German Economic Review 16(4): 391–407 doi: 10.1111/geer.12075

Economic Factors of Victimization: Evidence from Germany

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Abstract. *Victimization is a poorly studied topic in economic research. This paper considers economic factors of victimization using individual data. It tests the rational-choice-based hypothesis that the more attractive and poorly guarded targets are facing a higher risk of victimization. The used dataset also covers own criminal activities such that individual offending behavior can be studied as endogenous driver of victimization. Econometric results confirm that a criminal background is one of the major reasons of own victimization. In line with rational choice behavior of offenders, victimization is also associated with being a job holder and more schooling. Moreover, large peer groups increase the risk of victimization, whereas married and healthy people have a significantly lower risk of becoming a crime victim.*

JEL classification: *k42, H56, C35.*

Keywords: Victimization; offending; micro data; recursive bivariate probit.

1. INTRODUCTION

A recent survey on public safety and fear of crime in the German state Lower Saxony reveals that about 30% of the resident population above the age of 16 years have been a victim of (at least one) crime in the year 2012 (LKA Niedersachsen, 2013).[1] However, while there is a rich and growing literature on economic, social and demographic factors of crime, victimization – though just representing the flipside of offending behavior – has not yet received the attention from economic scholars that it deserves. Fajnzylber *et al.* (2000), Gaviria and Pagés (2002), Glaeser and Sacerdote (1999), Levitt (1999) as well as Justus and Kassouf (2013) provide notable exceptions. In particular, economics widely ignores the empirical regularity that many victims also are active criminals, and that criminals face a high risk of victimization. This paper tries to fill this gap in the literature by collecting theoretical arguments and providing hypotheses of victimization. I test the rational-choice-based hypothesis that the more attractive

1. Prevalence rates show that a majority of 12.5% is reporting cybercrime, 11% are victims of theft, 8% experienced damage to property and 2.3% are victims of assault. The LKA survey is based on 18,940 participants. Two very recent surveys confirm that between 2% and 3% of the population are victims of assault, but results on theft seem to differ. Based on a German wide victim survey on more than 35,000 participants of the year 2012, findings in Birkel *et al.* (2014) suggest that the prevalence rate of personal theft amounted to only 3.1%, whereas the assault rate of 2.8% is close to the one reported in LKA Niedersachsen (2013). Bug *et al.* (2015) compute correction factors for official crime statistics of the year 2013 by using data of a national sample of about 12,000 participants. Their results imply a prevalence rate of 2.5% for assault and a rate of 8.6% for theft.

and poorly guarded targets are facing a higher risk of victimization. The paper is evaluating the economic determinants of victimization in an econometric (recursive) bivariate Probit model, where offending and victimization are considered in a joint system of dependent variables. The analysis builds on research in Deadman and MacDonald (2004), Foreman-Peck and Moore (2010) and Silver *et al.* (2011) who presented their results in rather heterogeneous journals related to applied statistics, economics and criminology, respectively.

This paper extends existing work by focusing on and testing the hypothesis that important economic influences such as education, employment status, physical fitness, and personal indebtedness are significant drivers of the joint victimization-offending process, after controlling for other relevant risk factors such as family background, peer group influence or alcohol/drug addiction. A further contribution consists in using a sample of adults drawn from the German resident population, which is complementing previously used data, i.e., the Youth Lifestyle Survey (YLS) employed by Deadman and MacDonald (2004), the data from a particular population subgroup of potentially highly exposed patients released from a psychiatric hospital in Silver *et al.* (2011), and the group of pedestrians who have been interviewed in Foreman-Peck and Moore (2010).

Econometric results show that economic influences play an important role in victimization. Jobholders are more likely to become victims of crime than unemployed persons (confirming Glaeser and Sacerdote, 1999), whereas the employment status has no significant effect on offending tendencies. People with more schooling face higher risks of being victimized than those with low or no school degrees, whereas survey participants with high education show a lower propensity for criminal activity. Personal financial difficulties are associated with a higher propensity of committing crimes, whereas they show no significant link to victimization. The recursive bivariate Probit analysis confirms previous results that victimization and offending depend on common unobserved factors, and that own previous offending behavior is one of the major drivers of individual victimization risks.

This paper is organized as follows. Section 2 gives a survey of the literature. In Section 3, I present previous results based on empirical models of the joint victim-offender processes. Description of data and included covariates can be found in Section 4, along with a discussion of expected signs. In Section 5, econometric methods are introduced, and empirical results are presented in Section 6. Section 7 concludes.

