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# Does the Burglar Also Disturb the Neighbor? Crime Spillovers on Individual Well-being

Daniel Avdic and Christian Bunnings

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# Does the Burglar Also Disturb the Neighbor? Crime Spillovers on Individual Well-being

Daniel Avdic and Christian Bünnings\*

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## Abstract

Indirect psychological effects induced by crime are likely to contribute significantly to the total costs of crime beyond the financial costs of direct victimization. Using detailed crime statistics for the whole of Germany and linking them to individual-level mental health information from the German Socio-Economic Panel, we analyze whether local crime rates affect the mental health of residents. We estimate that a one standard deviation increase in local violent crime rates significantly decreases individual mental well-being among residents by, on average, one percent. Smaller effects are found for property and total crime rates. Results are insensitive to migration and not isolated to urban areas, but are rather driven by less densely populated regions. In contrast to previous literature on vulnerability to crime, we find that men, more educated and singles react more to variation in violent crime rates in their neighborhoods. One potential explanation could be that those who are more fearful of crime have developed better coping strategies and, hence, react less to changes in crime.

**Keywords:** fear of crime, spillover effect, mental health, vulnerability, neighborhood effects, panel data

**JEL classifications:** C23, I18, K42, R23

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# 1 Introduction

Crime activities account for large individual and societal costs all around the world. According to the U.S. Bureau of Justice the direct financial costs of crime to victims amounted to \$16bn and to \$179bn in government expenditures on police protection and the criminal justice system in 2007 (U.S. Department of Justice, 2007, 2008). While these direct, or tangible, costs of crime; i.e., property losses, medical bills and foregone income for the victim and the judicial, legal and correctional costs for the society of upholding law and order, are in themselves substantial, there are also other, intangible, costs which further contribute to the overall costs of crime. In particular, Dubourg et al. (2005) estimated that, based on QALY's and information reported in the British Crime Survey (BCS), the physical and emotional impact of crime against victims of crime composes more than half of the total costs of crime in the U.K – or approximately three percent of GDP (£36bn) in 2003. In addition, McCollister et al. (2010) found that tangible costs constituted only 12-47 percent of the total costs to victims in the U.K., depending on crime type. In contrast, the criminal justice system and the net value of lost property only accounted for twenty and ten percent of the total crime costs, respectively.<sup>1</sup>

Even when such *realized* (tangible and intangible) costs have been accounted for, *anticipatory* costs, relating to the psychological responses that criminal activity inflict through a fear of victimization among both victims and non-victims, remain unaccounted for (see e.g. Dolan et al., 2005). Anticipatory responses to crime can be categorized into behavioral responses, occurring whenever an individual changes behavior due to fear of crime (e.g. avoiding to go out at night, using the car rather than walking or bicycling, developing mistrust in others and reducing participation in social activities); or psychological responses, in which an individual's mental well-being is affected through the fear of crime (e.g. increased mental distress, worry or the development of depression symptoms). A host of sociological studies have, theoretically and empirically, investigated the mechanisms through which crime affects psychological outcomes through the fear of crime (see e.g. Aneshensel and Sucoff, 1996; Schulz et al., 2000; Ross, 2000; Ross and Mirowsky, 2001; Green et al., 2002; Whitley and Prince, 2005; Stafford et al., 2007; Jackson and Stafford, 2009). The general message from this literature is that individuals who worry more about crime also rate their mental health lower than other individuals, hence suggesting that costs of crime to non-victims might significantly contribute to the direct and indirect costs of victimization.

In this paper we contribute to the growing literature on quantifying the intangible costs of

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<sup>1</sup>In this context it is also interesting to note that estimates from contingent valuation surveys have typically found that respondents' value their willingness to reduce crime in their community much higher than officially stated costs of crime. One such example is Cook and Ludwig (2000), who, based on survey respondents' willingness to pay to reduce local crime, found the total costs of crime to victims to be \$694bn annually, or about forty times the direct victimization costs estimated by the U.S. Bureau of Justice.

crime by investigating how variation in local crime rates affects psychological well-being in a previously largely unexplored country: Germany.<sup>2</sup> To avoid cross-sectional sorting and confounding of individuals with varying mental health in areas with different crime levels, we utilize panel data on local crime rates from the German Federal Criminal Police Office and measures of mental health from the German Socio-Economic Panel linked using residential zip codes of the respondents. Using actual crime rates as a proxy for fear of crime, rather than self-reported fear from crime surveys, to estimate effects on mental health has the benefit that we are unlikely to capture other changing attitudes towards crime and social trends or bias in reporting behavior when comparing responses between groups (see e.g. [Farrall et al., 1997](#); [Farrall and Gadd, 2004](#); [Sutton and Farrall, 2005](#)). Moreover, most existing studies have focused on urban areas which normally only constitute a small part of a country. Even if most crimes occur in cities, it is not *a priori* clear that any psychological effects derived from a fear of crime are greatest in such places. Some authors have argued that individuals exposed to high level of crime may develop coping strategies or a resilience towards ‘incivilities’, which allow them to reduce their stress levels in dangerous situations ([Taylor, 1986](#); [Taylor and Shumaker, 1990](#)).<sup>3</sup> We explore this potential mechanism in detail by estimating psychological reactions to variation in crime rates – i.e. not crime levels – for the whole of Germany.

Recent contributions analyzing the causal pathway from fear of crime to mental health by using variation in local crime rates over time have found changes in crime rates to significantly affect subjective mental well-being among the local population. In particular, [Cornaglia et al. \(2014\)](#), using Australian data, estimate a disparity of the aggregate costs from indirect victimization of more than eighty times the direct costs of victimization. Similarly, [Dustmann and Fasani \(2013\)](#) apply data from the U.K. and find that changes in local crime rates affect residents’ mental health 2-4 times more than comparable variation in local unemployment rates. Hence, these findings suggest that crime may impact whole communities and, when aggregated, potentially constitutes a much greater and unaccounted cost factor than the costs attributable to direct victims of crime.

Our estimated results indicate, similar to [Cornaglia et al. \(2014\)](#) and [Dustmann and Fasani \(2013\)](#), that changes in local crime rates significantly affect the mental health of individuals living in the area. Results from our preferred specification imply that a one standard deviation increase in local crime rates significantly decreases individual mental well-being by one percent (0.442 MCS points) for violent crimes, while less strong impacts are found for property and total crime

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<sup>2</sup>Using the same data sources as this study (German Socio-Economic Panel and German Federal Criminal Police Office), [Krekel and Poprawe \(2014\)](#) analyze the effect of local crime on satisfaction with life and satisfaction with the living environment.

