What is the relationship between unemployment and rape? Evidence from a panel of European regions

Caruso, Raul

Catholic University of the Sacred Heart, Center of Applied Economics (CSEA)

March 2014

What is the relationship between unemployment and rape? Evidence from a panel of European regions

Raul Caruso*

Abstract

This paper analyzes the relationship between unemployment and rape in a panel of European regions. In particular, this paper is intended to test whether an 'opportunity perspective' holds for rape. The 'opportunity perspective' interprets the level of unemployment as an indicator of 'social inactivity', so that a negative relationship between violent crime and unemployment is predicted. Results show that rape and unemployment are positively associated so not confirming the opportunity perspective. Results are robust using alternative dependent variables, namely (i) the count of rape; (ii) the rape rate per 100,000 people.

Keywords: rape, sexual assault, violent crime, opportunity perspective, unemployment, youth unemployment, intimate and spousal violence.

Jel Codes: J12; J18; J64; K42; I29.

* Catholic University of the Sacred Heart. Milan, Center for Applied Economics (CSEA), e-mail: raul.caruso@unicatt.it. The author warmly thanks Adelaide Baronchelli for her research assistance, and Ilaria Petrarca, Luca Pieroni, Roberto Ricciuti and Emiliano Sironi for their comments on a draft of this work.

1. Introduction

The relationship between unemployment and crime is perhaps the most studied in the quantitative literature on crime. Theoretical studies predict a positive association between crime and unemployment, as the latter is considered a variable reliably capturing the opportunity costs associated to crime (e.g., Freeman, 1999; Ehrlich, 1996, 1973). A large body of empirical literature confirms that unemployment and property crime are positively associated. However, empirical results differ when considering different types of crime. The association between violent crime and unemployment may show the opposite sign, namely a reduction of crime associated with increasing unemployment. This hypothesis has been proposed by Cantor and Land (1985) and hereafter it is labelled 'opportunity perspective'. Stated briefly, the Cantor and Land argument posits that since unemployed individuals are less involved in social activities, their probability of being either victims or perpetrators of violent crime is lower.

Then, this paper analyzes the relationship between rape and unemployment to test whether the 'opportunity perspective' holds. Rape is a subcategory of violent crime. In general, rape is a sexual assault that involves some sexual intercourse by one of more persons against another person who did not express her or his consent. However, there is no common definition of rape but it varies significantly among countries. Three aspects deserve to be highlighted. First, the common critical component of any definition is the absence of consent of the victim. The second crucial component is the nature of the sexual intercourse. In particular, crucial to the definition is whether it includes penetration (by penis or object) or not. Third, only in some countries current definition of rape now includes also sexual intercourse which is not limited to coercion of a male on a female but also to male-male, female-female and even to female-male intercourses. The existing variety of legal definitions has prevented scholars from the

possibility of aggregating and standardization the available data. Moreover, the quantitative study of rape is also particularly difficult because it is the most unreported crime. Albeit aware that different sexual intercourse can be classified as rapes, hereafter, the underlying idea is that reported rape is mainly the coercive sexual intercourse of one or more males on a female. Such idea is mainly grounded on available evidence. In fact, most reported rapes are perpetrated by males on females[1]. Pino and Meier (1999) provide evidence and interpretation of male victims' underreporting. Allen (2007) empirically estimates that, other things equal, male victims were significantly less likely to report rape. Therefore, in what follows the empirical results can be intended to hold mainly for rape perpetrated by males on females.

With these severe limitations in mind, the research question is whether there is a relationship between unemployment and reported rape. The empirical analysis is focused on a panel of sixty European regions from Belgium, Germany, Italy and Netherlands. Put differently, do regions with higher unemployment exhibit a higher incidence of rape?

The paper is structured as follows: in the next section the conceptual background and the research hypothesis are expounded. Then, the data and the baseline empirical strategy are presented. Eventually robustness of results are checked testing for the relationship between emergence of rate and youth unemployment. In the last section results are summarized.