2. LITERATURE REVIEW AND PREVIOUS FINDINGS

Rational choice theory in the tradition of Becker (1968) assumes utility-maximizing behavior. Thus, on the one hand, would-be offenders choose attractive targets in order to maximize net awards, and potential victims of rational offenders are typically the economically and socially successful people, the less guarded, those in the proximity of offenders, and those who are visible and available ('exposed'). However, the more wealthy people also have the power of more effective self-protection such that there might be a negative effect of income on victimization (Becker and Ehrlich, 1972). Gaviria and Pagés (2002) provide a for-

mal model of the risks and benefits of victimizing citizens. Whether risks outweigh benefits, or vice versa, eventually depends on the relative market power of victims and offenders, but also on daily habits and routines. This prediction accords with the criminological routine activity (Cohen and Felson, 1979) and opportunity (Cohen *et al.*, 1981) models: the risk of victimization largely depends on individual lifestyles and routine activities that bring people without effective guardianship into direct contact with potential offenders.

Levitt (1999), who compared aggregate data of the US National Crime Victimization Survey (NCVS) from the 1970s and the 1990s in the United States, found that property crime victimizations have become increasingly concentrated among the poor. Analyzing victimization surveys of six Latin America cities, Fajnzylber *et al.* (2000) find that being unemployed is associated with higher victimization rates. There are only few papers studying victimization at the individual level. Using individual NVCS data, Glaeser and Sacerdote (1999) report that jobholders with more schooling face higher risks of being target than unemployed people or those with a low or no school degree. The finding by Glaeser and Sacerdote is in line with rational economic behavior, according to which optimizing criminals assess their expected return before committing a crime and victimize the wealthy before the poor. This hypothesis has been confirmed using data from Latin America. Gaviria and Pagés (2002) apply a public opinion survey, *Latinobarometer*, covering 17 Latin American countries data. They find that typical victims of crime in Latin America come from rich and middle class households and tend to live in larger cities. Based on Brazilian evidence, Justus and Kassouf (2013) estimated a non-linear relationship between wealth and the risk of property victimization and uncovered a concave (parabolic) effect of wealth on victimization, with only a small portion (less than 3%) of citizens in the sample being in the descending part of estimated curves. Thus, as suggested by the work of Becker and Ehrlich (1972), (very) wealthy citizens may have the means for effective self-protection such that there might also be a negative effect of income on victimization.

However, a clear weakness of this reasoning – and of classical rational choice theory in general – is that it ignores the empirical regularity that many victims also are active criminals, and that criminals face a high risk of victimization. This negligence is less distinct in criminological research. Already von Hentig (1941, 1948), Hindelang (1976) and Villmow and Stephan (1983) focused on the sociodemographic similarities of victims and offenders (male, young, urban, same neighborhoods and habits). Most criminological explanations of the victim-offender overlap are rooted in routine activity/lifestyles theories (Cohen and Felson, 1979) and low self-control (Gottfredson and Hirschi, 1990): Daily risky activity brings attractive and poorly guarded targets for crime into close proximity and interaction with potential offenders. Also the most recent related criminological research is referring to theories of low self-control, routine activity/risky lifestyles and subcultural gang behavior (see, e.g. Pauwels and Svensson, 2011; Pratt *et al.*, 2014; Pyrooz *et al.*, 2014; Turanovic *et al.*, 2014).

The stylized fact of the victim-offender overlap is much less recognized in the field of economics of crime. Economic applications considering behavioral interactions of both victims and offenders are rare. The criminologist Jan Van Dijk (1994) and the economist Isaac Ehrlich (1996), who both provide theoretical

analyses of the market for offenses, provide two remarkable exceptions. Their demand and supply curves of crime are based on incentives of offenders, as well as on tolerance and precautions of potential victims. A more recent exception the author is aware of is Foreman-Peck and Moore (2010). They consider the behavior of rational potential victims of violence who minimize the probability of injury, subject to constraints and the achievement of other objectives. Still, these approaches do not yet fully account of the stylized empirical fact that victims and offenders can be embodied in the same person.