<sup>3</sup>[Taylor and Shumaker \(1990\)](#) argues that “...the nonexistent or extremely weak linkage repeatedly observed between local crime levels and fear may reflect perceptual adaptation to the chronic hazard of local crime. Part of the perceptual adaptation, for some crimes, may be driven by the inoculating effects of prior exposure.”

rates. The estimates correspond closely to the findings in [Cornaglia et al. \(2014\)](#), both qualitatively and quantitatively. As a comparison, we benchmark the magnitude of our effect of crime with other life events known to cause mental distress and find that the impact of a one standard deviation increase in violent crime corresponds to about half the effect from losing one's employment and one seventh of the effect from becoming a widow. Moreover, using an established preference-based method for quantifying the monetary equivalent of mental health, our estimates suggest a cost per violent crime of about €16,800 implying that the indirect psychological costs of violent crime only in Germany exceed €9bn per year.<sup>4</sup> Finally, our results are insensitive to a number of robustness checks we perform to address potential concerns in the interpretation of the estimated parameters. In particular, the results are not dependent on exclusion of the three city-states (Berlin, Hamburg and Bremen), territorial changes in some of the regions over time or by excluding movers from the estimation sample.

A common finding in the literature on fear of crime is that some groups in the society, in particular women, the elderly and the poor, report higher fear of crime than other ([Pantazis, 2000](#); [McCrea et al., 2005](#)). Various social groups are likely to differ in their *perceived susceptibility* towards crime, i.e. in their subjective perceptions with respect to the likelihood of being targeted by criminals, their ability to control a threatening situation and the consequences of becoming a victim of crime (see e.g. [Skogan and Maxfield, 1981](#); [Warr, 1984, 1985, 1987](#); [Killias, 1990](#); [Ferraro, 1995](#); [Smith and Torstensson, 1997](#); [Jackson, 2009](#)). To construct efficient policy tools that aim at reducing the overall adverse effects of crime on mental well-being it is crucial to understand the complexity behind the psychological mechanisms as to how fear of crime originates. As we additionally have access to a wide selection of socioeconomic characteristics from the respondents, we can explore in more detail the dynamics behind the channels through which fear of crime affects mental health. We find, in contrast to much of the previous literature, that men, more educated and childless individuals react more to variation in violent crimes in their neighborhood – while still being less fearful on average. We interpret this finding as suggesting that heterogeneous perceptions of actual victimization risks for particular crime types matter more than differences in the perceived consequences of victimization. Furthermore, we find that the fear effect is driven by less densely populated areas, which indicates some support for the 'resilience' hypothesis that individuals in urban areas are more used to and able to cope with higher levels of crime through 'cognitive habituation' ([Taylor and Shumaker, 1990](#)).

Our findings are of relevance for national and regional policies to reduce the negative effects

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<sup>4</sup>As a comparison, [U.S. Department of Justice \(1996\)](#), using data from the National Criminal Victimization Survey, estimated that the total victimization cost of criminal activity against individuals and households was \$450bn per year from 1987-1990, or \$1,800 per resident. Most of these costs (\$345bn) were incurred from pain, suffering and reduced quality of life of the victims.

of fear of crime on well-being in the society. In particular, we largely confirm recent empirical findings for Germany to the extent that costs to non-victims seem to amount to a considerable part of total costs of crime and should therefore be accounted for when estimating the total burden of crime to society. Furthermore, we find that type of crime, personal characteristics and population density seem to play fundamental roles in determining the individual fear and well-being response. Hence, even if some societal groups may be more fearful of crime as they perceive themselves as more vulnerable to victimization, other factors, such as coping behavior and perceptions of victimization risk of certain crime types, may counteract or even dominate such reactions. This interpretation finds support in a series of papers attempting to explain why victims of crime appear less fearful than non-victims ([Denkers and Winkel, 1998a,b](#); [Winkel, 1998, 1999](#); [Winkel et al., 2003](#); [Vrij and Winkel, 1991](#)). Such insights into the complexity of the relationship between actual crime rates, fear of crime and its effects on mental well-being are important in order to develop fear-reducing policies which depend more on the physical, social and situational context at hand.

The paper is structured as follows. The next section describes the data we use for our empirical analysis, specifically the information from the German Socio-Economic Panel and the regional crime data we have at our disposal. Section three discusses the empirical approach we employ to estimate the impact of local crime rates on mental health outcomes. The main results, robustness checks and heterogeneity analyses are discussed in section four. Section five concludes.

## **2 Data**

### **2.1 Data on Mental Well-Being and further Individual Controls**

This study is based on individual-level data from the German Socio-Economic Panel (SOEP) waves' 2004, 2006, 2008 and 2010. The SOEP is a nationally representative longitudinal survey initiated in 1984 which collects annual information on both the household and the individual level. Detailed information on different sets of categories, such as demographic and labor market characteristics as well as education, health and attitudes, are available for all household members aged 17 and older. Currently, the SOEP comprises more than 20,000 individuals from more than 10,000 households ([Wagner et al., 2007](#); [SOEP, 2011](#)).

To measure an individual's mental well-being we use the Mental Component Summary Scale (MCS), which originates from the SF-12v2 health survey contained in the SOEP. The SF-12v2 health survey consists of twelve questions, with six questions each relating to physical and mental well-being, respectively. The latter is assessed by four dimensions – mental health, role-emotional,

Table 1: Descriptive Statistics - Individuals

Panel A: Mental Well-Being	Mean	S.D.	Min.	Max.
Mental component summary (MCS)	50.21	10.02	1.92	79.43
Social functioning (SF)	49.83	10.18	14.69	57.12
Vitality (VT)	49.64	9.89	26.73	70.60
Role emotional (RE)	50.06	10.05	13.34	58.08
Mental health (MH)	50.12	9.96	19.73	68.58
Panel B: Further Controls				
Female	0.52	0.50	0	1
Age				
[31 - 45]	0.28	0.45	0	1
[46 - 60]	0.28	0.45	0	1
[61 - 75]	0.22	0.41	0	1
[76 - ]	0.07	0.26	0	1
German citizenship	0.94	0.24	0	1
Higher education (high school and more)	0.84	0.36	0	1
Marital status				
Single	0.21	0.41	0	1
Widowed	0.07	0.25	0	1
Divorced	0.08	0.27	0	1
Separated	0.02	0.13	0	1
Children at home	0.29	0.45	0	1
Occupation				
Self-employed	0.06	0.24	0	1
Employee	0.45	0.50	0	1
Civil servant	0.05	0.21	0	1
Other (vocational training, etc.)	0.03	0.16	0	1
Unemployed	0.07	0.25	0	1

Notes: Own calculations based on the SOEP. Descriptive statistics refer to 72,362 person-year observations.

social functioning, and vitality – which are aggregated to the summary scale MCS using explorative factor analysis (Andersen et al., 2007). Both the sub-scores and the summary scale range from 0 to 100, where a higher score indicates better health status, and are standardized with a mean of 50 and a standard deviation of 10 in the reference year 2004. The MCS is frequently used in empirical health economics studies (see e.g. Schmitz, 2011; Marcus, 2013) and has been found to be a good and consistent measure of an individual’s mental health (see e.g. Gill et al., 2007; Salyers et al., 2000). The SF-12v2 health survey, and hence the MCS, was first implemented in the SOEP in 2002 and has henceforth been part of the individual questionnaire biannually. Descriptive statistics are provided in Panel (A) of Table 1.