2. The background and the research hypothesis

As noted above, this paper is intended to test whether an opportunity perspective holds for female rape. In brief, the 'opportunity perspective' interprets the level of unemployment as an indicator of 'social inactivity', so

[1] For example in US in 2010 the reported male rate of rape was only 0.1 per 1000 males. (Source: U.S. Department of Justice).

that a negative relationship between crime and unemployment is predicted (see Cantor and Land, 1985). Needless to say, the opportunity perspective is also in line with the idea of linkage between crime rates and social interactions as expounded in Glaeser et al. (1996). In sum, according to this 'opportunity perspective', as unemployed are engaged in a reduced number of social interactions, their 'opportunities' for delinquency are reduced. In fact, there is evidence of such negative relationship between unemployment and violent crime [see among others Caruso, 2011; Levitt, 2001; Entorf and Spengler, 2000; Britt, 1997] [2] . Indirect evidence of the opportunity perspective is also in Dahl and Della Vigna (2009) that show an increase of violent movies audience associated with a decreased rate of violent crime. In particular, the latter kind of relationship has been extensively studied with regard to rape and pornography. Similarly, both Ferguson and Hartley (2009) and Diamond (2009) rev. a substantial body of literature cautiously showing that as pornography availability increased rape rates decreased.

Consequently, when considering unemployment and rape, the relationship is not easy to predict. If the 'opportunity perspective' holds, the association between unemployment and rape can be predicted to be negative. On one hand, if considering perpetrators, unemployed are less likely to become sex offenders. On the other hand, the opportunity perspective may also posit that as female unemployed are involved in fewer social activities the probability of being sexually victimized can be predicted to be lower. In sum, the opportunity perspective would be confirmed if emergence of rape turns to be negatively associated with female unemployment rate in the econometric results.

However, in many studies it is reported that sex offenders are often intimate partners, friends or acquaintance [Devries et al. (2013), Watts and Zimmerman (2002)]. In such a case, the association between social relations and rape would not hold. In fact, opportunities of rape would take shape

[2] Mehlun et al. (2006) show the existence of a negative association between a measure of standard of living and violent crime. This can be considered also in line with the opportunity perspective.

even in the absence of any frequent social activity. Consequently, the relationship between rape and unemployment could be also expected to be positive. In this respect a positive association can be also predicted in the light of the studies explaining that intimate and spousal violence is often correlated with male unemployment or other forms of labor distress [see among others Benson et al. 2003; Macmillan and Gartner, 1999; Howell and Pugliesi, 1988].

In the light of these brief considerations it must not be surprising that in the economic literature on crime only a few studies report significant associations between rape and economic factors. In this respect, it must be noted that there is no recent economic literature that focuses explicitly on the association between rape and economic factors. Conclusions and insights can be drawn from studies focusing on violent crime. However, whenever rape is analysed, results on the relationship with economic factors are mostly inconclusive [see among others Han et al. (2013); Edmark (2005); Britt (1997)]. Only few studies report significant association between rape and economic variables. In particular, a negative association has been found for Greece in the period 1991-1998 in Saridakis and Spengler (2012) so confirming the opportunity perspective. Raphael and Winter-Ebmer (2001) also find a negative association. An indirect confirmation of opportunity perspective is provided by Grinols and Mustard (2006) that find an increase of rape in US counties where casinos have been established. Instead, Zimmerman and Benson (2007) find that rape is positively associated with total unemployment rate. The previous discussion leads to the hypotheses:

H_o: Rape is negatively associated with unemployment so confirming the 'opportunity perspective'.

H_1: Rape is positively associated with unemployment.

That is, hereafter, the econometric estimations would shed new light on the relationship between unemployment and rape either confirming or not the opportunity perspective already expounded in the established literature on the determinants of violent crime.

3. Data and the empirical strategy

In what follows, the empirical investigation is based on an unbalanced panel of 60 European regions of Belgium, Germany, Italy, and Netherlands. Hereafter, by 'region' it is meant the first sub-national administrative level, namely NUTS2 regions in Belgium, Italy and Netherlands and NUTS1 Länder in Germany[3]. The panel is unbalanced. That is, it is shaped primarily by the lack of data on rape at sub-national level for countries. Luckily, definition of rape in these countries does not differ widely so allowing also for a meaningful aggregation of data. Table 1 reports the regions, the sources and the definitions of dependent variables.

