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**PUTTING A PRICE TAG ON SECURITY:
SUBJECTIVE WELL-BEING AND
WILLINGNESS-TO-PAY FOR CRIME
REDUCTION IN EUROPE**

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Putting a price tag on security:
Subjective well-being and willingness-to-pay for crime reduction in Europe

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Abstract: Using information on life satisfaction and crime from the European Social Survey, we apply the life satisfaction approach (LSA) to determine the relationship between subjective well-being (SWB), income, victimization experience, fear of crime and various regional crime rates across European regions, while controlling for potentially confounding socio-economic variables. We show that fear of crime, criminal victimization and the average regionally perceived fear of crime significantly reduce life satisfaction across Europe. Building upon these results, we quantify the monetary value of improvements in public safety and its valuation in terms of individual well-being. The loss in satisfaction for victimized individuals corresponds to 21,790€. Increasing an average individual's perception within his neighborhood from unsafe to safe yields a benefit equivalent to 12,700€. Our results regarding crime and SWB in Europe largely resemble previous results for different countries and other criminal contexts, whereby using the LSA as a valuation method for public good provision yields similar results as stated preference methods and considerably higher estimates than revealed preference methods.

Keywords: crime rate, fear of crime, life satisfaction approach, subjective well-being, willingness-to-pay

JEL-Classification: D10, H41, H56, I31

1. Introduction

The ability to lead a life with neither fear nor actual experience of a violation of one's personal safety is an essential precondition for individual life satisfaction. Conversely, living in insecure and dangerous surroundings has far-reaching consequences, incurring different costs for the victims of crimes. Depending on its severity, criminal acts can affect victims due to uninsured financial losses, physical pain, emotional suffering, trauma or even death, thus substantially reducing their quality of life (Moller, 2005; Davies and Hinks, 2010; Medina and Tamayo, 2012; Hanslmaier, 2013; Staubli et al., 2014; Mahuteau and Zhu, 2015). Even non-victimized individuals can suffer from crime in their environment through growing fear, anxiety and psychological distress if they perceive an increased personal risk of victimization. To reduce the risk of crime, individuals might purchase safety devices such as safety locks or surveillance equipment, as well as starting to avoid certain areas in their neighborhood, staying at home at night and taking cabs rather than walking or using public transport (Cohen et al, 2004; Box et al., 1988; Ehrlich, 1996 for a list of possible effects of crime on non-victims). The combination of these individual reactions to crime can even lead to a general decline of neighborhoods as people withdraw from community life, the conditions for local businesses deteriorate and human capital diminishes due to the emigration of educated and wealthy inhabitants (Skogan, 1986; Cullen and Levitt, 1999).

Consequently, the efforts to reduce crime are often considered to be people's core preoccupation and one of the most important functions of the state (Valera and Guardia, 2014; Cohen, 2008; Di Tella and McCulloch, 2008). Accordingly, states allocate a substantial share of their resources for the provision of internal and external security. For instance, the member states of the European Union spent 3.2% of their yearly GDP on public order, safety and defense on average in 2013. This corresponds to 6.6% of the total state spending and an absolute expenditure of 432.8 billion Euros and about 850 Euro per capita, as determined by Eurostat. Although states spend considerable resources preventing crime, determining the optimal amount of government expenditure for public safety is a challenging objective. While determining the expenditure for public order, safety and defense is simple, attaching a value to its benefits – and thus justifying a specific level of state spending – remains difficult. Nevertheless, policy-makers deciding upon an optimal allocation of limited state resources require information about the economic value attributed to security by citizens (McCollister et al., 2010; Dolan et al., 2005).

However, the accurate valuation of security leads to a number of methodological difficulties, particularly because most security-related measures hold the characteristics of a public good, prominently by being non-excludable (Hummel, 1990; Tiebout, 1956).¹ Determining individuals' preferences for public goods is generally difficult as they are not directly traded in markets and individuals have incentives to strategically under- or over-state their true demand if asked (Frey et al., 2009). Despite these apparent difficulties, several revealed and stated preference methods have been proposed to determine the value of public goods, which have been discussed controversially (for an overview, see e.g. Pearce et al., 2006).²

In this paper, we present an alternative approach to valuing crime and public safety in monetary terms by using a broad sample of individuals' reported life satisfaction from a number of European countries. Following the life satisfaction approach (LSA), the monetary value of a change in the provision of a public good is interpreted as the corresponding amount of money that would be necessary to leave life satisfaction unaltered. While this approach has already been used for the valuation of a broad range of public goods and externalities, it has not yet been applied to general public safety in Europe, despite its potential merits for policy-makers interested in achieving an optimal level of security based on constituents' preferences.³

We thus evaluate the benefits of providing public safety measures in monetary terms, using information on individuals' reported life satisfaction, victimization experience and fear of crime from the European Social Survey (ESS). This household survey also contains information on respondents' place of residence corresponding to the EU classification of

¹ If e.g. criminals are arrested or crime prevention programs diminish the number of potential criminals, it is not possible to exclude others from the benefits of the reduced risk of victimization (Ehrlich, 1996; Head and Shoup, 1969). If safety measures cannot be provided to one person without simultaneously providing them to others, the latter can free-ride, i.e. they can consume the provided safety without paying (Hummel, 1990). For this reason, public safety or national defense is usually used as the textbook example for public goods and is considered one of the state's primary functions (Frey et al., 2009; Head and Shoup, 1969; Samuelson, 1955; Hummel, 1990).

² Revealed preferences methods have been used to determine the implicit price of public safety in the real estate property market (see e.g. Thaler, 1978; Blomquist et al., 1988; Lynch and Rasmussen, 2001; Gibbons, 2004). Cohen et al. (2004) applied the CVM to the issue of public safety, asking households how much they would be willing to pay to reduce specific crimes - ranging from burglary to murder - by 10% in their communities. Other examples are Ludwig and Cook (2001), who estimate the stated preference for a reduction in gun violence in the US, as well as Atkinson et al. (2005), who investigate respondents' WTP for different violent crimes in the United Kingdom.

³ To date, a limited number of studies have applied the LSA to evaluate different phenomena related to crime and safety (cp. Powdthavee, 2005; Moore, 2006; Frey et al., 2009; Cohen, 2008; Kuroki, 2013; Cheng and Smyth, 2015), while a number of studies investigate the effect of crime on different subjective well-being measures without valuing the estimated effect in monetary terms (see e.g. Michalos and Zumbo, 2000; Sulemana, 2015; Stickley et al., 2015).

regions. Regional crime statistics from official national authorities are additionally used in our analysis to estimate a micro-econometric life satisfaction function, including crime-related variables and income. Using the estimated coefficients, life satisfaction constant trade-offs between crime and income are obtained and used to determine people's implicit willingness-to-pay (WTP) for reductions in crime. Our paper thus analyzes – for the first time – the effect of victimization experiences and crime rates on SWB for a dataset containing the majority of European nations. This provides us with a large sample of almost 200,000 observations, allowing us to obtain WTP estimates for crime reduction with a high statistical precision. Apart from this novel evidence, the European data on WTP for crime reduction is compared to previous studies for different countries, time spans and types of crimes, as well as those using alternative methods of valuing public goods.