Panel (B) of Table 1 lists a set of socioeconomic characteristics which we include to adjust for individual heterogeneity in our empirical analysis, in particular with respect to the markers of vulnerability; gender, age and socioeconomic status. Gender differences in fear of crime are captured by including a dummy for females. We account for age by including binary indicators representing four age groups for individuals aged 31-45 years, 46-60 years, 61-75 years, and over 75 years (base category:  $\leq 30$ ). Furthermore, we control for marital status through indicator variables for being single, widowed, divorced, or separated (base category: married). We also include separate indicators for the presence of children at home and German citizenship and control for

educational background through a dummy indicating high school or higher degree, and for labor market status through five occupational dummies (base category: not employed). In subsequent analyses, we also estimate separate models conditional on these socioeconomic characteristics in order to investigate potential heterogeneity in responses to actual crime as suggested by the literature on crime vulnerability.

## 2.2 Data on Crime and further County Controls

Official crime statistics are extracted from the annual police crime statistics (PCS).<sup>5</sup> The PCS is provided by the German Federal Criminal Police Office (“Bundeskriminalamt”) and based on data supplied from each of the sixteen State Offices of Criminal Investigations (“Landeskriminalamt”). Besides detailed information on a national level, such as the number of almost all recorded types of crime in Germany, the PCS also comprises an overview on selected crimes on a more disaggregated level (NUTS 3). More specifically, we collect information on the total number of crimes as well as the number of bodily injuries, burglaries, thefts in/from cars, and the number of damages to property available for each of the 412 German counties (“Kreis”) since 2004.<sup>6</sup>

Following [Cornaglia et al. \(2014\)](#) we measure crime by the number of crimes per 100,000 inhabitants (crime rate). We consider three types of crime in our regression model as shown in Panel (A) of [Table 2](#): total crime, violent crime and property crime. The latter consists of the number of burglaries, thefts in/from cars and damages to property. Violent crime equals the number of bodily injuries and total crime covers all reported crimes on a county-year basis. Although we only have access to a small subset of crime categories, these are among the most frequent criminal offenses, covering roughly 25 percent ( $\approx 521.67+1446.99/7510.63$ ) of the total number of reported crimes.

In our analysis we also adjust for time-varying county characteristics that may be correlated with local crime rates and simultaneously affect mental well-being of inhabitants, as shown in Panel (B) of [Table 2](#). The local unemployment rate enters the set of county characteristics to control for county-specific economic conditions that may affect both the level of crime (see e.g. [Raphael and Winter-Ebmer, 2001](#); [Gould et al., 2002](#)) and individual’s mental well-being ([Clark and Oswald, 1994](#)). Moreover, we include average income per capita to account for both financial distress (see e.g. [Cornaglia et al., 2014](#)) and local wages that have been found to be related to crime (see e.g. [Grogger, 1998](#); [Gould et al., 2002](#)). The demographic structure is captured by the share of foreign-born and the age structure of the population, separated by gender. Additionally,

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<sup>5</sup>See [http://www.bka.de/DE/Publikationen/PolizeilicheKriminalstatistik/pks\\_node.html](http://www.bka.de/DE/Publikationen/PolizeilicheKriminalstatistik/pks_node.html)

<sup>6</sup>Until 2010, the category ‘bodily injuries’ refers to all bodily injuries. Since 2010, this category consists of dangerous and serious bodily injuries. This is not a problem for our analysis as this change applied to all counties simultaneously, and hence should be captured by the set of fixed calendar time effects we include in our models.

Table 2: Descriptive Statistics - County

Panel A: Crime Rates	Mean	S.D.	Min.	Max.
Total crime	7,510.63	3,284.00	2,367.00	29,352.00
Violent crime	521.67	304.13	45.00	2,108.00
Property Crime	1446.99	675.67	343.57	4,606.72
Panel B: Further Controls				
Unemployment rate	10.84	5.03	1.90	31.40
Income per capita	18,109.76	2,456.44	13,479.00	31,199.00
Share of foreigners	8.47	5.41	0.70	26.20
Age structure	56.78	7.42	34.80	86.80
Males [0 - 19]	9.81	1.34	5.92	14.29
Males [20 - 39]	12.82	1.47	9.46	17.92
Males [40 - 59]	15.21	1.07	12.35	19.04
Females [0 - 19]	9.32	1.26	5.51	13.53
Females [20 - 39]	12.31	1.64	8.98	19.12
Females [40 - 59]	14.87	0.94	12.24	18.24
Total crime clearance rate	56.78	7.42	34.80	86.80

Notes: Own calculations. Crime variables and clearance rates are extracted from the PCS. Further county characteristics are taken from "Regionaldatenbank" and INKAR 2011. Descriptive statistics refer to 72,362 person-year observations.

to proxy for regional variation in quality of the criminal justice system we incorporate the total crime clearance rate.<sup>7</sup>

We link data on local crime rates and further county controls to the individuals in the SOEP by exploiting information on respondent's place of residence and the year of the interview. In particular, we use an individual's zip code to identify the county of residence and link corresponding county crime rates for each interview year. In cases where an unambiguous assignment of individuals to counties based on the zip code was not possible, we exclude the respective individuals from the estimation sample.<sup>8</sup> Additionally, our observation period (2004-2010) covers two administrative reforms that changed the composition of counties in two federal states. In Saxony-Anhalt, this territorial reform became effective on July 1, 2007 and reduced the number of counties from 21 to 11 by amalgamating existing counties. In Saxony, a similar reform went into effect on August 1, 2008 and reduced the number of counties from 29 to 13. To be able to compare the affected counties before and after the reforms went effective, we apply the new territorial structure also to the years before the reforms actually took place.<sup>9</sup>

Our observation period covers the years 2004, 2006, 2008 and 2010 as these are the years in which the outcome variable, crime rates and individual zip-code information are available simultaneously. We end up with a final estimation sample consisting of 72,362 person-year observations

<sup>7</sup>The information on regional unemployment rates, average income per capita as well as the age structure of the population on county level is extracted from "Regionaldatenbank", available at: <https://www.regionalstatistik.de/genesis/online/logon>. Information on the share of foreigners is taken from INKAR 2011. Total crime clearance rate is extracted from the PCS.

<sup>8</sup>We lose 2.5% of the observations due to zip codes that are not uniquely assignable to a county.