3. OFFENDING AND VICTIMIZATION AS OUTCOMES OF A JOINT INTERACTIONAL SYSTEM

Only few empirical studies consider victimization and offending as a joint statistical process, that is, both variables are treated as two dependent variables, each of which is determined by (not necessarily the same) exogenous factors. A crucial element is the additional consideration of latent factors that cover unobserved heterogeneity and potentially influence the joint victimization-offending system. The adequate method is the bivariate Probit model (technical details are described below), which also considers the dichotomous nature in used datasets (victimized/non-victimized, criminal/non-criminal). The first application to joint offending-victimization processes the author is aware of is the paper by Deadman and MacDonald (2004). Their approach is innovative in that they apply a *recursive* bivariate Probit system to study the victim-offender overlap. Using data of the 1998 Youth Lifestyles Survey (YLS), i.e. a nationally representative sample of people aged 12–30 years living in private households in England and Wales, they consider victimization in the equation of interest and treat offending as one of its (endogenous) explanatory factors. They find a set of mutual and distinct risk factors for groups of victims and offenders. Their results confirm the hypothesis that former offending is a significant factor for victimization. They also test a range of personal, area and risk characteristics such as going out at night or hanging out on street that influence the probability of being a crime victim. Among others, their results indicate that those who were bullied at school appear are more likely to be victims of violent crime when compared with those who were never bullied.

The same positive interrelationship between unobserved drivers of victimization and offending has been documented in a doctoral dissertation by Shaffer (2004) and by Foreman-Peck and Moore (2010). Their empirical models differ from each other with respect to included explanatory variables: Shaffer (2004) has a strong focus on the significant role of peer effects, whereas Foreman-Peck and Moore (2010) highlight the importance of risk aversion and time preference. They use a sample of pedestrians who were approached in the Cardiff city center in the evening and asked if they would participate in a survey of attitudes to disorder. Their empirical evidence suggests that less risk averse and more impatient individuals were more liable to violence and have a higher likelihood of becoming a victim. Silver *et al.* (2011) consider violent offending and victimization within a sample of discharged psychiatric patients. The authors confirm that most significant factors of victimization would also hold for offending. They also

reaffirm that both offending and victimization are affected by some positively correlated unobserved factors not accounted for in the data. Silver *et al.* (2011) presume that violence and victimization are linked through interactional processes such as provocation and retaliation, or chronic relationship conflicts. The authors further show that with respect to what they call 'social' factors such as employment and socioeconomic status, most parameter estimates turn out to be insignificant in the victimization equation of the bivariate Probit model, something which might be explained by the particular sample considered in this paper. They find, however, that various clinical test values and the number of residential moves a patient underwent are associated with an increased likelihood of victimization.

The strong positive effect of a joint latent factor found in all mentioned articles is highly significant, after controlling for numerous socioeconomic, parental, life-style/routine activity, peer group and clinical variables, as well as time preferences and risk aversion, albeit all these factors have never been included simultaneously. From the robustness of previous results it seems that both victimization and offending are still subject to correlated latent factors. However, it is still an open question whether this conclusion holds in a broader sample of adults, and in an empirical model where several important risk and socioeconomic factors such as alcohol addiction, education, employment status, health status and financial situation are simultaneously included.

4. DATA, COVARIATES AND DISCUSSION OF EXPECTED RESULTS

The empirical analysis of this paper is based on a survey of 960 adults drawn from the German population (henceforth referred to as *German Crime Survey*). The data have been collected in 2004 (conducted by *TNS Infratest*) using a questionnaire on socioeconomic and parental backgrounds, education, professional experience, peers and social capital and criminal experience (both offending and victimization; see Table 1 for descriptive statistics). The sample has originally been designed as a nationwide control group (of non-imprisoned citizens) to the *German Inmate Survey*[2] (see Entorf, 2009; Entorf *et al.*, 2008, for details). Therefore, the survey is not a representative sample of the German resident population but a non-imprisoned match of the German prison population. Accordingly, the guidelines to interviewers focused on adherence of quota

2. The *German Inmate Survey* consists of a survey of prison inmates who were interviewed during the time period 2003–2004, and a simultaneous survey addressed at the management and administration units of visited prisons. The survey design followed a two-stage approach that combined stratified and random sampling. In a first step, prisons were chosen such that the sample of prisons provides a representative sample of the population of all prisons in Germany. The stratification scheme was realized along the criteria 'region/state' (i.e. regions represented by 'Bundesland') as well as the criteria 'number of prisons per 100,000 state inhabitants', 'prisoners per 100,000 state inhabitants', 'share of prisoners convicted according to adult (juvenile) penal law' and 'share of prisoners with a term equal and more (less than) two years'. The second step consisted of a random draw from the population of selected prisons. The survey was organized and performed by a team of researchers from Darmstadt University (which included the author), design and the wording of the questionnaire was accomplished in joint cooperation with criminologists and practitioners.