Table 1 - Definitions and Sources

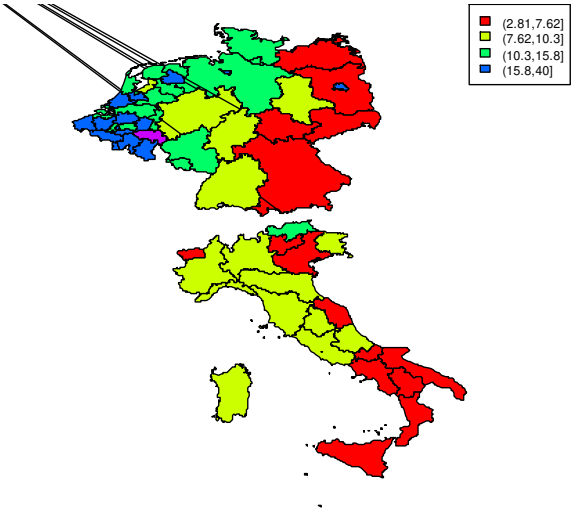
	Definition	entities under observation	years available	Source
Belgium	sexual penetration of any kind and by any means on a person who does not consent	11 regions NUTS2	2000, 2005-2010	Police federale belge
Germany	rape and sexual coercion	16 Länder NUTS1	2000-2011	Polizeiliche Kriminalstatistik (for each Land)
Italy	the act of forcing someone to do or suffer sexual acts, by force or by threat or abuse of authority	19 regions NUTS2 + 2 provinces NUTS3	2004-2011	ISTAT

[3] List of regions is provided in the Appendix

Netherlands	a type of sexual assault usually involving sexual intercourse, which is initiated by one or more persons against another person without that person's consent	12 regions NUTS2	2005-2010	CBS- Statistic Netherlands

In order to have a visual exposition Figure 1 shows the map by quartiles of rape rate per 100,000 inhabitants in 2010. The regions shaded in the darkest colors are the regions with the higher rape rate per 100,000 inhabitants in 2010. Belgian regions appear to be those exhibiting the highest rape rates. In particular, the highest figure is reported for Liége (40 per 100,000) followed by Bruxelles (37.8 per 100,000). The lowest figure is reported in Sachsen (2.8 per 100,000). Averages per country are: Belgium (26.83 per 100,000 inhabitants), Netherlands (13.35 per 100,000 inhabitants), Germany (10.08 per 100,000 inhabitants) and Italy (7.65 per 100,000 inhabitants).

Figure 1 – Map by quartiles of rape rate per 100,000 inhabitants in 2010



Hereafter, the empirical model to be estimated in its general form is:

$$rape_{it} = (\, unemployment_{it-1}, X_{it-1}, year\ dummies).$$

For sake of accuracy, hereafter I adopt two different measures for rape: *rape* denotes alternatively either 1) the natural logarithm of the reported rape rate per 100,000 people for region i (where i=1,….60) at time t. or 2) the actual count of rapes reported for region i (where i=1,….60) at time t. In the first case an OLS estimator is applied whereas in the latter case, given the count nature of the dependent variable, a negative binomial estimator is used[4]. In both cases, a fixed effects estimator is applied[5]. The main explanatory is the one-year lagged level of unemployment whereas X_{it-1} is a vector of (lagged) control variables. The time trend is captured by means of year dummies.

[4] In the appendix II results of a robustness check using a GMM estimator are reported.
[5] The Hausman test supports the fixed effects estimator. Results are not disclosed but they are available upon request.

In particular, the set of control variables includes: (i) the natural logarithm of density of population; (ii) the natural logarithm of patent intensity and (iii) the natural logarithm of capital formation; (iv) the real growth rate of gross value added as proxy of current economic growth; (v) a measure of education levels. All these variables are drawn from Eurostat. In addition, there is a dummy that denotes whether brothels are legal or not in that country. This variable is intended to capture whether the popular idea of legalized and organized prostitution as rape-reducing policy holds. In particular, it is reasonable to consider that where prostitution has lost its social stigmata and reduced street prostitution, behavior of sex buyers becomes accepted at social level. Brothels are legal and regulated in Germany and Netherlands [6]. Contrariwise, they are not allowed in Belgium and Italy.

The inclusion of density of population among covariates descends from the opportunity perspective. In fact, a higher likelihood of encounters between individuals can be expected to take shape in highly populated areas. Consequently, a higher density of population might be associated with a higher emergence of violent crime. Both patent intensity (as a measure of innovation) and capital formation are expected to capture future economic opportunities[7]. Needless to say, short term economic growth does capture economic opportunities perceived in the recent past. In general, better economic opportunities - either future or past - might be expected to be negatively associated with emergence of crime. The measure of education adopted is defined as the percentage of persons aged 25-64 and 20-24 with upper secondary or tertiary education attainment. The relationship between education and rape is not easy. On one hand, there is a substantial evidence on a negative relationship between different forms of violent crime and education so suggesting a negative relationship [see among others Brugard

[6] On legal status of brothels and prostitution see http://www.europarl.europa.eu/hearings/20040119/femm/document1_en.pdf

[7] Both measures are used in Beraldo et al. (2013).

and Falch, 2013]. On the other hand it would be possible to speculate that educated individuals are likely to report rape because they are more capable of computing both the personal and social advantages of reporting than less educated people so determining a positive sign for the coefficient. In this respect, Soares (2004a) and Soares (2004b) show that education levels are strong predictors of crime reporting. Descriptive statistics of the variables are presented in table 2. In appendix table A.1 reports the correlation matrix.