<sup>9</sup>To transform the affected county characteristics to the 'new' structure, we exploit that the amalgamating process took place mainly on county level, which allows to simply collapse the relevant variables. In cases where not all parishes of an existing county have been jointly assigned to a new county, we use parishes' population and territorial area to weight the variables accordingly.

from 26,842 different individuals. Overall, the sample covers 408 out of the 412 German counties representing over 99 percent of the German territory and population.<sup>10</sup>

### 3 Empirical Approach

To evaluate the impact of local crime on mental well-being we combine longitudinal information on regional crime statistics with individual level data representative of the whole of Germany. Specifically, we estimate a linear regression model, where mental health ( $mcs$ ) of individual  $i$  living in region  $r$  at time  $t$  is expressed by the following equation:

$$mcs_{irt} = \alpha + \beta_c crime_{rt} + \beta_x X'_{it} + \beta_z Z'_{rt} + \lambda_t + \lambda_r + \lambda_i + \lambda_r \times t + \varepsilon_{irt}.$$

The key explanatory variable is  $crime_{rt}$ , a measure of local crime in region  $r$  at time  $t$ . We use three different types of crime rates: total crime, violent crime, and property crime. As outlined in [Section 2](#),  $X'_{it}$  and  $Z'_{rt}$  captures relevant time-varying individual characteristics, such as marital or employment status, and county characteristics, such as the unemployment rate or the demographic structure of the population, respectively.  $\lambda_t$ ,  $\lambda_r$ , and  $\lambda_i$  represent time, regional, and individual fixed effects, respectively. Finally, we also control for time-varying unobserved heterogeneity on county level, not already absorbed by the set of covariates included in  $Z'_{rt}$ , by including a full set of county-specific linear time trends. The regression error is denoted by  $\varepsilon_{irt}$ . To account for arbitrary correlations across observations within a region we estimate standard errors clustered at the county level.<sup>11</sup>

The parameter of interest is  $\beta_c$ , the average impact of a unit change in local crime rates on individual mental well-being, which is identified under an IID assumption of the error term. Exploiting the longitudinal characteristics of our data we account for cross-sectional health sorting of individuals into areas with different crime rates. Assuming that variation in local crime rates are conditionally independent of individual mental health and that moving decisions are picked up by the individual fixed effects, we can consistently estimate  $\beta_c$ . Selective migration would not be captured by the individual fixed effects but, since only about one percent of the sampled individuals move across regions during the period under consideration, this should not cause any major problems for our empirical analysis. Nevertheless, we informally investigate the validity of this identifying assumption by performing a number of complementary robustness checks.

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<sup>10</sup>The SOEP is representative at the national level but may not be representative at the federal state level or even smaller geographical areas, such as counties. This constitutes no problem for our analysis, because inference is not conducted on county level but for Germany as a whole.

<sup>11</sup>In unreported regressions, we also use standard errors that are clustered at the individual level. The results remain robust and are available upon request.

## 4 Results

### 4.1 Perceived vs. Actual Crime

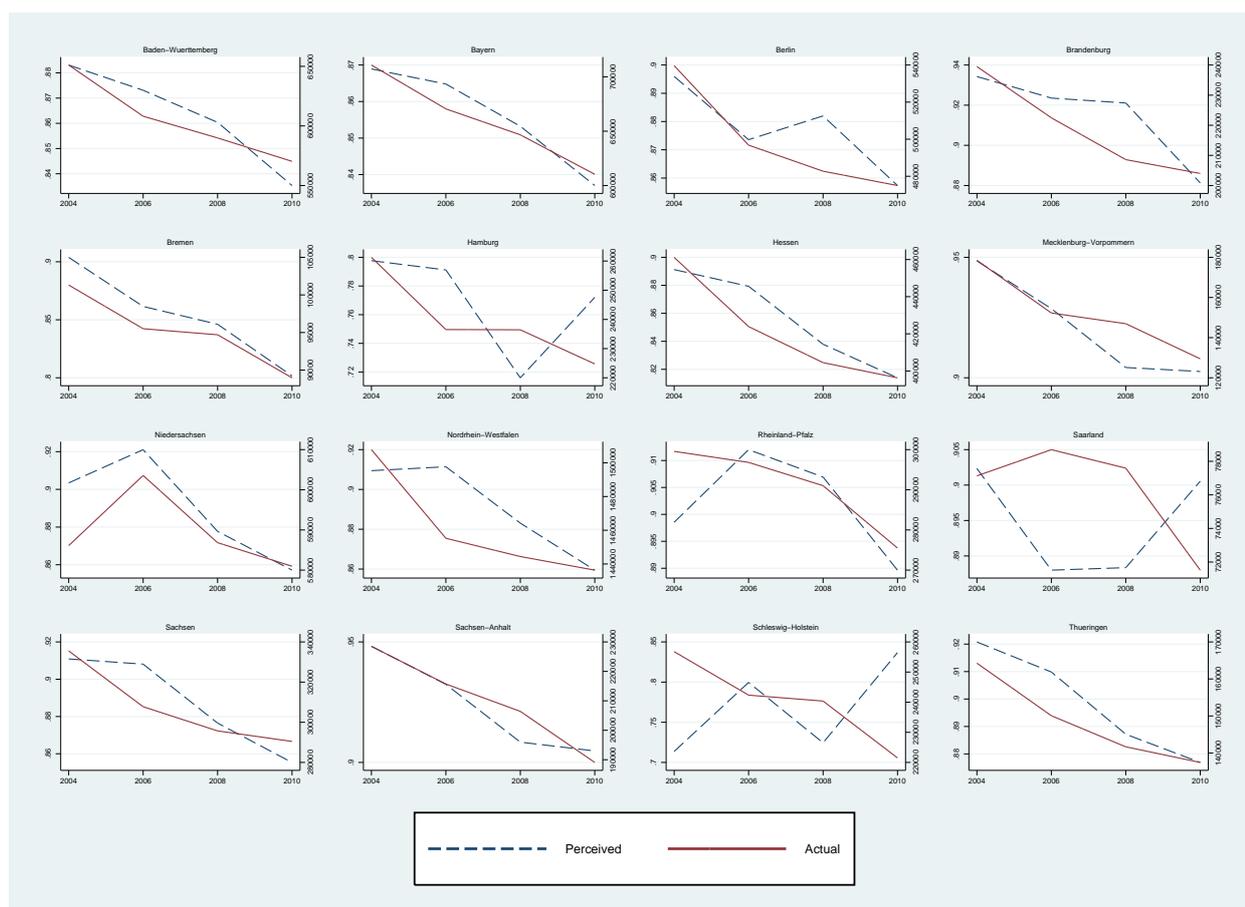
Before turning to results from estimation we show some descriptive results on the observed relationship between actual crime rates and individual perceptions of crime from our estimation sample. As outlined in the introduction, fear of crime is considered to be the dominant underlying psychological mechanism through which actual crime affects mental well-being. Using self-reported fear of crime to estimate the psychological impact of crime may complicate identification due to correlations between fear and other confounding factors, such as more general attitudes toward social decay or differences in reporting behavior across groups. As our empirical analysis relies on changes in actual crime rates to estimate the indirect effects caused by fear of crime we can avoid much of these empirical difficulties. However, by using actual crime data we need to instead assume that crime rate variation is a valid proxy for changes in fear of crime. We assess the plausibility of this assumption by exploiting supplementary information on individuals' concerns about crime in Germany contained in the SOEP.