The remainder of this paper is organized as follows. In the following section two, we present our assumptions for the ensuing application of LSA data to value public goods, present our data and outline the empirical strategy. Section three presents our results and offers a comparison to previous different valuations, before section four concludes.

2. Method

2.1 Empirical approach

Using the LSA to investigate the effect of crime on life satisfaction leads to several statistical problems. A common approach uses indicators for the regional intensity of crime, such as the number of crime incidences or the crime rate, thus matching regional crime indicators to individual level data. For instance, this strategy has been applied by Frey et al. (2009) for terrorism, Hanslmaier (2013) for street crimes, Medina and Tamayo (2012) for homicides, Tella and MacCulloch (2008) for violent assaults and Cohen (2008) for violent crime. Rather than using official crime statistics, Davies and Hinks (2010) and Powdthavee (2005) calculate crime rates using information on the share of respondents per region reporting victimization in household surveys. However, both approaches remain problematic.

Most prominently, crime is most likely correlated with a number of other regional characteristics that similarly affect life satisfaction and cannot be controlled for, e.g. a general deterioration of the respective neighborhoods (Dolan and Peasgood, 2007; Gibbons and Machin, 2008). These poorly measurable factors complicate the statistical isolation of the effect of crime on life satisfaction from the effect of those omitted variables, which

consequently limits the validity of regional crime indicators (Linden and Rockoff, 2008; Luechinger and Raschky, 2009; Frey et al., 2009). Furthermore, since different types of crimes co-occur and not all types of crimes can be controlled for, it is difficult to attribute the estimated effect solely to the sub-categories of crime included in the respective analysis (Rajkumar and French, 1997; Thaler, 1978; Lynch and Rasmussen, 2001; Cohen, 1988). Another issue of using regional indicators is that crime can have an impact beyond the immediate area in which it was committed. An increase in criminal activity in one area may even be interpreted as a higher risk of victimization somewhere remote. Thus, the estimated effect of crime on life satisfaction might fall short of the actual effect, owing to regional spillovers (Frey et al., 2004; Gibbons and Machin, 2008). As the spatial spreading of fear is not objectively measurable, it is difficult to separate affected from unaffected individuals.

In addition to including these commonly used measures in our analysis, we also include another measure by drawing upon previous studies using information about victimization experiences and fear of crime from the same persons who report life satisfaction, following Medina and Tamayo (2012), Hanslmaier (2013), Davies and Hinks (2010) and Moller (2005). This approach eliminates the identification issues of using regional crime indicators, which subsequently only affects the residual effect captured by the regional crime indicator. Using information on individuals' fear and crime experience, the overall average effect of crime on life satisfaction is separated into its different components. The crime victimization variable then accounts for all effects that an act of crime has on a victim's life satisfaction via uninsured financial losses, physical and psychological harm not accounted for by the fear of crime variable. The fear of crime variable consequently accounts for the effect of crime on the life satisfaction of victims and non-victims due to increased fear, while the regional crime indicator accounts for all residual effects that arise primarily due to financial costs incurred by the respective community, such as insured losses and expenditure for public safety.⁴

⁴ It can be argued that individuals are compensated for the differences in the exposure to different levels of crime on private markets. Assuming equilibrated private markets and rational agents with accurate risk perception, price differentials in private markets fully compensate individuals for the expected utility loss due to the exposure to crime. Even if these strict assumptions are not fulfilled, people might still be partially compensated in private markets, which would have an offsetting effect on life satisfaction. The LSA as measured in this study thus merely captures the residual effect of crime that people are not already compensated for in private markets (see e.g. Van Praag and Baarsma, 2005; Luechinger and Raschky, 2009; Frey et al., 2009).

2.2 Data

The main variables used for the analysis are individuals' self-reported SWB, income and a number of variables representing their exposure to crime. These variables – as well as other individual and regional control variables – are taken from the European Social Survey (ESS, 2013) and Eurostat, the statistical office of the European Union (see: <http://ec.europa.eu/eurostat>).

The ESS interviews nationally representative cross-section samples of individuals across Europe every two years starting in 2002, whereby we use all rounds up to 2012. A total of 34 countries took part in all six rounds of the survey.⁵ The average number of observations per year is approximately 48,500, whereby approximately 1,920 individuals have been interviewed per country and year on average (SD of 439). The SWB questions are asked during each round and the wording of the questions and response scales is identical throughout all survey years. The life satisfaction question is: 'All things considered, how satisfied are you with your life as a whole nowadays?' Answers are given using an eleven-point numeric scale comprising integers running from zero to ten with additional verbal labels attached to the endpoints of the scale saying 'Extremely dissatisfied' and 'Extremely satisfied'. The responsiveness to this question is high, with not more than 1,750 missing values among a total of about 290,000 observations.⁶

We further use the ESS data on respondents' household incomes, whereby the income intervals provided in the survey are converted into a continuous variable by using the mean of the respective interval. The final income interval has no upper limit and thus is dropped from the analysis, with both approaches being common practice (Frey et al., 2009; Luechinger, 2010; Berg and Carbonell, 2007). Mean values are converted into 2012 Euros and the values are adjusted for inflation using a harmonized consumer price index. Other personal characteristics included are age, sex, marital status, labor force status and type of settlement.

A number of variables representing people's exposure to crime are used. First, respondents are asked if they or another member of their household have become a victim of a burglary or

⁵ The countries included in the dataset are Albania, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kosovo, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom.

⁶ The distribution of reported life satisfaction levels across Europe and an illustration of the average reported life satisfaction per region for 2012 are documented in the appendix (Table A1, Figure A1, respectively). Since the life satisfaction variable is an ordinal categorical variable, the mean is calculated assuming that the distance between each response category is equal, which is a standard procedure in happiness economics (see e.g. Easterlin, 1995; Diener and Seligman, 2004; Diener et al., 2013).

assault in the last five years. From these answers, we create a dummy variable (DV) with a value of 1 if the respondent affirms and 0 otherwise. Furthermore, the respondents state their fear of crime, being asked: ‘How safe do you – or would you – feel walking alone in this area after dark? Do – or would – you feel very safe, safe, unsafe or very unsafe?’. We similarly create a DV for each response category and interpret the question as a general indicator of the respondents’ fear of crime.