Table 2 - Descriptive Statistics

Variable	Obs	Mean	st.dev.	Min	Max
Rape*	508	342.4213	352.5697	2	2508
Rape rate per 100,000 people	500	13.3841	8.566	1.639	44.29
Unemployment rate (t-1)	648	8.138426	4.861662	1.2	25.7
Population density (as Inhabitants per km²)	720	502.004	968.6303	28.8	7131.1
Growth Rate of Gross Value Added (GVA) (t-1)	607	1.060	2.533	-10.8	9.5
Patent Intensity (as patent application to EPO) (one year lagged)	539	528.3685	1141.265	0.35	6272.55
Gross Fixed Capital formation (one year lagged) (millions euro)	557	14393.14	16969.64	756.4	96006.8
Legal brothels	780	.466667	.4992078	0	1
Education	749	66.9921	14.7286	36.5	96
Youth Unemployment rate (t-1)	605	17.979	11.908	2	60.2
Youth Male Unemployment rate (t-1)	531	17.699	11.0115	3	55.7
Youth Female Unemployment rate (t-1)	500	20.0348	15.02487	3	69.9

***Sources for rape are listed in Table 1. **All other variables are drawn from Eurostat.**

Results are presented in table 3 below. In general the association between rape and unemployment appears to be positive and robust. Coefficients are positive and significant at desirable levels. Put differently, regions with higher level of unemployment also have higher incidence of rape. In sum, the opportunity perspective does not hold for rape.

In particular, in OLS regressions the estimated elasticity of unemployment on rape is 0.372 in the specification without including the

GVA growth rate and education levels. It is 0.388 in the estimation including the GVA growth rate and the education levels. Control variables - whenever significant - exhibit the expected signs. In particular, patent intensity and capital formation are negatively and significantly associated with lower level of rapes. Interpreting them as proxies for future economic growth, it would mean that expectations and prodromes of economic growth are associated with fewer rapes. At the same time in model 2 there is a positive and significant association between lagged growth rate of gross added value and the rate rape. In model 2, education also appears to be positively related to crime. As noted above, the reasonable interpretation of this result is that education does not increase rape but rather 'reported rape'. This would explain the positive association with the dependent variable.

In negative binomial regressions (models 3-4) the positive association between rape and unemployment is confirmed. Put differently, the opportunity perspective does not hold for rape even if considering the count of rape as dependent variable. Moreover, the association between education and rape is also robust. Other covariates do not seem to be significantly associated with rape. They exhibit insignificants coefficients. Only the dummy variable capturing the existence of legal brothels is significantly and negatively associated with rape. This suggests that where prostitution has lost its social stigma so to be organized in legitimate business, sexual attitudes and behaviors of individuals may be differently shaped.

Table 3 – Rape and Unemployment

	1	**2**	**3**	**4**
	OLS§	**OLS§**	**NEG-BIN**	**NEG-BIN**
	FE	**FE**	**FE**	**FE**
Unemployment rate (t-1) (logged)	**.372*** **	**.388*** **	**.221*** **	**.173** **
	(.105)	(.190)	(.078)	(.087)
Real Growth rate of GVA (t-1)		**.019*** **		.008
		(.007)		(.006)
Density of population (t-1)(logged)	.010	-.017	-.001	.027

	(.079)	(.028)	(.064)	(.068)
Education (logged)		**1.221*** **		**.931*** **
		(.382)		(.324)
Patent Intensity (t-1) (logged)	**-.183*** **	**-.220*** **	.022	.014
	(.055)	(.066)	(.051)	(.052)
Capital formation (t-1) (logged)	**-.271*** **	**-.385*** **	-.078	-.134
	(.122)	(.150)	(.078)	(.090)
Legal brothels (dummy)	**-**	**-**	**-1.159*** **	**-1.554*** **
			(.422)	(.437)
Year Dummies	**YES**	**YES**	**YES**	**YES**
Constant	**5.25*** **	1.346	**4.782*** **	**2.288*** **
	(1.203)	(1.200)	(.864)	(1.585)
Observations	300	285	291	277
Groups	60	58	51	50
Rsq within	.1855	.2288	-	-
Rsq Between	.0001	.0204	-	-
Rsq overall	.0015	.0279	-	-
Log- Likelihood	-	-	-1135.779	-1073.0277
Wald chi2	-	-	59.41	77.44