Table 1 Descriptive statistics

Variable	Obs.	Mean	SD	Min	Max
Offending (conviction)	960	0.070833	0.25668	0	1
Victimization	960	0.278125	0.448309	0	1
Economic status					
No school	960	0.087500	0.282713	0	1
Hauptschule	960	0.422917	0.494279	0	1
Low/no school degree	960	0.535417	0.499004	0	1
Abitur or University	960	0.235417	0.424480	0	1
Unemployed	960	0.203125	0.402534	0	1
Good health condition	960	0.797917	0.401763	0	1
Personal indebtedness	960	0.061458	0.240294	0	1
Other factors					
Age	960	37.8	120.964	18	69
Male	960	0.878125	0.327311	0	1
Married	960	0.603125	0.489504	0	1
Has children	960	0.601042	0.489939	0	1
Foreign citizenship	960	0.116667	0.321190	0	1
Muslim	960	0.015625	0.124084	0	1
No confession	960	0.271875	0.445157	0	1
Village	960	0.378125	0.485171	0	1
Has more than 20 loose friends	960	0.551042	0.497647	0	1
Has no close friend	960	0.063542	0.244061	0	1
Has one close friend	960	0.137500	0.344553	0	1
Criminal record of parents or siblings	960	0.054167	0.226464	0	1
Parents divorced or separated	960	0.102083	0.302915	0	1
Serious drug or alcohol problem	960	0.021875	0.146351	0	1

Note: Descriptive statistics for adult non-pupils (age ≥ 18).*Source:* Author's calculation based on the *German Crime Survey* (see Entorf *et al.*, 2008, for details).

with respect to education, age, gender and nationality/migration background. Thus, compared to the overall German population, the education level of survey participants is rather low, most people are relatively young and males are strongly overrepresented. Both inmates and participants of the control group filled in identical questionnaires, except questions regarding current and former imprisonment.

Evidence on victimization is based on the following survey question: 'Did you yourself once or more often become the victim of an offence?' Respondents were asked to tick one of the following three possibilities: 'No/Yes, relatively petty (victim of theft or similar)/Yes, quite massively, as the victim of the following offence(s):_ _'. A substantial share of 27.8% of the sample experienced a previous victimization of any kind of which the large majority (24.5% of the sample) was perceived as 'relatively petty', i.e. a theft or similar (property) crime. The survey questionnaire also covers previous offending as existence of any previous conviction (yes/no) and by type of crime (violent, property, road traffic, other). In total, 9.7% of the respondents report a conviction. In line with most the literature, we

restrict the analysis to non-traffic violations of the German penal code, i.e. we treat survey participants with road traffic offenses (speeding, etc.) as non-offenders. Subtracting this share (2.6%) from 9.7%, results in a share of 7.1% with some (former) criminal behavior.

The subsequent econometric analysis is based on adults (18 years and above). Given the focus on economic factors such as unemployment, financial difficulties and education, I exclude pupils and students from the sample. According to the predictions of economic and criminological theories, included covariates should cover (potential) income and wealth, risky lifestyles as well as variables which partial out effects originating from the demographic composition of the sample. Age effects are controlled for by including age and age-squared. One of the factors which proxies the potential of personal income and wealth is education. As expected from previous research (see, e.g. Lochner and Moretti, 2004), absence of school degrees ('no school') and finishing only some basic school ('Hauptschule', ISCED 2) would diminish job market opportunities and increase the probability of a criminal career, whereas intermediate degrees ('Realschule/FOS') and top degrees ('Abitur/University', ISCED 4 or higher) are expected to reduce criminal risk. As regards victimization, Glaeser and Sacerdote (1999) express their surprise that the more educated face higher risk of victimization. However, as higher education is often associated with higher income and higher residential mobility, the positive sign is in line with the behavior of rational offenders seeking lucrative and available targets. Indeed, also evidence from Germany published in Dölling *et al.* (1998), who performed one of the few large-scale victim surveys in Germany (based on ca. 20,000 participants), and from Latin America in Gaviria and Pagés (2002) has confirmed the result that higher education is associated with a higher risk of victimization. Preliminary descriptive statistics from the most recent Germany-wide victim survey, 'Barometer Sicherheit in Deutschland' (Birkel *et al.*, 2014), reveals that citizens, who earned 'Abitur' as highest school-leaving qualification (and are qualified to attend university), face a higher risk of being a victim of personal theft than those with lower education.

Subsequent results are based on *low/no school degree* which summarizes the categories 'no school' and 'Hauptschule' (plus some few respondents who attended special-needs schools). According to classical rational choice arguments, *unemployed* persons should be less attractive targets of crime but might have higher incentives for (property) crime. *Good health* is a dummy variable which is equal to 1 when respondents chose 'no serious disease' as response instead of one of several health problems mentioned in the questionnaire. Good health is expected to be associated with good physical fitness and high self-esteem. This personal characteristic should entail better means of self-protection against victimization, in particular when compared to disabled or mentally ill people. The problem of *excessive debt obligations* ('have problems paying back duties') is an economic factor of crime, because it brings about incentives for property crimes. It is somewhat surprising that this covariate of crime has gone rather undetected so far in the literature (with the notable exception of McIntyre and Lacombe, 2012).