Since the ESS contains information on respondents’ place of residence using the NUTS classification or similar regional coding schemes, the survey data can be connected to official numbers of crime incidences or crime rates from Eurostat, which covers the entire survey period on a national level.⁷ Due to difficulties in comparing crime rates across countries owing to national differences in legal and criminal justice systems, the reporting behavior of victims and the processing of information by the police, only the homicide rates are used, for which national differences are negligible according to Eurostat.⁸

A different approach towards a regional crime indicator is to use the share of ESS respondents in a certain territory reporting victimization and interpreting these results as a proxy for the crime rate in the respective area (Powdthavee, 2005; Davies and Hinks, 2010).⁹ We thus use the average fear of crime per region as an indicator of regional crime.¹⁰ Using the fear-of-crime variable, a regional average is calculated using the coding of the variable in the dataset, with a value of 1 for ‘very safe’, 2 for ‘safe’, 3 ‘unsafe’ and 4 for ‘very unsafe’, assuming that the ordinal categories are equidistant.¹¹

2.3 Empirical strategy

Let the life satisfaction of individual i be a latent and continuous – i.e. cardinal – variable for true well-being w_i , which is assumed to be comparable across individuals (Van Praag and

⁷ NUTS refers to the “Nomenclature of Territorial Units for Statistics”; it is the regional classification used by Eurostat. The regions usually correspond to administrative divisions within the country and are intended to be of comparable population size at the same level. The standards for establishing regions are 3 to 7 million people for NUTS 1, 800,000 to 3 million for NUTS 2 and 150,000 to 800,000 for NUTS 3. A comprehensive overview of the NUTS - including the current and former NUTS codes - can be found at: <http://ec.europa.eu/eurostat/web/nuts/history>.

⁸ For the discussion of inter-country comparison of crime rates by Eurostat, see: http://ec.europa.eu/eurostat/cache/metadata/de/crim_esms.htm.

⁹ Figure A2 in the appendix provides a choropleth map for the share of victimized respondents per region in 2012.

¹⁰ The distribution for the whole sample is given in Table A2 in the appendix.

¹¹ Figure A3 in the appendix provides a choropleth map for the average fear of crime per region in 2012.

Baarsma, 2005; Layard et al., 2008). Among other things, life satisfaction depends on an individual's income y_i and exposure to crime c_i , whereby w_i can be written as

$$w_i(y_i, c_i). \quad (1)$$

When individuals are asked to state their level of life satisfaction LS_i , they apply a non-differentiable reporting function $r_i(w_i)$, which maps true utility onto the available survey scale with ordered categories ranging from 0 to 10. The reporting function is strictly increasing in w , i.e. $r(w^*) > r(w)$ for all $w^* > w$. Hence, $r(\cdot)$ is a positive monotonic transformation of $w(\cdot)$. Furthermore, it is assumed that different individuals map their internal well-being identically onto a survey scale, with the result that $r_i(\cdot)$ is reducible to $r(\cdot)$ (see Layard et al., 2008; Carbonell and Frijters, 2004). Reported life satisfaction can thus be written as

$$LS_i = r(w_i(y_i, c_i)) + \varepsilon_i, \quad (2)$$

where ε_i is an additive error term allowing for random mistakes that individuals make in reporting their internal level of life satisfaction. Following this specification and based on the data described in the preceding section, we explain the reported life satisfaction of individual i at time t living in location k by the equation

$$\begin{aligned} LS_{itk} = & \beta_0 + \beta_1 VC_{itk} + \beta_2 \text{Fear}_{itk} + \beta_3 CI_{tk} + \beta_4 \ln y_{itk} \\ & + \beta_5 X_{itk} + \beta_6 R_{tk} + \gamma_k + \kappa_k + \varepsilon_{itk}^* \end{aligned} \quad (3)$$

where VC_{itk} is a DV that equals 1 if the respondent reports that she or another member of the household has been a victim of a burglary or assault in the past five years. Fear_{itk} represents respondents' answers to the feelings-of-safety question, whereby a DV for each response category is included. CI_{tk} refers to crime indicators for region k at time t . Similar to other micro-econometric satisfaction functions, respondents' household income y_{itk} is logarithmically transformed (see e.g. Luechinger and Raschky, 2009). Furthermore, to account for shared fixed costs and the lower consumption of children, we include the square root of the household size to capture the effect of an increasing number of household members on equivalence income (Luechinger, 2010). This variable as well as age, sex, marital status, labor force status and type of settlement are represented by X_{itk} . R_{tk} is a vector of regional macro-economic variables such as GDP and unemployment. Finally, γ_k and κ_k are region and time fixed effects. The former are included to capture unchanging region-specific differences in life satisfaction, while the latter control for region-independent temporal changes of the dependent variable. The region fixed effects are particularly important for estimating the effect of the regional crime indicators on life satisfaction, as unobserved

region-specific characteristics are possibly correlated with both crime and life satisfaction (Di Tella et al., 2003). The composite error term $\varepsilon_{itk}^* = \varepsilon_{itk} + v_{itk}$, where ε_{itk} is the individual random error and v_{itk} the ordinary error term.

As life satisfaction is measured on an ordinal scale, equation (3) should be estimated by means of ordered probit or ordered logit regression (Van Praag and Baarsma, 2005; Kuroki, 2013). However, previous studies have shown that it makes little difference whether life satisfaction is treated as an ordinal or interval scale (see e.g. Carbonell and Frijters, 2004). Most previous studies using the LSA have thus used OLS to demonstrate the relationships between life satisfaction and the main variables and applied regression models suited for ordinal dependent variables when estimating the monetary value of the respective public good (e.g. Luechinger, 2009; Frey et al., 2009; Luechinger, 2010; Luechinger and Raschky, 2009).

We use a robust estimator of variance for all estimations and additionally adjust standard errors for clustering (Moore, 2006; Luechinger and Raschky, 2009; Frey et al., 2009). Problems due to clustering arise because observations within a cluster or group are potentially not independent of one another. In this case, the clusters or groups are regions per year. Reported life satisfaction as well as a number of the explanatory variables of individuals living in one region at the same time are likely similar due to a shared ethnic and cultural background and equal exposure to certain features of the environment. In the case of clustered data, the residual error terms of different individuals of the same cluster are potentially correlated, thus violating the Gauss-Markov assumptions. The higher the intra-class correlation of a variable, the more underestimated its standard errors. Intraclass correlation is a measure of how much of the variation of a variable is attributable to observations within clusters compared to between clusters (Tay and Diener, 2011). Therefore, the underestimation of standard errors is particularly problematic for variables that have only one value per cluster and thus the highest possible intra-class correlation (Moulton, 1990; Klock, 1981). This is obviously the case for regional crime indicators and hence requires the adjustment of standard errors.

3. Results

3.1 Personal characteristics

We use a number of personal characteristics in each regression model. For illustration purposes, Table 1 separately reports the estimates for a ‘baseline’ regression (Model A) including only personal characteristics.¹²

	<i>Model A</i>	
	Coef.	t-value
Household income		
ln y	0.506***	34.1
Hh size ^{1/2}	-0.133***	-7.53
Labor force status		
Paid work	Reference group	
Education	0.293***	12.1
Unemployed	0.974***	-29.3
Unemployed (not seeking job)	-0.707***	-14.9
Permanently sick or disabled	-1.112***	-29.5
Retired	-0.0419*	-2.08
Community or military service	0.0521	0.42
Housework	-0.0701***	-3.53
Other	-0.191***	-3.61
Type of settlement		
Large city	Reference group	
Suburbs	-0.0286	-1.22
Town or small city	-0.0125	-0.61
Country village	0.0625**	2.90
Farm or home in countryside	0.178***	5.74
Other personal characteristics		
Male	Reference group	
Female	0.107***	10.2
Age	-0.0749***	-34.0
Age ²	0.000702***	32.0
Not married	Reference group	
Married	0.451***	34.8
Constant	Yes	
Year-specific effects	Yes	
Region-specific effects	Yes	

¹² Since the estimates for these variables do not hold particular interest, they will not be individually listed in the following tables, with the exemption of household income and size, which are necessary to calculate the monetary equivalent of changes in the crime variables.