SOEP participants are asked whether they are 'very concerned', 'somewhat concerned' or 'not concerned at all' about crime in Germany. We collapse this information into a binary indicator reflecting any concerns about crime, which serves as benchmark for actual crime. [Figure 1](#) shows the development of actual crime and the share of those expressing any concerns about crime in Germany separately for each of the 16 federal states (*Bundesland*). As can be seen, the trends of both graphs are very similar in almost all federal states indicating that changes in individuals' perception of crime are in accordance with changes in actual crime.<sup>12</sup> Apart from potential geographical differences in the perception of crime, certain societal groups perceive themselves as more vulnerable to victimization and, hence, develop a higher fear of crime. As mentioned in the introduction, higher levels of fear of crime among women, the elderly or individuals of lower socioeconomic status are well established findings in the literature (e.g. [Warr, 1984](#); [Pantazis, 2000](#); [McCrea et al., 2005](#)), although actual victimization rates are typically lower in most of these groups. In [Figure 2](#) of the Appendix, we relate concerns about crime across these different societal groups and benchmark them to actual crime rates. As expected, women, the elderly and individuals with lower education typically worry more about crime in Germany, which is in line with the findings in the literature. Again, actual crime and worries about crime follow the same trend suggesting that actual crime is a credible proxy for fear of crime.

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<sup>12</sup>This does not fully hold for the federal states Saarland and Schleswig-Holstein, which may partly be explained by too few observations. We also assess sensitivity of the empirical results by excluding both states from the estimation sample. Results remain qualitatively and quantitatively robust and are available upon request.

Figure 1: Concerns about Crime vs Actual Crime by Federal State



Notes: Own calculations based on the SOEP and the PCS. The figure shows the number of actual crimes and the share of the population with at least some worries about crime in Germany separately for each of the 16 federal states of Germany.

## 4.2 Main Results

Table 3 reports the results from 15 separate regressions using the combined mental health score (MCS) as the outcome variable. Each cell shows the results of a separate regression, where each of the three rows refers to a specific crime category (total, violent, property) and each of the six columns to a different model specification, ranging from the raw bivariate correlation in column (1) to the full set of control variables in column (6).

Most of the coefficient estimates show the expected negative sign, indicating a negative spillover effect from changes in local crime rates on individual mental well-being. Except for the coefficient of violent crime in our preferred specification (column 6), the estimated parameters are not statistically significant, however. This may reflect the relatively scarce variation in crime rates during the measurement period. Comparing the results across the six columns shows that the estimated coefficients are mainly driven by county characteristics rather than by individual controls; in particular for the estimated effect of violent crime rates. The latter estimate increases substantially when controlling for unobserved heterogeneity across regions in the form of both fixed county effects and county-specific linear time trends. This can be interpreted as indication that selection

Table 3: The Effect of Crime Rates on Mental Well-Being

	(1)	(2)	(3)	(4)	(5)	(6)
Total Crime	0.004 (0.051)	0.007 (0.051)	0.023 (0.097)	0.003 (0.110)	0.012 (0.121)	-0.038 (0.155)
Violent Crime	-0.017 (0.466)	-0.182 (0.709)	-0.667 (0.508)	-0.703 (0.513)	-0.797 (0.535)	-1.453** (0.730)
Property Crime	0.155 0.253	-0.167 (0.256)	0.057 (0.415)	-0.085 (0.487)	-0.064 (0.551)	-0.332 (0.442)
Time FE		✓	✓	✓	✓	✓
County FE			✓	✓	✓	✓
Individual FE				✓	✓	✓
Time-varying controls					✓	✓
Time trends						✓
# Observations	72,362					

Notes: Own calculations based on data from the SOEP and the PCS. Each cell shows the estimated coefficient, multiplied by 1,000, of a separate regression. Altogether 15 regressions were performed. Standard errors clustered at the county level are in parentheses. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ .

takes place to a great extent on the regional level, rather than within counties. In addition, the increasing absolute magnitude of the estimated coefficients from column (1) to (6) might indicate potential attenuation bias that shrinks the coefficient estimates towards zero. Hence, if additional confounding factors (i) exist and (ii) bias the results in the same direction as most of the variables in our model, then the reported results might constitute conservative estimates of the effect of local crime on mental well-being.<sup>13</sup> In the remainder of this section, we restrict our analysis to the preferred specification in column (6).

In order to assess the economic relevance of the estimated coefficients we pursue different strategies. We begin with considering the raw estimated coefficient as shown in Table 3 in more detail. The coefficient estimate of violent crime (1.453), which is multiplied by 1,000 for ease of illustration, implies that a one unit increase in violent crime rates decreases individual MCS, which ranges from 0 to 100, by approximately 0.0015 points, or 0.003 percent (evaluated at the mean), on average. This may appear as a rather small effect at first sight. Yet, taking into account that this is an average effect for all inhabitants and – more importantly – that a one unit increase in crime rates, which translates to one additional crime per 100,000 inhabitants, is an almost negligible change, the results indicate a considerable spillover effect of local crime on mental well-being when aggregated. Finally, our empirical results reinforce previous empirical findings. In particular, the point estimate of violent crimes is almost identical to the one estimated by Cornaglia et al. (2014). For property crimes we observe a larger but statistically insignificant effect, which is also in line with the results in Cornaglia et al. (2014).<sup>14</sup>

<sup>13</sup>One plausible explanation for this conservative bias could be that more resilient individuals tend to stay in high-crime areas while individuals with lower tolerance levels choose to reside in places with lower crime rates. This is also consistent with the results from the heterogeneity analysis reported below.

<sup>14</sup>However, Dustmann and Fasani (2013) find the overall effect to be mainly driven by property crime rather than violent crime rates. This may reflect differences in the definition of the crime categories.

Table 4: Quantifying the Effect of Crime on Mental Well-Being

	(1)	(2)	(3)
Total Crime <sup>+</sup>	-0.125 (0.509)		
Violent Crime <sup>+</sup>		-0.442** (0.222)	
Property Crime <sup>+</sup>			-0.225 (0.299)
Unemployed	-0.890*** (0.317)	-0.886*** (0.317)	-0.890*** (0.317)
Widowed	-3.034*** (0.632)	-3.028*** (0.632)	-3.035*** (0.632)
# Observations		72,362	

Notes: Own calculations based on data from the SOEP and the PCS. Each column shows the estimated coefficients of a separate regression. Altogether 3 regressions were performed. <sup>+</sup> indicates normalized variables. Standard errors clustered at the county level are in parentheses. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$

Following [Dustmann and Fasani \(2013\)](#), another way of quantitatively assessing the magnitude of the estimated effects is to relate them to the corresponding mental health impacts from two major life events (unemployment and losing one's partner). The results from this exercise are shown in [Table 4](#). For ease of interpretation, we have normalized all crime variables to have mean zero and unit standard deviation, so that the estimated coefficients can be interpreted as the effect of an increase by one standard deviation in the respective crime category on mental well-being. Depending on the type of crime, the impact of an increase by one standard deviation ranges from one seventh (total crime) to one half (violent crime) of the estimated effect of becoming unemployed. More precisely, a one standard deviation increase in violent crime rates decreases MCS by 0.442 points, or approximately 0.9 percent (evaluated at the mean). Although slightly larger, the overall range of the estimated effect sizes (one seventh to one half) is similar to the one observed by [Dustmann and Fasani \(2013\)](#) (one seventh to one fifth).