§Robust standard errors clustered by region in OLS models 1-2

4. Rape, unemployment and youth unemployment

In what follows, the empirical analysis would focus on youth unemployment rather than total unemployment. Youth unemployment is the level of unemployment for active population aged 15-24 years. Why youth unemployment could be expected to be related with violent crime? First, youth unemployed may be expected to exhibit violent behavior because of grievance and frustration so raising the probability of committing sex crimes. Such relationship has been proved to be significant by Gould et al. (2002). Moreover, it is commonly established that violent crime depends heavily upon the age structure. In particular, youth is expected to perpetrate more violent crimes than adults [see among others Buonanno et al. (2014), McCall et al. (2013); Phillips (2006); Levitt (1999); Marvell et al. (1991)].

Table 4 reports the results. The relationship between rape and youth unemployment also appears to be positive. In particular, in OLS regressions the estimated elasticities of youth unemployment on rape are 0.16 and 0.17 for total youth unemployment and male youth unemployment respectively. These elasticities appear to be lower than those computed in the previous section with regard total unemployment. In addition, the main result that could be claimed is that the male youth unemployment explains entirely the positive association between youth unemployment and rape. In fact, youth female unemployment is not significantly associated with rape irrespectively of the estimator used. The latter result heavily confirms the idea according to which the opportunity perspective does not hold for rape.

Table 4 - Youth Unemployment and Rape

	1	**2**	**3**	**4**	**5**	**6**
	OLS	**OLS**	**OLS**	**NEG-BIN**	**NEG-BIN**	**NEG-BIN**
	dep. variable: rape rate per 100,000			**dep. variable: count of rapes**		
	FE	**FE**	**FE**	**FE**	**FE**	**FE**
Youth Unemployment rate (t-1) (logged)	**.158****			**.125****		
	(.081)			(.066)		
Youth Male Unemployment (t-1) (logged)		**.170*****			**.113****	
		(.063)			(.055)	
Youth Female Unemployment (t-1) (logged)			-.007			-.011
			(.070)			(.058)
Real Growth rate of GVA (t-1) (logged)	**.020****	**.014****	**-.010***	.009	.006	.001
	(.006)	(.006)	(.006)	(.006)	(.006)	(.007)
Density of population (t-1)(logged)	.010	.030	3.473	.043	.0533	.357
	(.028)	(.027)	(2.470)	(.062)	(.059)	(.229)
Education (logged)	**1.949*****	**2.079*****	**1.823*****	**1.358*****	**1.582*****	**1.522*****
	(.439)	(.490)	(.509)	(.331)	(.343)	(.349)
Patent Intensity (t-1) (logged)	-.169	.024	-.011	.050	.118**	.089
	(.118)	(.077)	(.083)	(.057)	(.061)	(.064)
Capital formation (t-1) (logged)	**-.321***	**-.485*****	**-.610*****	**-.149***	**-.331*****	**-.378*****
	(.117)	(.213)	(.221)	(.095)	(.099)	(.112)
Legal brothels (dummy)	-	-	-	**-1.312*****	**-1.640*****	**-1.627*****
				(.431)	(.473)	(.531)
Year Dummies	YES	YES	YES	YES	YES	YES
Constant	**-2.3875*****	**-2.399*****	**-19.261*****	**.365*****	**1.082*****	**.525**
	(2.751)	(1.215)	(14.412)	(1.643)	(1.656)	(2.161)
Observations	264	231	218	256	221	211
Groups	57	52	49	49	42	42
Rsq within	.2042	.2676	.2565	-	-	-

Rsq Between	.1103	.1581	.3771	-	-	-
Rsq overall	.0980	.1447	.3447	-	-	-
Log- Likelihood	-	-	-	-984.922	-862.743	-816.5396
Wald chi2	-	-	-	68.38	91.60	68.57

5. Conclusions

The research question of this paper was whether or not the 'opportunity perspective' as posited by Cantor and Land (1985) holds for rape. The 'opportunity perspective' interprets the level of unemployment as an indicator of 'social inactivity'. The 'opportunity perspective' would hold if the relationship between rape and unemployment is negative. By contrast, this paper shows the existence of a positive relationship between unemployment and rape. In fact, results show that rape and unemployment are positively associated so violating the 'opportunity perspective' which has been proved to hold for other forms of violent crime. These results confirm those produced in Zimmerman and Benson (2007). In particular, results are robust using alternative dependent variables and estimators, namely (i) the count of rape; (ii) the rape rate per 100,000 people. Moreover, findings are confirmed also when considering youth unemployment rather than total unemployment. Interesting to note is that youth female unemployment does not contribute to explain rape. In fact, the results appear to be driven totally by youth male unemployment. This result confirms those produced in Gould et al. (2002) for US. The results are in line with the literature which explains emergence of intimate and spousal violence in the presence of unemployment and labor market distress.