Adj. R ²	0.258
No. of observations	204,554
No. of clusters	1,625

Table 1. The effect of personal characteristics on life satisfaction. 1. The dependent variable is reported life satisfaction. (2) OLS estimates. (3) Standard errors are adjusted for clustering on the level of regions and years.

* P <, ** p < 0.01, *** p < 0.001

The estimated coefficients for the personal characteristics correspond to those previously found in the literature. For instance, age has a u-shaped relationship with life satisfaction, with a turning point at the age of 53 (see e.g. Blanchflower and Oswald, 2008; Weiss et al., 2012). Regarding labor force status, being in education is most conducive to life satisfaction. Individuals who cannot work due to permanent sickness or disability score particularly low on the life satisfaction scale, scoring on average 1.112 points lower than individuals of the reference group, i.e. those in paid work. Being unemployed is also highly detrimental to life satisfaction, even after controlling for the effect of lower income. Those who are unemployed but not looking for a job (−0.707 points) suffer significantly less than those who are seeking employment (−0.974 points) (p=.000). Living in rural areas also enhances life satisfaction. On average, women report slightly higher life satisfaction than men (+0.107 points) and married individuals are happier than those who are not (+0.451 points).

3.2 Homicide rate and life satisfaction

We expect all crime variables to have a negative effect on life satisfaction. To investigate this effect, we first include the homicide rate for the smallest available territorial units.¹³ For this specification, we cannot identify a robust and significant negative relationship between reported life satisfaction and the regional homicide rate. Running the same regression separately for each country to account for potential cross-national dissimilarities in national crime reports similarly yields no robust pattern of a negative significant relationship between the homicide rate and reported life satisfaction, whereby the estimated coefficient is only significantly negative for four of nineteen countries and considerably differs in size.

To account for another potential source of error, we run the regression separately for each NUTS level. As the size of the regional unit increases, information on possible intra-regional variation in crime is lost. One could thus expect that a successful identification of the effect of the homicide rate on life satisfaction is hampered by the inclusion of observations that can

¹³ This leaves us with ca. 11,000 observations for the homicide rate on each, country, NUTS 1 and 3 level and ca. 20,000 observations on NUTS 2 level.

only be assigned to highly aggregate regional units. However, even when restricting the dataset to observations with information on the regional homicide rate at the NUTS 3 level, there is no statistically significant correlation between the homicide rate and life satisfaction.

Finally, we run the regression separately for sub-groups of respondents according to their indicated type of settlement. As crime predominantly takes place in large cities and suburbs, one could expect that people living in agglomerated places are particularly affected.¹⁴ Once again, there is no robust and significant negative relationship.

We apply the same testing procedure for the regional crime variable representing the share of respondents per region and survey year who reported having been a victim of burglary or assault in the last five years. Burglary and assault are less severe than homicide, which might worsen the chances of identifying their effect on life satisfaction. However, the variable has two advantages: first, as the victimization question was included in each survey round, the number of observations considerably increases; and second, it is not prone to some of the issues of official crime statistics. Despite these potential advantages, the results are similar to those obtained for the homicide rate. The results look more robust in general but do not hold when other regional variables such as GDP and unemployment are controlled for.

3.3 Regional perception of safety and life satisfaction

By contrast, the regional average of the feelings-of-safety variable has a robust and significantly negative effect on life satisfaction (see Model *B* in Table 2). The effect on life satisfaction of an increase in the average regional fear of crime by one point – e.g. from ‘safe’ to ‘unsafe’ – is equal to an increase in household income by a factor of approximately 2.5. Comparing the estimated effect of the regional level of fear (–0.490) to that of the personal characteristics in Model *A*, it can be stated that the difference in life satisfaction between individuals living in regions with a one-point difference in the level of regional fear is somewhat greater than the gap in life satisfaction between married and unmarried individuals. A two-point difference in the regional level of fear corresponds to the life satisfaction gap between job-seeking unemployed and individuals in paid work.

¹⁴ See e.g. Glaeser and Sacerdote (1996), Gibbons (2004), Bannister and Fyfe (2001). The pattern of higher crime rates in agglomerations can also be found in the ESS. The share of respondents who report victimization living in suburbs and villages is 22.83% and 14.09%, respectively.

3.4 Victimization, fear of crime and life satisfaction

Next, we include a dummy variable for respondents who report having been victimized in the last five years. As can be seen from Model *C* in Table 2, those respondents have a significantly lower life satisfaction of 0.226 points. This effect decreases by 30% after controlling for individuals' fear of crime in Model *D*. Almost one-third of the losses in life satisfaction of respondents reporting victimization is thus due to an increase in fear of crime. As expected, the effect of average regional fear of crime decreases in size (–61%) and significance when individuals' fear of crime is controlled for. If individuals' levels of fear and victimization experiences are controlled for, the regional crime indicator only captures broader 'context' effects of crime. To examine the validity of the results, two more models are estimated.

In a first step, using information on respondents' household size, we sub-divide the victim-of-crime variable. As already mentioned, the question regarding victimization experience refers to the entire household. Since respondents' household size is known, it is possible to refine the variable into cases where the respondent can be determined as being the actual victim (i.e. if the respondent states being the only member in the household) or not (two or more household members).¹⁵

¹⁵ However, there remains a residual risk of incorrectly identifying a respondent as being the actual victim as the victimization question refers to the last five years, whereas the question on household size refers to the moment of the interview.

	<i>Model B</i>		<i>Model C</i>		<i>Model D</i>	
	Coef.	t-value	Coef.	t-value	Coef.	t-value
Crime variables						
Regional crime indicator						
Regional fear of crime	-0.490***	-5.18	-0.472***	-4.98	-0.183*	-1.93
Victimization experience						
Unvictimized household	—	—	Reference group		Reference group	
Victimized household	—	—	-0.226***	-15.9	-0.161***	-11.7
Feelings of safety						
Very safe	—	—	—	—	Reference group	
Safe	—	—	—	—	-0.258***	-15.6
Unsafe	—	—	—	—	-0.603***	-29.1
Very unsafe	—	—	—	—	-0.952***	-27.8
Household income						
ln y	0.508***	34.0	0.510***	34.2	0.486***	32.8
hh size ^{1/2}	-0.132***	-7.55	-0.130***	-7.42	-0.124***	-7.13
Constant	Yes		Yes		Yes	
Personal characteristics	Yes		Yes		Yes	
Region-specific effects	Yes		Yes		Yes	
Year-specific effects	Yes		Yes		Yes	
Adj. R ²	0.260		0.261		0.269	
No. of observations	200,463		199,909		197,939	
No. of clusters	1,625		1,625		1,625	

Table 2. The effect of crime on life satisfaction I. 1. The dependent variable is reported life satisfaction. (2) OLS estimates. (3) Standard errors are adjusted for clustering on the level of regions and years. * P <, ** p < 0.01, *** p < 0.001

Across the entire sample, 52,253 respondents reported having been victimized in the past five years, of which 9,032 reported being the only member of the household. The loss in life satisfaction for the latter group of respondents should be greater than for the former group. However, the estimated coefficient for the latter group is only a lower-bound estimate of the loss in life satisfaction for actual victims, as it cannot be precluded that the former group also includes actual victims. As can be seen from Model *E* in Table 3, the latter group suffers a loss of 0.318 points in life satisfaction compared to non-victimized households. This loss is 52% greater than the loss of the remainder of respondents reporting victimization.