Some of the control factors listed in Table 1 may be subsumed under both economic and criminological labels. For instance, social capital and intact family

bonds are not only important indicators of social control theory (Hirschi, 1969) but also established factors of economic success and already used in economics of crime models (see, e.g. Buonanno *et al.*, 2009). So, some variables cannot be assigned to fields in an unambiguous one-to-one relation, but may be subject to observational equivalence. Further standard covariates of crime are age, gender, marital status, urbanity and migration background. Religion, too, is an economic factor since Max Weber's (1905) seminal contribution on the protestant work ethic and the spirit of capitalism. Not surprisingly, also many papers on criminal behavior include religions affiliation. In line with the early paper by Hirschi and Stark (1969), most articles found that it has a crime-reducing effect (see Baier and Wright, 2001, for a survey). In the present study, religion is covered by *no confession*[3] and *Muslim religion*.

Among the factors representing *peers, family and subcultural influence*, a very strong effect is expected from *criminal family background* (parents or siblings with criminal record, i.e. previous conviction in a court). *Friends* and *peers*, too, should be of relevance for both offending and victimization. For example, a large number of loose friendships could be an indicator of strong subcultural influences and risky lifestyles (i.e. simultaneously increasing the risk of offending and victimization), whereas *one close friend* might have the opposite effect of protecting from 'bad' risky lifestyles. *Serious illicit drug/alcohol problems* completes the list of covariates. It is expected to be associated with both, victimization and criminal behavior.

5. ECONOMETRIC MODELLING

As both offending and victimization are measured as binary variables, in a first step factors of crime and victimization are studied by applying (univariate) Probit models. They analyze the probability P of the occurence of an event Y (i.e. offending and victimization which both take values $Y = 1$ or $Y = 0$) by using a normally distributed link function Φ, i.e. $P(Y_i = 1) = \Phi(X_i \cdot \beta)$, where Y_i represents the outcome variable of 'victimization' and 'offending', respectively, of individual i, X_i represents a vector of explanatory factors, and β is the vector of corresponding weights estimated by maximum-likelihood methods (see, e.g. Wooldridge, 2010). Marginal effects of the univariate Probit analysis (ignoring any problems of endogeneity of offending and victimization as well as joint dependencies) are presented below (Table 2).

The primary aim is to estimate a *recursive* bivariate Probit model of victimization. 'Recursivity' in bivariate Probit models applies to bivariate Probit models with a recursive ordering of endogenous variables, i.e. in the present case the endogenous variable 'criminal behavior' will be used as regressor in the first equation of primary interest, and it will be further explained in the second equation of the model. Simultaneous equations with both continuous and dummy endogenous variables have been introduced by Heckman (1978). Wooldridge (2010, Ch. 15.7.3) covers them as models with a 'binary endogenous explanatory

3. This implies that individuals do not consider themselves as members of any organized religious community, first and foremost not as member of the catholic or protestant churches.

Table 2 Univariate probit

	Offending	Victimization
Offending	–	0.258 (0.068)***
Victimization	0.055 (0.019)***	–
Economic status		
Low/no school degree	0.031 (0.013)**	−0.125 (0.031)***
Unemployed	0.008 (0.018)	−0.073 (0.036)**
Good health condition	−0.013 (0.017)	−0.095 (0.041)**
Personal indebtedness	0.121 (0.050)**	0.027 (0.066)
Other factors		
Age	0.002 (0.004)	0.007 (0.009)
Age^2	−0.000 (0.000)	−0.000 (0.000)
Male	0.046 (0.010)***	0.052 (0.044)
Married	−0.001 (0.017)	−0.092 (0.043)**
Has children	0.004 (0.017)	−0.046 (0.045)
Migration background	−0.023 (0.015)	−0.027 (0.046)
Muslim	0.150 (0.122)	0.103 (0.141)
No confession	−0.021 (0.016)	0.056 (0.035)*
Village	−0.016 (0.012)	−0.007 (0.031)
Has more than 20 friends	−0.003 (0.012)	0.078 (0.029)***
Has no single close friend	−0.015 (0.019)	0.042 (0.064)
Has one close friend	−0.000 (0017)	−0.054 (0.041)
Criminal record of parents or siblings	0.074 (0.041)*	0.105 (0.074)
Parents divorced or separated	0.093 (0.035)***	0.029 (0.052)
Serious drug or alcohol problem	0.033 (0.051)	0.024 (0.104)
Log-likelihood	−193.66	−525.99
Pseudo-R^2	0.211	0.073
Number of observations	960	960

