 in the Online Appendix. This is reassuring of the results, as younger people are more likely to migrate, so this serves as a proxy for increases/decreases in younger, more crime-prone population. However, one should still be aware of the deficiencies of official migration data, and the fact that if criminals relocate to areas with more opportunities, this will not be reflected in the official statistics.

Second, the possibility of an endogenous relationship between unemployment and crime, which is discussed extensively by other authors [10, 11, 18], is not fully

excluded. The primary reason for this is the lack of credible instrument for unemployment on the county level in the observed period in Croatia. Still, the lack of anecdotal evidence of crime having an impact on economic activity, as well as some illustrative evidence, offers some assurance that the estimated relationship does not suffer from reverse causality. Third, omitted variable bias is not completely excluded. There is still, albeit slim, possibility that some variables, which are not accounted for by the full set of the county and year fixed-effects have an impact on both unemployment and crime.

The present paper also opens several avenues for future research. This study presents early research in the post-transition country and a less-developed democracy. It would be interesting to see the results from countries with similar institutional and historical background. Further, this paper presents the average effect of unemployment. From a policy perspective, it would be useful to see the effect on marginal individuals, similar to [46]. Presumably, the estimated effect would be substantially larger for the underprivileged younger population. On that note, further micro-level evidence on the offenders and the victims of property crime would be useful. Even more so considering the counter-intuitive effect found for robberies. As for the identification of the UC relationship, the use of natural experiments as a source of exogenous variation in unemployment might give some insight into the extent of potential bias in the presented estimates.

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