Furthermore, the correlation between life satisfaction and regional crime indicators may be spurious due to unobserved co-varying regional characteristics. To check whether the estimate on the regional crime indicator is influenced by such characteristics, we include the unemployment rate and the natural logarithm of the GDP at purchasing power parity per capita at the regional level. As can be seen when comparing Models *F* and *D*, the estimate for average regional fear appears to remain unaffected by the inclusion of the macro-economic variables; indeed, the estimated coefficient even decreases from -0.183 to -0.193 . However, the sample size considerably decreased due to the inclusion of the macro-economic variables. If Model *D* is re-estimated with the same observations left in Model *F*, the results look different. The estimated coefficient for this modified Model *D* is equal to -0.323 ($p=0.006$). Thus, the coefficient is reduced in both size and significance by the inclusion of macro-economic variables. Therefore, the variable for the regional level of fear captures some variation in the dependent variable due to the economic situation of a region.

The changes in the estimated coefficients for the victim-of-crime variables from Model *E* to *F* are similarly interesting: the coefficient for victimized households decreases by 55%, whereas the coefficient for victimized respondents decreases by only 24%. This decrease can be attributed to the inclusion of individuals' level of fear in Model *F*. The disproportional reduction of the coefficients for the two victim-of-crime variables provides further validation of the estimated effect of victimization on life satisfaction. The likelihood that respondents who report victimization are the actual victims decreases with household size. Respondents who are not actually victimized but rather experience the victimization of another person in the household are mainly affected due to increased fear. Actual victims also experience an increase of fear, as well as suffering from other consequences. Therefore, a relatively smaller proportion of the overall effect captured by the variable representing actual victims should be

due to an increase in fear, thus explaining the disproportional decrease of the estimated coefficients for the victim-of-crime variables from Model *E* to *F*.¹⁶

	<i>Model E</i>		<i>Model F</i>	
	Coef.	t-value	Coef.	t-value
Crime variables				
Regional crime indicator				
Regional fear of crime	—	—	-0.193 ⁺	-1.72
Victimization experience				
Unvictimized household	Reference group		Reference group	
Resp. or other hh member victimized	-0.209***	-13.4	-0.0941***	-4.81
Respondent victimized	-0.318***	-11.2	-0.242***	-6.20
Feelings of safety				
Very safe	—	—	Reference group	
Safe	—	—	-0.232***	-10.9
Unsafe	—	—	-0.571***	-20.9
Very unsafe	—	—	-0.921***	-18.7
Macro-economic variables				
Unemployment rate (Age 20-64)	—	—	-0.0174**	-2.67
ln GDP p.c. (PPP)	—	—	1.097**	2.99
Household income				
ln y	0.507***	34.1	0.465***	24.1
hh size ^{1/2}	-0.141***	-7.92	-0.105***	-4.49
Constant	Yes		Yes	
Personal characteristics	Yes		Yes	
Region- and year-specific effects	Yes		Yes	
Adj. R ²	0.259		0.217	
No. of observations	203,992		97,696	
No. of clusters	1,642		649	

Table 3. The effect of crime on life satisfaction II. 1. The dependent variable is reported life satisfaction. (2) OLS estimates. (3) Standard errors are adjusted for clustering on the level of regions and years. * P <, ** p < 0.01, *** p < 0.001

¹⁶ Again, the number of observations between the two models varies considerably. If Model *F* is estimated without the macro-economic variables, the differences in reductions amount to 32% and 22%.

3.5 Willingness-to-pay for crime reduction

Using the estimated coefficients of the micro-econometric life satisfaction function for the crime variables and household income, it is possible to calculate the amount of money necessary to hold life satisfaction constant if the intensity of regional crime changes, an individual becomes a victim of crime or experiences a change in their fear of crime. The estimated monetary values are referred to as the (implicit) WTP. Following the nomenclature introduced in section 2.3, the utility constant change in household income can be obtained solving

$$w(y, c) = w(y + \Delta y, c + \Delta c), \quad (4)$$

where Δy is the monetary amount necessary to keep life satisfaction constant if c is changed by Δc . According to the micro-econometric life satisfaction function in (3) and after dropping all irrelevant terms, (4) can be rewritten as

$$\begin{aligned} \hat{\beta}_2 CI + \hat{\beta}_4 \ln y &= \hat{\beta}_2 (CI + \Delta CI) + \hat{\beta}_4 \ln (y + \Delta y) && \text{or} \\ -\hat{\beta}_4 \ln [(y + \Delta y) y^{-1}] &= \hat{\beta}_2 \Delta CI && \text{or} \\ \Delta y &= y [\exp (-\hat{\beta}_2 \hat{\beta}_4^{-1} \Delta CI) - 1] && (5) \end{aligned}$$

Equation (5) is derived for the variable representing regional crime indicators but is exemplary for all three crime variables. As can be seen from (5), due to the logarithmic transformation of the income variable, Δy depends upon the initial level of household income. In the following, we calculate the WTP for an individual with the average annual household income of 25,010€ based on the whole dataset. Three hypothetical changes of the crime variables used in the regressions presented above are considered. First, the monetary amount necessary to compensate a respondent for being victimized is calculated. Unlike the other two variables, for the victim-of-crime variable it is unreasonable to consider a reduction of the variable given that an individual who has been victimized cannot be de-victimized. On the other hand, the level of individual and regional fear can be reduced. To calculate the WTP for a victim, we use the estimated coefficients of Model *F*, whereby we only consider individually identifiable victims.

	<i>Victimization</i>	<i>Fear</i>	<i>Av.reg. Fear</i>
Δc	Non-victim to victim	Unsafe to Safe	Decrease by one standard deviation (-0.245 points)
$ \Delta y $			
OLS			
Point est.	21,790€	12,700€	6,270€
Stand. err.	2,753€	598€	1,055€
95% CI	[16,389€-27,191€]	[11,724€-14,676€]	[4,201€-8,339€]
Ordered Probit			
Point est.	21,093€	12,306€	6,092€
Stand. err.	2,816€	529€	1,099€
95% CI	[15,574-26,611€]	[11,270-13,342€]	[3,938€-8,246€]

Table 4. Willingness-to-pay for a reduction of the exposure to crime. 1. WTP estimates are in 2012 Euros. 2. WTP estimates are calculated for an individual with the average annual household income of 25,010€. 3. Point estimates are calculated according to (5). 4. Standard errors and CI for the WTP estimates are derived according to the delta method (see e.g. Oehlert, 1992).