Notes: Standard errors in parentheses; ***, ** and * represent significance at the 1%, 5% and 10% level, respectively. Marginal effects are obtained as average partial effects, standard errors are computed using the delta method. See Table 1 for data.

variable' which allows maximum-likelihood estimating of the non-linear 'causal' structure despite the endogenous nature of both on victimization and offending:

$$\begin{aligned} V_i^* &= X_i\beta_1 + \delta O_i + \upsilon_{1i} \\ O_i^* &= X_i\beta_2 + Z_i\beta_3 + \upsilon_{2i}. \end{aligned} \tag{1}$$

Here, residuals v_{1i} and v_{2i} are jointly distributed as bivariate normal with means 0 and unit variances. O_i^* and V_i^* are latent indicators of observed binary realizations of O_i and V_i, respectively.[4] The difference between univariate and bivariate Probit is the potential non-zero correlation ρ between the unobserved explanatory factors in the two equations. Given $\delta \neq 0$, equation (1) imposes the hypotheses that offending has an influence on victimization. A complementary

4. $O_i = 1$ if the propensity to offend, O_i^*, exceeds a certain but latent threshold, $O_i = 0$ otherwise. The same applies to V_i^*. See econometric or statistical textbooks (e.g. Wooldridge, 2010) for details.

exogeneity test depends on significance of the coefficient of correlation between residuals, ρ. Its insignificance after including offending into the victimization equation would imply that the victimization equation could be treated independent of the second equation and that offending could be treated as 'exogenous' to victimization anyway (see Maddala, 1983; Monfardini and Radice, 2008).

Estimation is performed using maximum-likelihood methods. Note that the endogenous nature of O on the right-hand side variable of the victimization equation can be ignored in non-linear maximum-likelihood estimations (see Greene, 2012, pp. 785–787; Greene and Hensher, 2010, pp. 90–91; Wooldridge, 2010, Ch. 15.7.3, for details). Besides consistency and efficiency of ML estimation, another advantage of the recursive bivariate Probit model is that (different) exogenous variables may appear in both equations. Maddala (1983) pointed out that there should to be at least one 'instrument' z in the 'exogenous' equation (i.e. it should be excluded and redundant in the equation for the endogenous variable of interest). This rule has been followed subsequently. It should be noted, however, that Wilde (2000) has shown that such exclusion restriction is not generally needed in multi-equation Probit systems and that identification is achieved as soon as both equations of bivariate Probit models contain a varying exogenous regressor (see also Monfardini and Radice, 2008; Wooldridge, 2010, Ch. 15.7.3). This also applies in the case considered below.

6. RESULTS

Marginal effects of the preliminary univariate Probit analysis are presented in Table 2. It turns out that victimization and offending are both highly significant in the respective equation of the other variable. As the focus is on the estimation of the joint process, results are only briefly discussed at this stage of analysis: The likelihood of victimization increases with more schooling, being a member of a large peer group, being a jobholder (instead of being unemployed), existing health problems and it decreases with being married and member of a (Christian) church. Higher criminal activity is significantly (at least at the 10% significance level) associated with low or no education, being male, originating from a family with a criminal record of parents or siblings, broken homes (parents divorced or separated) and excessive indebtedness. The picture does not change much when victimization and offending are excluded from the offending and victimization equation, respectively (results not reported; results are available on request).

The main focus of my comments is on estimated *recursive* bivariate Probit models. Results are presented in Table 3. As the coefficient of correlation between residuals, ρ, is significant ($p = 0.06$), offending is confirmed as endogenous variable in the equation of victimization (such that estimating a joint system is justified), where it has a highly significant effect. Thus, criminal careers are a major source of own victimization risks. Own criminal experiences even seem to mask potential family influences and render them of second-order importance: see the insignificance of parameters on criminal records of parents and siblings and on divorced/separated parents. Moreover, including offending as a factor of victimization affects the latent factor driving both offending and