With regard to the covariates, the positive association between rape and education is also worth noting. Such association appears to be robust across the models estimated. As noted above, *ex-ante*, the sign was not easy to predict. On one hand, in the literature there is substantial evidence on a negative relationship between different forms of violence and education. On

the other hand one might have speculated that educated individuals are more capable of computing both the personal and social advantages of reporting rape so determining a positive sign for the coefficient. In sum, the positive association between rape and education can be interpreted more accurately as the association between education and 'level of reported rape' rather than actual level of rape. Yet, there is robust evidence that the existence of legal brothels is strongly and negatively associated with both dependent variables. However, such result has to be handled with care before suggesting any specific policy in this respect. In fact, there is evidence that legalized prostitution increases human trafficking (Cho et al., 2013) so determining a further social disadvantage.

Finally, as noted above, this work has severe limitations due to (a) lack of data; (b) variety of definitions and limit to aggregations of data (c) the acknowledged underreporting of rape. In spite of these shortcomings, evidence is fairly robust: rape is positively associated with unemployment.

More in general, this work also contributes to throw light on the relationship between economic factors and emergence of different forms of crime. In this respect, it must be noted that the results also contribute to explain the dominance of insignificants coefficients in the existing literature on crime while targeting the relationship between violent crime and economic variables. Put differently, disentangling rape from violent crime would help to explain better the relationship between violent behaviors and economic opportunities.

References

Allen, D. W., 2007, The Reporting and Underreporting of Rape, *South. Econ. J.* 73, 623-641.

Benson M. L., Fox G. L., De Maris A., Van Wyk J. 2003, Neighborhood Disadvantage, Individual Economic Distress and Violence Against Women in Intimate Relationships, *J. Quant. Crim.* 19, 207-235.

Beraldo S., Caruso R., Turati G., 2013. Life is Now! Time Preferences and Crime, Aggregate Evidence from the Italian Regions, *J. Soc. Econ.* 47, 73-81

Britt, C. L., 1997. Reconsidering the unemployment and crime relationship, Variation by age group and historical period. *J. Quant. Crim.* 13, 405-428.

Brugard K.H., Torberg F., 2013, Post-compulsory education and imprisonment, *Lab. Econ.* 23, 97-106.

Buonanno P., Drago F., Galbiati R. 2014, How much should we trust crime statistics? A comparison between UE and US, LIEPP working paper, n.19.

Buonanno P., 2006. Crime and Labour Market Opportunities in Italy (1993–2002), *Labour*, 20, 601-624

Buonanno, P., Leonida L., 2009, Non Market Effects of Education on Crime, Evidence from Italian Regions, *Econ. Educ. Rev.* 28, 11-17

Cantor, D., Land K.C., 1985. Unemployment and Crime Rates in the post world War II United States, A theoretical and empirical analysis. *Am. Soc. Rev.* 50, 317-332.

Caruso, R., 2011. Crime and Sport Participation, Evidence from Italian Regions over the Period 1997-2003. *J. Soc.-econ.* 40, 455-463.

Cho Seo-Young, Dreher A. Neumayer E., 2013, Does Legalized Prostitution Increase Human Trafficking?, *Wor. Dev.* 41, 67-82

Dahl, G., DellaVigna S., 2009. Does Movie Violence Increase Violent Crime? *Quar. J. Econ.* 124, 677-734

Devries Karen M. Mak Joelle Y.T, Garcia-Moreno Claudia, Petzold Max, Child Jennifer C. Falder Gail, Lim Stephen, Bacchus Loraine J. Engell Rebecca E. Rosenfeld Lisa, Pallitto Christina, Vos Theo, Abrahams Naeemah, Watts Charlotte H. 2013. The Global Prevalence of Intimate Partner Violence Against Women, *Science*, 340, 1527-1528

Diamond, M., 2009. Pornography, public acceptance and sex related crime, A review, *Int. J. Law Psich.* 32, 304-314.

Ehrlich, I. 1973. Participation in Illegitimate Activities, A Theoretical and Empirical Investigation. *J. Pol. Econ.* 81, 521-565.