As can be seen from Table 4, a victimized individual would have to be compensated with 21,790€. Put differently, a non-victimized individual would be willing to accept victimization for a compensation of 21,790€. Table 4 not only reports the point estimates but also the standard errors and confidence intervals for the estimated WTP. The two measures of statistical dispersion for the WTP are calculated using the delta method (see e.g. Oehlert, 1992). The 95% confidence interval for the estimated WTP ranges from 16,389€ to 27,191€. Table 4 also contains the estimated WTP using ordered probit estimations (see Model *E** in Table A3 in the appendix). Both the OLS and ordered probit result in remarkably similar estimates. The estimated compensation for a victimized individual using the ordered probit is 21,093€, i.e. only 3% lower than the OLS estimate.

For the individual fear-of-crime variable, we consider a reduction of fear represented by a move from feeling unsafe to safe in the local area. The calculated WTP is based upon the estimated coefficients of Model *D*. Individuals would on average be willing to pay 12,700€ if offered the means to increase their feelings of safety from ‘unsafe’ to ‘safe’. Owing to the high statistical significance of the fear of crime DVs, the confidence interval of the resulting CS (11,724€ to 13,676€) is fairly narrow. Again, the difference between the estimate based on the OLS and ordered probit is marginal (3%) (See Model *D** in Table A3 in the appendix). For the average regional fear of crime, we calculate the WTP for a hypothetical reduction of one standard deviation (–0.245 points). The WTP is determined using the estimated coefficients of Model *B*. A decrease in average regional fear by –0.245 points enhances life

satisfaction by 0.12 points, which could be offset by a 6,270€ reduction of initially 25,010€ annual household income. The corresponding estimate using ordered probit amounts to 6,092€ (See Model *B** in Table A3 in the appendix).

3.6 Comparison with estimates of previous valuation studies

Comparing the estimates presented in Table 4 to those previously found by studies using the LSA is difficult since few studies estimate monetary equivalents of the effects of crime. Moore (2006) is the only study estimating the impact of fear of crime in monetary terms. Using data from the first round of the ESS in 2002, he estimates a compensation of 13,538€ if an individual moves from ‘no fear’ to ‘fear’. Frey et al. (2009) calculate the monetary amount that individuals living in terrorist prone regions of Paris and Northern Ireland would be willing to pay if the number of incidents was reduced to the level prevailing in the rest of the respective country. The numbers are 7,230€ and 1,040€ or 26% and 4% of annual household income in the British Isles and France, respectively. Using cross-sectional data from a household survey conducted in South Africa, Powdthavee (2005) estimates the monetary equivalent of being a victim of robbery, burglaries, housebreaking or murder in the past 12 months as US\$21,142, whereby a conversion to 2012 Euros yields an estimate of 23,500€. While this estimate is similar to ours, comparability is problematic as the crimes included in the analysis, the respective time span and the average household income substantially differ. Using survey data from the US, Cohen (2008) estimates that respondents who have been victims of a burglary in the previous 12 months would have to be compensated with an equivalent of 87,000€. Using the same victim-of-crime variable on data from Japan, Kuroki (2013) estimates a WTP of approximately 29,000€-43,500€. When taking into account the different features of the data, we conclude that previous estimates are largely comparable to ours.

A further interesting aspect is the comparison of our results to studies using stated and revealed preference methods to estimate the WTP for changes in regional crime intensities. Cohen et al. (2004) elicited stated preferences for a number of different offences including burglary and serious assault, whereby the estimates are 23,650€ and 66,230€, respectively. Taken at face value, the estimates are not considerably different to those found in studies applying the LSA.

Our results can further be compared to those from hedonic pricing studies, in which the coefficient of the crime rate in a hedonic pricing reveals the value by which housing prices

decrease on average if the crime rate increases. If the crime rate is interpreted as the personal victimization risk and it is assumed that individuals only suffer from crime if they are victimized, the coefficient can be used to unveil the average expected cost of becoming a victim of crime. For instance, using US data from 1971, Thaler (1978) finds a WTP (per household) to avoid a property crime of US\$575 in 1971, which would translate to 2,538€ in 2012 Euros. Although comparability with the results obtained using the LSA is restricted, the estimates of hedonic pricing studies appear to be considerably lower (see e.g. Hellman and Naroff, 1979; Lynch and Rasmussen, 2001; Gibbons, 2004; Bowes and Ihlanfeldt, 2001; Clark and Cosgrove, 1990).

3.7 Limitations

Our results generally confirm that both victimization and fear of victimization have an impact on individuals' life satisfaction, corresponding to a considerable monetary value. However, using data on life satisfaction has several limitations that need to be addressed.

We found no effect of regional crime rates, which cannot be accounted for by the incomparability of crime statistics across countries as neither the homicide rate nor the variable representing the share of respondents per region and survey year reporting victimization could explain variations in life satisfaction for each country separately. However, an incorrect setting of boundaries might have driven the results, given that the fear induced by crime cannot be objectively localized (See Gibbons and Machin, 2008). Second, even the smallest regional units in the dataset might be too large if the effects of the considered types of crime are highly localized and the intra-regional variation in crime is high (See Hanslmaier, 2013). Third, individuals' subjective perception of victimization risk rather than the objective risk represented by crime rates determines fear (See Frey et al., 2004). Accordingly, perceptions may not correspond to the objective risk but they could rather be influenced by single negative experiences with crime, the consumption of local media and visibility of crime (Hanslmaier, 2013).

Rather than drawing upon crime rates, individually stated fear of crime can be used. However, subjective assessments might be influenced by person-specific traits such as the level of optimism (Hamermesh, 2004). A correlation between the respective subjective assessment of safety and life satisfaction could thus simply reflect different levels of optimism in society and not a causal negative effect of fear on life satisfaction. If such personally traits indeed

affect people's subjective assessments, the true effect of fear on life satisfaction would probably be overestimated in this study.

Therefore, we would argue that the estimated effects of experienced victimization are the most reliable measure. However, one potential problem of this measure is individuals erroneously mis-reporting on the victimization question due to the long period of inquiry, which would lead to either an over- or under-estimation depending on whether an under- or over-reporting of crimes dominates. Furthermore, it is not entirely clear what effect the victimization variable captures, as it includes two kinds of offences and respondents might – due to unfamiliarity with the legal definitions – not correctly differentiate them from other categories of crime and thus incorrectly report victimization (Kuroki, 2013).

Finally, regarding the estimation of individual monetary compensation for crime victims, one potential source of bias is the assumption that causality runs from both income and crime to life satisfaction, i.e. income enhances and crime diminishes life satisfaction rather than vice versa. In the latter case, there would be an over-estimation of the causal effect of crime on life satisfaction, particularly for fear of crime, since unhappiness might cause individuals to be more anxious (Kuroki, 2013; Davies and Hinks, 2010). However, there are no studies addressing the potential reverse causation for fear and life satisfaction. In terms of victimization and happiness, a number of psychological studies have shown that victimization causes losses in well-being and not vice versa (See e.g. Atkeson et al., 1982; Kilpatrick et al., 1985).