Table 3 Recursive bivariate Probit estimation

	Offending	Victimization
Offending	–	0.619 (0.108)***
Economic status		
Low/no school degree	0.034 (0.014)**	−0.136 (0.030)***
Unemployed	0.010 (0.019)	−0.075 (0.036)**
Good health condition	−0.024 (0.019)	−0.081 (0.040)**
Personal indebtedness	0.137 (0.050)***	–
Other factors		
Age	0.003 (0.004)	0.004 (0.008)
Age^2	−0.000 (0.000)	−0.000 (0.000)
Male	0.051 (0.010)***	0.043 (0.045)
Married	−0.006 (0.016)	−0.104 (0.038)***
No confession	0.030 (0.017)*	0.040 (0.034)
Has more than 20 friends	−0.006 (0.013)	0.078 (0.029)***
Criminal record of parents or siblings	0.095 (0.045)**	0.035 (0.074)
Parents divorced or separated	0.100 (0.035)***	−0.017 (0.050)
ρ	−0.579 (0.246)	
Likelihood-ratio test of $\rho = 0$ (p-value)	3.48* (0.062)	
Log-likelihood	−729.91	
Number of observations	960	

Notes: Standard errors in parentheses; ***, ** and * represent significance at the 1%, 5% and 10% level, respectively; significance of rho is tested using a likelihood-ratio test. Marginal effects are obtained as average partial effects, standard errors are computed using the delta method. See Table 1 for data. E*xcessive indebtedness* is excluded from the victimization equation but highly significant in the offending equation. The difference in the log-likelihoods between the full model and the restricted model is very small and the exclusion can be easily confirmed on grounds of a likelihood-ratio test ($p = 0.34$).

victimization and leads to a negative correlation of residuals. The same finding is reported by Deadman and MacDonald (2004). Thus, in line with other work (e.g. Foreman-Peck and Moore, 2010; Silver *et al.*, 2011) we confirm that common unobserved heterogeneity is a significant source of the joint system of offending behavior and victimization.

The status of unemployment has no effect on offending, but individuals who report being employed show higher risk of victimization than unemployed people. Likewise, the victimization rate of better educated respondents exceeds the one of less educated survey participants. As the bulk of victimization reported in the survey is related to property crimes, these results can be interpreted by rationality of offenders who prefer lucrative targets to less attractive ones (confirming Dölling *et al.*, 1998; Gaviria and Pagés, 2002; Glaeser and Sacerdote, 1999; but contradicting Fajnzylber *et al.*, 2000). The result is also in line with the work by Vollaard and Van Ours (2011) who find that owners of expensive own-occupied homes face a higher risk of burglary. Thus, with regard to the Becker and Ehrlich (1972) hypothesis, it seems that criminals are more successful in targeting the more fortunate people than these are in protecting themselves against victimization.

A further explanation is that employed individuals are more exposed to risk because they spend more time in public areas during their commute to and from

the workplace than unemployed people do. Sampson (1985) reports that, even after controlling for other neighborhood characteristics, victimization rates of residents of high mobility areas are at least double those of residents in low mobility neighborhoods. Also Silver *et al.* (2011) find that people with residential moves face higher risks of being crime victim. Still, people might find the result somewhat surprising. Hence, an alternative explanation could be that higher levels of education may be associated with less underreporting of crimes.

Other factors of victimization show expected effects. *Physical fitness* and *marriage* are significantly linked to lower victimization rates, confirming results by, for example, Dölling *et al.* (1998), Finkelhor and Asdigian (1996) and Glaeser and Sacerdote (1999). Married people seem to avoid a risky lifestyle such that their probability of being victimized is reduced by about 12% compared to single, divorced or widowed individuals. *Large peer groups* increase the risk exposure. More than 20 (loose) friendships increase the risk of victimization by more than 7% which confirms predictions of routine activity/lifestyle theory. Previous victimizations studies found being *male* among the risk factors (Deadman and MacDonald, 2004; Dölling *et al.*, 1998; Fajnzylber *et al.*, 2000; Foreman-Peck and Moore, 2010; Glaeser and Sacerdote, 1999). In our study, 'male' has the expected sign but turns out insignificant in the recursive specification. Insignificance for victimization also holds for the criminal family background and separated/divorced parents. This may look surprising at first glance, but it should be noted that these factors still have an indirect impact on victimization. The channel of influence of these variables follows the recursive structure of the model, i.e. they first impact offending, and then, via offending, also victimization depends on parental responsibility and family problems. So the lacking significance in the structural model equation of victimization is not necessarily at odds with expectations.