Finally, we also provide a rough approximation of the monetary costs of the mental health effects to the society as a whole. To this end we estimate the monetary amount necessary to compensate individuals for a decrease in mental well-being as caused by the increase in crime rate. As we do not possess the necessary information to quantify what a marginal change in the MCS scale imply in monetary terms, we make use of the estimated value from [Cornaglia et al. \(2014\)](#), referring to a one percentage point loss in Social Functioning (SF).<sup>15</sup> Using their estimate, which is based on QALY of \$50,000 (Australian Dollars) and amounts to \$211 ( $\approx$  €142), seems also reasonable in our context as our main estimation results correspond closely, both qualitatively and quantitatively, to each other. To apply their measure, we first estimate the effect violent crime

<sup>15</sup>More precisely, we do not have the necessary information to transform the SF-12 data into a SF-6D health state. The latter is a preference-based single index measure of health which can be used to calculate QALYs.

rates have on SF, which is one out of four sub-score of the MCS. As can be seen from [Table 8](#) in the Appendix, a one unit increase in violent crime rates decreases SF by -0.00099 (s.e. 0.00082) percentage points, which is about two thirds of the effect estimated for the overall measure MCS. Using this estimate, we calculate that the society would be willing to pay around €16,800 to reduce violent crimes by one. Assuming that this amount represents a good approximation for the average cost of violent crime, our estimates imply that the total indirect psychological costs of bodily injuries amount to around €9bn in Germany in 2010. However, this estimate is evidently contingent on a number of crucial assumptions and should be interpreted carefully.

### 4.3 Sensitivity Analysis

To assess the sensitivity of the main results, [Table 5](#) provides the results from several robustness checks. Column (1) serves as benchmark and shows the results of the main specification as shown in column (6) of [Table 3](#).

A potential concern to our empirical strategy might be due to movers in our estimation sample. More precisely, our approach is valid as long as endogenous moving decisions are fully captured by the individual fixed effects and observed time-varying controls. To further assess the credibility of this assumption we report the estimation results restricting the sample to non-movers. We opt for the more conservative approach and exclude all individuals who move and not only those who move across counties. It is clear from column (2) of the table that excluding movers does not affect the estimation results – as expected given the low share of movers.

One may also worry that inferences may be driven by the three large German city states of Berlin, Hamburg and Bremen for which we have no further disaggregated data. These states are characterized by a relatively small territorial size, high population densities and high crime rates. Column (3) reports the results when excluding these states from the sample. Although qualitatively robust, the coefficient estimates are even larger in absolute magnitude as compared to the pooled sample. This is especially true for the estimated coefficient of violent crime, which increases by around 30 percent.<sup>16</sup>

As discussed in [Section 2](#), administrative reforms related to the territorial structure became effective during our observational period and decreased the number of counties in Saxony-Anhalt and Saxony in 2007 and 2008, respectively. To be able to compare affected counties before and after the respective reform went effective, we have superimposed the new territorial structure also in the years before the reform became effective. To test whether this affect our estimation results, we report the results obtained from the restricted estimation sample in column (4). Excluding both

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<sup>16</sup>Hence, more dense regions seem to react less to changes in crime, indicating the existence of a resilience effect. We investigate this further below.

Table 5: Sensitivity Analysis

	Full Sample (1)	w/o Movers (2)	w/o City States (3)	w/o Area Reforms (4)	Trimmed Sample (5)
Total Crime	-0.038 (0.155)	-0.033 (0.187)	-0.041 (0.156)	-0.044 (0.173)	0.013 (0.192)
Violent Crime	-1.453** (0.730)	-1.453** (0.772)	-1.916** (0.815)	-1.278 (0.805)	-1.540* (0.791)
Property Crime	-0.332 (0.442)	-0.280 (0.470)	-0.358 (0.444)	-0.339 (0.474)	-0.303 (0.520)
# Observations	72,362	66,988	68,034	64,276	64,772

Notes: Own calculations based on data from the SOEP and the PCS. Each cell shows the estimated coefficient, multiplied by 1,000, of a separate regression. Altogether 15 regressions were performed. Standard errors clustered at the county level are in parentheses. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$

states does not affect the point estimates to any noticeable extent.

To ensure that the previous results are not predominantly driven by outliers, we also use a trimmed sample where we have excluded observations below the 5<sup>th</sup> and above the 95<sup>th</sup> percentile of the crime rate change distribution. From column (5) we see that the estimated coefficients and standard errors of the crime rates under consideration are very similar to those obtained from the unrestricted sample, hence indicating that outliers seem to play no crucial role in our estimation sample.

Finally, there might be concerns that part of the effect we capture originates from the effect of crime victims. Although we lack information on direct victimization in our data we believe that this should not severely bias our estimation results for several reasons: First, existing literature on the relationship between direct victimization and the perception of crime, especially the fear of crime, provides mixed results and point towards no clear connection (see e.g. Hill et al., 1985; Skogan, 1987; Box et al., 1988). Moreover, there are some indications that fear of crime is only weakly correlated with direct victimization (see e.g. Moore and Shepherd, 2006) but much more related to indirect victimization (see e.g. Hale, 1996). Second, the absolute magnitude of a potential bias induced by victims should be negligible as the share of victims in our estimation sample is likely to be considerably smaller than the share of non-victims. Third, our estimation results are unaffected by individual characteristics. Accordingly, if these characteristics are correlated with the probability of becoming victimized and direct victimization effects were important, one would expect to find differences in the estimated impact of crime rates on mental well-being when adjusting for individual characteristics.

## 4.4 Heterogeneity Analysis

### 4.4.1 Vulnerability to Crime

As mentioned in the introduction, a common finding in the literature is that various socioeconomic groups perceive different levels of fear of crime, although they do not differ in their exposure to crime. These differences might be explained by a higher perceived likelihood of becoming a victim or the feeling of being unable to protect themselves or their property against crime. Existing literature (e.g. [Warr, 1984](#); [LaGrange and Ferraro, 1989](#); [Hale et al., 1994](#); [Parker and Ray, 1990](#)) has identified gender, age and socioeconomic status as markers of higher vulnerability to crime. Specifically, women, the elderly and individuals of lower socioeconomic status has been found to perceive particularly high levels of fear of crime. This also holds for our sample as shown in [Figure 2](#) in the Appendix. Apart from differences in the absolute level of perceived fear of crime across various subgroups in the society it is important to understand how these subgroups react to changes in crime rates. This might be a helpful insight for policy-makers into how to design more personalized and, hence, more effective interventions aiming at reducing fear of crime and its negative spillovers on mental well-being of individuals.

To investigate whether response to changes in crime rates also depend on these markers of vulnerability, we use information on gender, age, the presence of children at home and education. Each of the variables is used to split the original estimation sample into two sub-samples on which we reestimate the model and compare the coefficient estimates. The results of these split sample regressions along with the baseline results are presented in [Table 6](#). With respect to the coefficient estimate of violent crime rates we find a significant effect for males, which is roughly 45 percent higher than the respective one obtained for females. Against the large body of literature that highlights higher vulnerability to crime of women, this may appear as rather counterintuitive at first sight. Yet, it is important to note that violent crimes in our data set only consists of bodily injuries, which usually have a higher prevalence among men, and does not cover sexual offenses, such as rape, which have been found to evoke especially high levels of fear among women ([Warr, 1985](#)). We also observe larger coefficient estimates of violent crime rates for older individuals, those without children at home and individuals with high school diploma or higher education.