4. Conclusion

The central purpose of this study was to evaluate the benefits of providing public safety measures in monetary terms by using a broad European sample. Such evaluations can be used to assist policy-makers in reaching efficient decisions concerning the allocation of resources or as a benchmark when evaluating appropriate monetary compensations for victimization. Safety is one of people's major concerns, reflecting the strong demand for measures ensuring freedom from crime (Cohen, 2008; Di Tella and MacCulloch, 2008). In order to efficiently provide public safety measures, their value needs to be determined (Frey et al., 2009). In this study, the LSA has been applied for this purpose. To determine the value of public safety, information on individuals' SWB, their income, victimization experience, fear of crime and several other personal characteristics are employed. Using the information on respondents' place of residence according to the NUTS classification, regional crime statistics from official

national authorities gathered by Eurostat are appended. A micro-econometric happiness function including crime-related variables and income is estimated using both OLS and ordered probit. Using the estimated coefficients, changes in the crime variables can be evaluated directly in terms of life satisfaction, as well as relative to the effect of income on life satisfaction.

Fear of crime, criminal victimization and the average regional level of fear are found to significantly reduce life satisfaction. If a public policy measure improves an individual's perception of safety of his neighborhood from unsafe to safe, the benefit of a person holding the average household income is equivalent to 12,700€. Respondents who report that their household has been a victim of a burglary or assault score on average 0.226 points lower than non-victimized households. As expected, the loss in life satisfaction – corresponding to 21,790€ – is even greater for those respondents who are the only members of their household and hence identifiable as being personally victimized. The regional homicide rate and the regional share of respondents reporting victimization are not found to significantly reduce life satisfaction. Merely the average level of fear in a region has a significant impact on life satisfaction, which is still significantly associated with life satisfaction even after controlling for the individual level of fear. This effect is slightly altered if controlling for potentially co-varying regional characteristics. Our results for a large-scale European context are comparable to studies on crime and SWB in fairly different countries, categories of crime and time spans. In domains that enable a comparison with estimates derived from stated and revealed preferences methods, it appears that only WTP estimates obtained by applying the stated preferences are of comparable size, whereas WTP estimates derived from revealed preferences methods like hedonic pricing are considerably smaller.

From a policy perspective, our results on crime and SWB in Europe can be used to argue that measures aimed at avoiding victimization and reducing the fear of crime across the population can be attributed substantial monetary value, particularly when projecting the individual level results to large populations. We suggest that further research should more precisely determine the value for different aspects of criminal- and anti-criminal activities to provide more detailed information to policy-makers concerning which investment in public security leads to the highest returns in life satisfaction. This might lead to a reallocation of resources to domains that are attributed higher monetary values through the indirect valuation mechanism of SWB measures. Furthermore, our results suggest that the perception of criminal activity is a central determinant of life satisfaction, potentially being as important as the actual crime rates. Thus, we would suggest that policy-makers and researchers more closely evaluate how

to invest resources not only in terms of reducing crime rates, but also in increasing public perception of safety. Both strategies might substantially diverge, since the perception of safety might be partly unrelated to actual crime statistics and could thus be improved through simple measures that can be maintained without substantial resource investments, such as a higher visibility of security agencies. Despite the lower costs, an improved general feeling of safety could thus substantially contribute to increases in SWB.

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Appendix

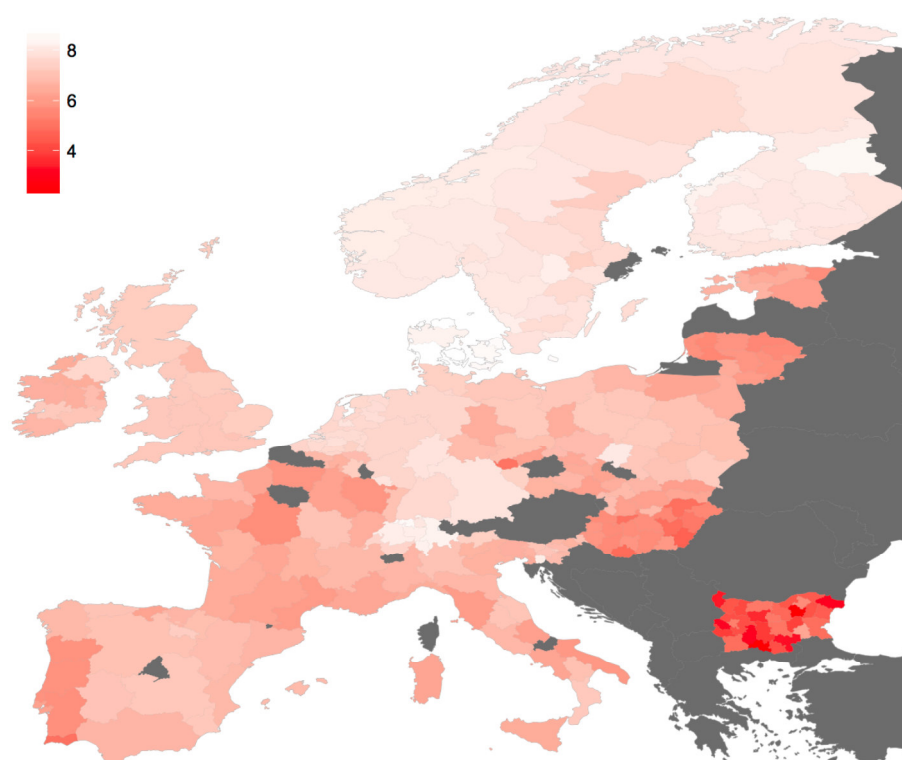


Figure A1. Average Life Satisfaction per Region in 2012. Average reported life satisfaction per region in 2012. The life satisfaction question is: ‘All things considered, how satisfied are you with your life as a whole nowadays?’ Answers are given on an eleven-point numeric scale comprising integers running from zero to ten.