This leads to the discussion of covariates of offending, i.e. the 'exogenous' equation of the two-equation system, where *criminal background of parents or siblings* and *parents divorced or separated* indeed belong to the most important covariates of offending. This finding confirms results found elsewhere in the literature (see, e.g. Amato, 2000; Hjalmarsson and Lindquist, 2012; Rowe and Farrington, 1997). As expected from previous research on testing causal effects of education on crime (Lochner and Moretti, 2004; Machin *et al.*, 2011, 2012), also absence of school degrees or finishing only some basic school ('low/no school degree') increase the probability of a criminal career. Also as usual, men are more likely associated with criminal involvement. In accordance with other publications (see Baier and Wright, 2001), religious affiliation seems to have a crime reducing effect. Individuals who ticked *no confession* in their questionnaire have a 3% higher propensity of being convicted for an offense. However, Heaton (2006) argues that the negative effect of religion on crime might suffer from an endogeneity bias. As this issue is beyond the scope of this paper, we do not investigate this question further and can only leave it for further research. Finally, we observe a strong association of crime with excessive personal debt obligations which confirms recent results by McIntyre and Lacombe (2012), who use spatial data and find that *personal indebtedness* is related to personal theft crimes.

Interestingly enough, some variables show no significant effects. Similar to Bell *et al.* (2013) we do not find any effect of *migration background* on victimiza-

tion. There is also no such effect on offending which is confirming Bianchi *et al.* (2012) and in line with the recent survey by Bell and Machin (2013). Likewise, *serious drinking or illicit drug problems* remain insignificant (and have been left out of the final specification). This finding is contrary to results by Foreman-Peck and Moore (2010), Jensen and Brownfield (1986) and Lauritsen *et al.* (1991). The reason for lacking significance might be that its effect has been partialled out by related control variables such as parental influence, peer pressure and excessive indebtedness.

7. CONCLUDING REMARKS

Though often experienced in everyday life, victimization is a poorly studied topic in economic research. Rational choice theory would predict that rational offenders prefer targeting the wealthy before the less fortunate, but, on the other hand, more prosperous people would also have the means for better self-protection. Economics of crime research also widely neglects the fact that there is a significant overlap of victims and offenders, i.e. own victimization can also be rooted in risky environments and peer groups. Using individual data and recursive bivariate Probit modeling, this paper focuses on economic factors of victimization, but it also considers criminal involvement as explanatory (endogenous) factor of victimization.

Empirical evidence used in this study is in line with the rational choice hypothesis of offenders who are selecting attractive and less guarded targets: Victimization is associated with being employed and more years of schooling, even after controlling for socioeconomic and demographic factors, family background and own involvement in criminal activities. However, observed results might also be explained by higher mobility and commuting of jobholders in high density areas. Thus, exposure to risk, too, seems to be one of the key factors of victimizations, and its effect can be reinforced when risky lifestyles and everyday activities make potential victims vulnerable against criminal attacks. This presumption, also known as routine activity theory in the field of criminology, is in line with the result that large peer groups increase the risk of victimization, whereas married people appear to avoid potentially harmful situations and show a significantly lower risk of becoming a crime victim. 'Good health' is reducing the likelihood of victimization which in turn confirms that the less healthy and less guarded face a higher risk. Results also show that own criminal involvement is one of the major sources of victimization which is endorsing the criminological hypothesis of adverse effects originating from risky lifestyles. Among the covariates of crime itself, low education, broken homes and criminal family background are important risk factors, but also personal indebtedness, a widely neglected problem in the previous economics of crime literature, plays a significant role.

This paper has some limitations that provide opportunities for future research. For instance, empirical evidence is based on longitudinal information gathered from a cross-sectional survey such that causal conclusions should be drawn with appropriate caution. A major task for future research particularly on the victim-offender overlap is to map inherent relational conflicts and reciprocal relation-

ships, which might play an important role for the behavior of victimized offenders and criminal victims. Controlling joint unobserved heterogeneity is a key issue when studying the simultaneous occurrence of crime and victimization. Thus, availability of panel data on interactional network activities which allow observing criminal activities after the experience of victimization, and any victimization after the event of criminal activity, would provide significant progress.

A second problem not fully addressed in my paper is the lack of a comprehensive economic victimization-offender theory. Though there is a rather rich theoretical literature on criminal behavior, and despite some few economic contributions on victimization, theoretical economists have not yet addressed the stylized fact of simultaneous (or sequential) offending and victimization experiences. Future research might be inspired by the behavioral economics literature. According to Fehr and Gächter (2002), punishing 'unkind' behavior of others or 'negative reciprocity' seems to be a social norm rooted in general human behavior. Thus, retaliation might be one of the elements of a future integral theory of the victim-offender overlap. At any rate, this paper has shown that classical explanations based on rational economic behavior and criminological routine activity theory should still play prominent roles.

Future research and policy advice would also benefit from extending the empirical research to data of high spatial resolution. The identification of 'hot spots', i.e., places where poorly guarded individuals interact with potential offenders, allows implementing a crime prevention strategy that targets victimization within hot spots. Such policy would kill two birds with one stone and would be more efficient than taking an untargeted scattergun approach.

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