Apart from the larger effect for older individuals, these findings are – similar to those obtained for gender – contradicting expectations from the concept of vulnerability to crime. However, empirical findings with respect to the latter mainly rely on cross-sectional variation in crime rates while our analysis builds on changes in crime rates and their perceptions among different subgroups of the population. Hence, our results indicate that even if certain subgroups feel more

Table 6: Heterogeneous Responses to Crime with respect to Individual Characteristics

	Full Sample	Gender		Age		Children		Education	
		Male	Female	< 50	≥ 50	no	yes	Low	High
Total Crime	-0.038 (0.155)	0.072 (0.168)	-0.157 (0.208)	-0.054 (0.166)	-0.030 (0.281)	0.105 (0.214)	-0.328 (0.228)	-0.122 (0.383)	-0.037 (0.159)
Violent Crime	-1.453** (0.730)	-1.786** (0.847)	-1.232 (0.925)	-1.029 (0.987)	-1.679 (1.042)	-1.821** (0.834)	-0.856 (1.347)	-0.438 (2.261)	-1.681** (0.732)
Property Crime	-0.332 (0.442)	-0.233 (0.540)	-0.416 (0.571)	-0.537 (0.615)	-0.136 (0.596)	0.000 (0.528)	-0.986 (0.825)	-0.115 (1.183)	-0.395 (0.450)
# Obs.	72,362	34,868	37,494	37,016	35,346	51,554	20,808	11,397	60,965

Notes: Own calculations based on data from the SOEP and the PCS. Each cell shows the estimated coefficient, multiplied by 1,000, of a separate regression. Altogether 27 regressions were performed. Standard errors clustered at the county level are in parentheses. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$

vulnerable to victimization, other factors seem to counteract these reactions. For instance, although men or better educated individuals have been found to perceive lower levels of fear of crime, they might be more aware about the development of crime in their neighborhood and, hence, may react more to changes in local crime rates. In addition, certain subgroups, particularly those who perceive themselves as more vulnerable to victimization, such as women or those with children, may develop strategies and behaviors to protect themselves and their relatives from criminal victimization and to cope with crime in general. These coping strategies may also lead to lower sensitivity to changes in crime, although absolute levels of fear of crime may remain high.

#### 4.4.2 Geographical Size and Population Density

Most of the previous empirical literature on the relationship between crime, fear of crime and its spillover effects on individual's mental well-being has focused on metropolitan areas. Although densely populated areas are typically characterized by higher crime rates as compared to more rural areas, it is a priori not clear if negative spillover effects of crime on individual mental well-being are restricted to or particularly large in urban regions. Individuals who live in metropolitan areas and, hence, are subject to higher levels of crime, might also be more used to crime and might have developed strategies to cope with higher crime rates in their neighborhood. This, in turn, may imply that variation in crime in less densely populated areas, where crime rates are lower and individuals are less used to crime, may affect individual mental-wellbeing to a greater extent than in more urban environments. This notion is also supported by the greater, in magnitude, estimated coefficients observed in [Table 5](#) where the three German city-states Berlin, Bremen and Hamburg were excluded. As our data set covers the whole German territory we are able to investigate whether the effect of local crime differs between urban and rural regions.

To test for heterogeneous responses to crime between urban and rural regions, we use information on both the territorial size and population density, where larger and less densely populated

Table 7: Heterogeneous Responses to Crime with respect to County Characteristics

	Full Sample	Territorial Size				Population Density			
		Q-1	Q-2	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4
Total Crime	-0.038 (0.155)	0.155 (0.170)	-0.421 (0.380)	-0.448 (0.454)	-0.093 (0.159)	0.133 (0.375)	-1.156*** (0.356)	0.069 (0.272)	0.091 (0.205)
Violent Crime	-1.453** (0.730)	-1.781 (1.348)	-1.687* (0.997)	-1.774 (2.128)	-3.625 (2.433)	-2.018 (2.887)	-6.191*** (2.479)	-2.360 (1.746)	-1.440 (0.966)
Property Crime	-0.332 (0.442)	0.076 (0.543)	-1.216 (1.138)	-1.474 (1.518)	-0.246 (1.387)	1.706 (1.776)	-3.997*** (1.097)	-0.222 (1.131)	-0.031 (0.551)
# Obs.	72,362	15,893	19,786	18,534	18,149	11,401	14,365	20,620	25,976

Notes: Own calculations based on data from the SOEP and the PCS. Each cell shows the estimated coefficient, multiplied by 1,000, of a separate regression. Altogether 27 regressions were performed. Standard errors clustered at the county level are in parentheses. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$

counties represent more rural areas. More precisely, we divide the sample into four quartiles according to both indicators and estimate the model separately for each quartile with results shown in Table 7.<sup>17</sup> The first column refers to the results from the unrestricted sample and serves as benchmark. Considering the results with respect to the territorial size, the estimated coefficients of violent crime are of comparable magnitude across the first three quartiles, but more than twice as large in the fourth quartile. Although large standard errors render most of the coefficient estimate insignificant, their absolute size is substantial and in line with the findings of the unrestricted sample. Assuming that counties of larger territorial size (Q3 and Q4) are predominantly rural counties, the results can be interpreted as a first indication that individuals living in such areas might be particularly sensitive to changes in local crime rates.

As shown in the last four columns of Table 7, this conjecture is substantially reinforced when using the population density instead of the territorial size to classify counties into urban and rural areas respectively. The coefficient estimates of violent crime are similar in magnitude across all quartiles except for the second quartile, which represents more rural areas. Compared with the other quartiles, it is clear that the effect of changes in crime rates is almost exclusively driven by the second population density quartile. Furthermore, we also find a considerable and statistically significant effect of both property and total crime rates on mental well-being for this quartile. Hence, these empirical findings provide support for the ‘resilience’ hypothesis, according to which individuals who are less exposed to crime become more sensitive to variations in crime rates. Together with the findings with respect to differences in socioeconomic characteristics these empirical results point towards a more complex relationship between actual crime rates, fear of crime and its effects on individual’s mental well-being (Pain, 2001).

<sup>17</sup>The different subsamples are not equally sized as the quartiles refer to number of county-year observations instead of person-year observations.

## 5 Conclusion

This article investigates whether variation in local crime rates affects the mental well-being of residents using rich nationally representative data for the whole German population. Linking local crime data to individual-level information on mental health from the German Socio-Economic Panel we find that a one standard deviation increase in local crime rates decreases individual mental well-being by about one percent (0.442 points on the MCS SF-12v2 scale) for violent crimes (corresponding to about one half of the impact of becoming unemployed), while weaker effects are found for property and total crime rates (one fourth and one seventh of the impact of unemployment, respectively). Using established QALY measures, we estimate the indirect psychological cost per violent crime to be around €16,800 or a total societal cost in excess of €9bn per year for Germany. These results are not sensitive to selective migration nor isolated to large urban areas, but are rather driven by less densely populated areas, suggesting that previous contributions might have underestimated the mental health effects from fear of crime. Furthermore, in contrast with much of the literature on perceived vulnerability to crime, our estimation results show that men, more educated and childless individuals react more to increases in violent crimes in their neighborhood. We conjecture that this finding might be explained by heterogeneous perceptions of actual victimization risks and coping strategies rather than differences in the perceived susceptibility of the consequences of and ability to control crime events.