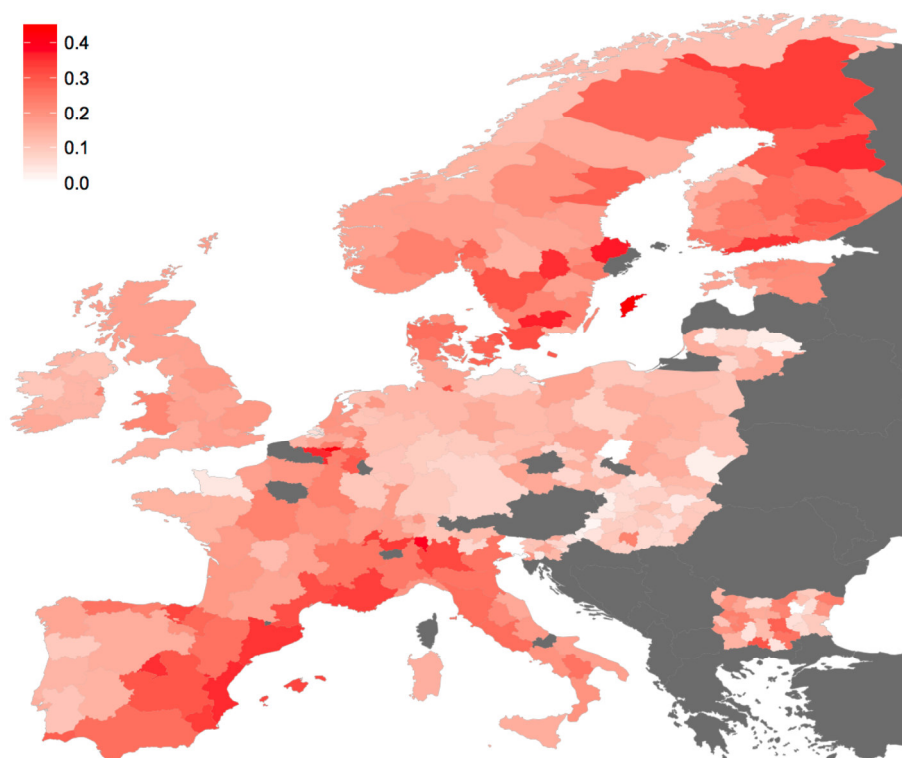


Figure A2. Share of Victimized Respondents per Region in 2012. Share of respondents per region reporting victimization in 2012. The corresponding question is: ‘Have you or a member of your household been the victim of a burglary or assault in the last 5 years?’.

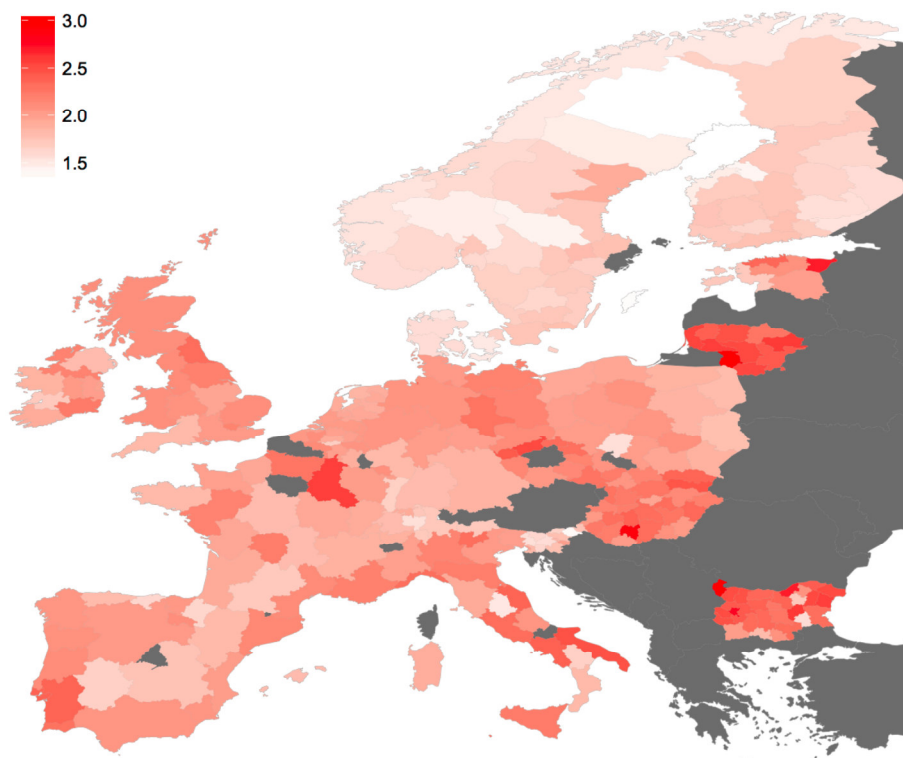


Figure A3. Average Feelings of Safety per Region in 2012. Average feelings of safety per region in 2012. The corresponding question is: ‘How safe do you – or would you – feel walking alone in this area after dark? Do – or would – you feel (1) very safe, (2) safe, (3) unsafe or (4) very unsafe?’ The average is calculated using the numeric coding of the variable.

<i>All things considered, how satisfied are you with your life as a whole nowadays?</i>	<i>No. of individuals</i>	<i>%</i>
0 Extremely dissatisfied	6,310	2.17
1	4,334	1.49
2	7,591	2.62
3	13,263	4.57
4	13,943	4.81
5	35,334	12.18
6	26,229	9.04
7	47,095	16.23
8	68,154	23.49
9	38,870	13.4
10 Extremely satisfied	29,053	10.01
Total	290,176	100.00

Table A1. Overall life satisfaction. Absolute numbers and percentage of respondents who chose the respective answers to the question: ‘All things considered, how satisfied are you with your life as a whole nowadays?’ The data refer to a cross-section of 290,176 people for round 1 to 6 of the ESS.

<i>How safe do you – or would you – feel walking alone in this area after dark?</i>	<i>No. of individuals</i>	<i>%</i>
Very safe	72,648	25.20
Safe	142,654	49.47
Unsafe	57,547	19.96
Very unsafe	15,488	5.37
Total	288,337	100.00

Table A2. Absolute numbers and percentage of respondents who chose the respective answers to the question: ‘How safe do you – or would you – feel walking alone in this area after dark?’ The data refer to a cross-section of 288,337 people for round 1 to 6 of the ESS.

	<i>Model D*</i>		<i>Model B*</i>		<i>Model E*</i>	
	Coef.	t-value	Coef.	t-value	Coef.	t-value
Crime variables						
Regional crime indicator						
Average regional fear of crime	-0.0674	-1.53	-0.213***	-4.87	—	—
Victimization experience						
Unvictimized household	Reference group		—	—	—	—
Victimized household	-0.0711***	-10.7	—	—	—	—
Resp. or other hh member victimized	—	—	—	—	-0.0928***	-12.4
Respondent vicitimized	—	—	—	—	-0.139***	-10.6
Feelings of safety						
Very safe	Reference group		—	—	—	—
Safe	-0.162***	-19.0	—	—	—	—
Unsafe	-0.311***	-31.4	—	—	—	—
Very unsafe	-0.435***	-27.4	—	—	—	—
Household income						
ln y	0.219***	31.3	0.228***	32.6	0.227***	32.6
hh size ^{1/2}	-0.0443	-5.15	-0.0467***	-5.47	-0.0505***	-5.82
Constant	Yes		Yes		Yes	
Personal characteristics	Yes		Yes		Yes	
Region-specific effects	Yes		Yes		Yes	
Year specific effects	Yes		Yes		Yes	
Pseudo-R ²	0.068		0.065		0.065	
No. of observations	197,939		200,463		203,992	
No. of clusters	1,625		1,625		1,642	

Table A3. The effect of crime on life satisfaction using ordered probit. 1. The dependent variable is reported life satisfaction. (2) Ordered probit estimates. (3) Standard errors are adjusted for clustering on the level of regions and years. * P <, ** p < 0.01, *** p < 0.001