Ehrlich, I. 1996. Crime, Punishment and the Market for Offenses, *J. Econ. Perspec.* 10, 43-67.

Entorf, H., Spengler, H., 2000. Socioecon. and Demographic Factors of Crime in Germany, Evidence from Panel Data of the German States. *Int. Rev. Law Econ.* 20, 75–106.

Fajnzylber, P., Lederman D., Loayza N. 2002, What Causes Violent Crime? *Eur. Econ. Rev.* 46, 1323-1357

Ferguson C.J., Hartley R.D., 2009. The pleasure is momentary….the expense damnable? The influence of pornography on rape and sexual assault, *Aggr. Viol. Behav.* 14, 323-329

Freeman, R. 1999. The Economics of Crime. in O. Ashenfelter and D. Card (eds.), *Hand. Lab. Econ.* 3C, 3529–3571.

Grinols, E.L., Mustard, D.B., 2006. Casinos Crime and Community Costs, *Rev. Econ. Stat.* 88, 28-45

Glaeser E.L., Sacerdote B., Scheinkman J.A., 1996. Crime and Social Interactions, *Quart. J. Econ.* 111, 507-548.

Gould, E, D., Weinberg B.A., Mustard, D.B., 2002. Crime Rates and Local Labor Market Opportunities in the United States, 1979–1997. *Rev. Econ. Stat.* 84, 45–61.

Han, L., Bandyopadhyay S., Bhattacharya S., 2013. Determinants of Violent and Property Crimes in England and Wales, a Panel Data Analysis. *Appl. Econ.* 45 , 4820–4830.

Howell M. J., Pugliesi K. L. 1988. Husbands who harm, predicting spousal violence by men, *J. Fam. Viol.* 3, 15-27.

Levitt S., 2001. Alternative strategies for Identifying the Link Between Unemployment and Crime. *J. Quant. Crim.* 17, 377-390.

Levitt S., 1999. The Limited Role of Changing Age Structure in Explaining Aggregate Crime Rates, *Crim.* 37, 581-598

Marvell T.B., Carlisle Jr E. M.. 1991. Age Structure and Crime Rates, the Conflicting Evidence, *J. Quant. Crim.* 7, 237-273.

Macmillan R., Gartner R., 1999. When She brings Home the Bacon, Labor-force participation and the Risk of Spousal Violence against Women, *J. Mar. Fam.* 61, 4, 947-958.

McCall P. L., Land K. C., Brooks D. C., Parker, K.F., 2013. The Age structure-crime rate relationship, solving a long-standing puzzle. *J. Quant. Crim.* 29, 167-190.

Mehlum H., Miguel E., Torvik R., 2006, Poverty and crime in 19th century Germany, *J. Urb. Econ.* 59, 370-388.

Phillips, J.A., 2006. The Relationship between Age Structure and Homocide Rates in the United States, 1970-1999. *J. Res. Crime Del.* 43, 230-260

Pino, N.W., Meier R.F., 1999. Gender Differences in Rape Reporting. *Sex Roles*, 40, 979-990.

Raphael S., Winter-Ebmer, R., 2001. Identifying the Effect of Unemployment on Crime. *J. Law Econ.* 44, 259-283

Saridakis G., Spengler H., 2012. Crime, Deterrence and unemployment in Greece, A Panel data approach, *Soc. Sc. J.* 49, 167-174.

Soares R. R., 2004a. Crime reporting as a Measure of Institutional development, *Econ. Dev. Cult. Ch.* 52, 851-871.

Soares R. R., 2004b. Development, crime and Punishment, accounting for the international differences in crime rates, *J. Dev. Econ.* 73, 155-184.

Watts C., Zimmerman, C., 2002. Violence against women, global scope and magnitude, *Lancet*, 359, 1232-1237

Zimmerman P.R., Benson B.L., 2007. Alcohol and rape, An "economics-of-crime" perspective, *Int. Rev. Law Econ.* 27, 442-473.