To conclude, crime is a societal problem causing not only direct costs in terms of financial losses to direct victims of crime and upkeep of the criminal justice system, but also creates negative externalities to a potentially much larger population of individuals who are indirectly exposed and affected by crimes in their local neighborhoods. Fear of crime and victimization may lead to intangible costs in the form of behavioral and psychological responses which may greatly outweigh the direct and tangible costs among victims of crime. This paper confirms earlier findings that increases in crime rates induces significant mental stress of residents where crime is on the rise, but furthermore also contribute with evidence that these effects vary along a number of dimensions; such as the social, geographical and demographic context. Such insights into the complexity of the relationship between crime levels, fear of crime and its psychological responses, necessitates for policy-makers to customize more individualized responses to crime depending on the context at hand in order to achieve political goals of reducing the psychological impacts of crime. Indeed, on the question of the benefits of implementing focused victimization prevention programs in high crime areas, [Taylor and Shumaker \(1990\)](#) concludes that

“Participation in such efforts may be associated with people unhabituating to the

threat profile; concern and fear may then increase; later on psychological distress may also increase [...] Programs such as Block Watch that may be useful in low crime areas may be extremely counterproductive in other high crime areas. Although police departments and other agencies may wish to push one program for all locations, such a strategy could be ineffective at best and potentially harmful at worst." (pp. 637-638)

The results obtained in this study lend support to such an interpretation.

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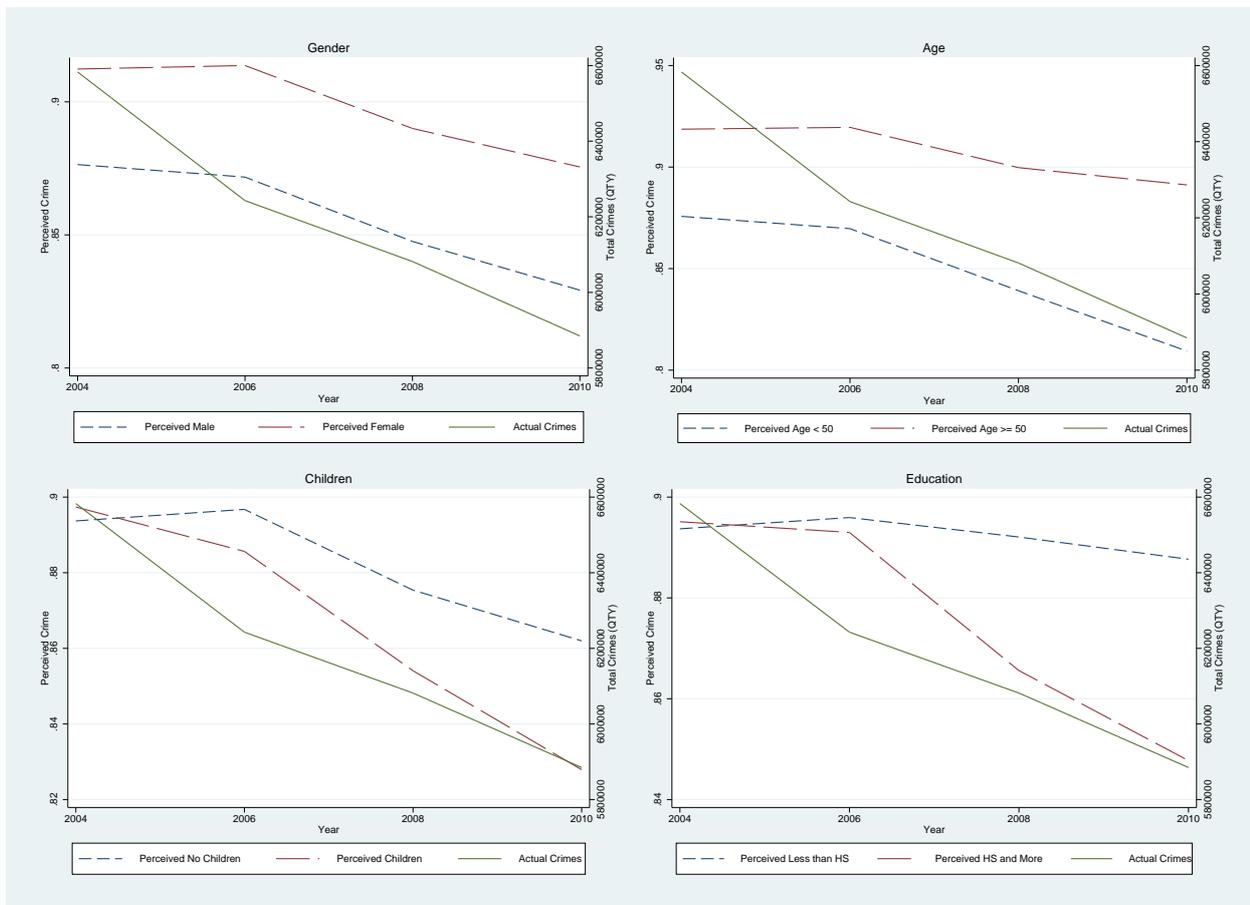
# A Appendix

Table 8: The Effect of Crime Rates on the Four Sub-scores of the MCS

	MCS (1)	SF (2)	VT (3)	RE (4)	MH (5)
Total Crime	-0.038 (0.155)	-0.042 (0.190)	-0.037 (0.132)	0.018 (0.184)	-0.043 (0.124)
Violent Crime	-1.453** (0.730)	-0.990 (0.821)	-0.889 (0.719)	-0.597 (0.702)	-1.111 (0.719)
Property Crime	-0.332 (0.442)	0.084 (0.518)	-0.380 (0.564)	0.080 (0.429)	-0.363 (0.443)
Time FE			✓		
County FE			✓		
Individual FE			✓		
Controls			✓		
Time trends			✓		
# Observations	72,362				

Notes: Own calculations based on data from the SOEP and the PCS. Each cell shows the estimated coefficient, multiplied by 1000, of a separate regression. Altogether 15 regressions were performed. Columns (1) refer to the overall measure of mental-wellbeing (MCS) as the dependent variable. Columns (2) to (5) use the sub-scores social functioning (SF), vitality (VT), role emotional (RE), and mental health (ME) as dependent variable. Standard errors clustered at the county level are in parentheses. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ .

Figure 2: Concerns about Crime vs Actual Crime by Individual Characteristics



Notes: Own calculations based on the SOEP and the PCS. The figure shows the number of actual crimes and the share of the population with at least some worries about crime in Germany separated by four socioeconomic characteristics.