Appendix I

Regions
Belgium
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest
Prov. Antwerpen
Prov. Limburg (B)
Prov. Oost-Vlaanderen
Prov. Vlaams-Brabant
Prov. West-Vlaanderen
Prov. Brabant Wallon
Prov. Hainaut
Prov. Liège
Prov. Luxembourg (B)
Prov. Namur
Germany
Baden-Württemberg
Bayern
Berlin
Brandenburg
Bremen
Hamburg
Hessen
Mecklenburg-Vorpommern
Niedersachsen
Nordrhein-Westfalen
Rheinland-Pfalz
Saarland
Sachsen
Sachsen-Anhalt
Schleswig-Holstein
Thüringen
Italy
Piemonte
Valle d'Aosta/Vallée d'Aoste
Liguria
Lombardia
Provincia Autonoma Bolzano/Bozen
Provincia Autonoma Trento
Veneto
Friuli-Venezia Giulia
Emilia-Romagna
Toscana
Umbria

Marche
Lazio
Abruzzo
Molise
Campania
Puglia
Basilicata
Calabria
Sicilia
Sardegna
Netherlands
Groningen
Friesland (NL)
Drenthe
Overijssel
Gelderland
Flevoland
Utrecht
Noord-Holland
Zuid-Holland
Zeeland
Noord-Brabant
Limburg (NL)

Table A.1 - Correlation Matrix

	rape	rape rate	Unemploymen t	Youth Unemployment	Youth male unemployment	youth female unemployment	Real Growth rate of GVA (t-1)	Density of Population	Education	Patent Intensity (t-1)	Capital Formation (t-1)	Legal brothels
rape	1											
rape rate per 100,000	-0.0254	1										
Unemployment	-0.1534	-0.0733	1									
Youth Unemployment	-0.3297	0.0002	0.6403	1								
Youth male Unemployment	-0.263	0.0092	0.7485		1							
Youth female unemployment	-0.3729	-0.0283	0.5004	0.9701	0.8803	1						
Real Growth rate of GVA (t-1)	0.1295	0.1242	-0.0118	-0.2723	-0.2455	-0.2866	1					
Density of Population	0.0775	0.4468	0.2893	0.1041	0.2017	0.0055	0.06	1				
Education	0.2815	0.0139	0.1321	-0.5989	-0.4535	-0.7028	0.3063	0.105	1			
Patent Intensity (t-1)	0.821	-0.2241	-0.2299	-0.3986	-0.3624	-0.405	0.1676	-0.0928	0.3217	1		
Capital Formation (t-1)	0.8786	-0.3083	-0.2228	-0.3566	-0.3197	-0.3676	0.1158	-0.0837	0.2378	0.8981	1	
Legal brothels	0.3414	-0.1896	-0.0263	-0.6628	-0.5438	-0.7306	0.3284	0.0228	0.8314	0.4048	0.3246	1

Appendix II

For sake of robustness, in this appendix following Fajnzylber et al. (2002) Buonanno (2006) and Buonanno and Leonida (2009), I present a dynamic panel-data Arellano-Bond GMM estimation. The model is:

$$rape_{i,t} = \rho rape_{i,t-1} + \beta_1\, unemployment_{i,t-1} + \beta_2 X_{i,t-1} + \delta_i + \varepsilon_{i,t}. \qquad \text{(A.1)}$$

Where $rape_i$ denotes the natural logarithm of rape rate per 100,000 inhabitants reported in region i, and the variables are the same of general model presented in the main text, and δ_i is a region-specific unobservable effect. Results are presented in table A.II below. They confirm a positive association between unemployment (both total and youth) and rape rates. Interestingly, a significant association between lagged rape rate and current rape rate emerges only in models 3-4 when youth unemployment is considered.

Table A.II– Rape and Unemployment – GMM estimator

	1	**2**	**3**	**4**
Rape rate per 100,000 (t-1)	.027	.018	**.255****	**.264****
	(.089)	(.092)	**(.137)**	(.139)
Unemployment rate (t-1) (logged)	**.172***	**.246****		
	(.111)	(.119)		
Youth Unemployment (t-1) (logged)			**.276*****	**.288*****
			(.095)	(.096)
Real Growth rate of GVA (t-1) (logged)	-.011	.007		.006
	(.078)	(.008)		(.007)
Density of population (t-1)(logged)	-.011	-.0165	-.015	-.022
	(.0780)	(.0799)	(.069)	(.700)
Education		-.327		
		(.860)		
Patent Intensity (t-1) (logged)	-.086	-.102*	**-.174*****	**-.182*****
	(.0600)	(.062)	(.0801)	(.0817)
Capital formation (t-1) (logged)	.016	-.036	.232	.200
	(.188)	(.201)	(.190)	(.192)

Year Dummies	YES	YES	YES	YES
Constant	2.496	3.616	-.023	.1703
	(1.904)	(3.798)	(1.9321)	(1.975)
Observations	178	168	162	178
Groups	51	50	49	51
Wald chi2	35.07	34.92	43.29	43.31
Sargan test	55.319	54.130	35.327	35.358
All variables are instrumented using lag t-1				