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ECONOMIC PAPERS

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Local Determinants of Crime: Do Military Bases Matter?

#211

Imprint

Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstr. 150, 44801 Bochum, Germany

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Ruhr Economic Papers #211

Responsible Editor: Christoph M. Schmidt

ISSN 1864-4872 (online) – ISBN 978-3-86788-244-6

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RWI
RUHR UNIVERSITÄT BOCHUM RUB
Ruhr Graduate School in Economics

Bibliografische Informationen der Deutschen Nationalbibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über: *http://dnb.d-nb.de* abrufbar.

ISSN 1864-4872 (online)
ISBN 978-3-86788-244-6

Alfredo R. Paloyo, Colin Vance and Matthias Vorell[1]

Local Determinants of Crime: Do Military Bases Matter?

Abstract

Using a unique panel dataset, we estimate the impact of the military base realignments and closures (BRACs) in Germany on the intensity of criminal activity surrounding the base. We use a fixed-effect model to account for time-invariant unobservables in our panel of 298 military bases for the period 2003–2007. We also take advantage of geographic information system software to mitigate estimation issues arising from the spatial nature of the dataset. Estimation results are presented for total crime and four other subcategories: breaking and entering, automobile-related crime, violent crime, and drug-related crime. The estimates indicate that there is no effect of BRACs on criminal activity surrounding the base. We also confirm existing findings in the literature on the determinants of crime.

JEL Classification: H56, K42, R19

Keywords: Armed forces; BRAC; deviant behavior; geographic information system

October 2010

1 Alfredo R. Paloyo, RGS Econ, Ruhr-Universität Bochum, and RWI; Colin Vance, RWI and Jacobs University Bremen; Matthias Vorell: RWI. *– For comments on earlier drafts, thanks are due to Thomas K. Bauer. A.R. Paloyo gratefully acknowledges the financial support provided by the RGS Econ.* *– All correspondence to Alfredo R. Paloyo, Ruhr Graduate School in Economics, Hohenzollernstr. 1–3, 45128 Essen, Germany, E-Mail; paloyo@rwi-essen.de.*

1 Introduction

Against the background of the transformation of the German Federal Defense Forces, we examine the socioeconomic impact of military bases on the surrounding communities. In particular, we focus on the effects of military bases and military personnel on the level of crime of the surrounding area. The current realignment of the German Federal Defense Forces gives us the unique opportunity to use a natural experiment to estimate the causal impact of military base closures on crime.

Crime is a complex social phenomenon that deserves special focus from social scientists. Various aspects of crime have been examined by psychologists, sociologists, lawyers, political scientists, and, beginning with the work of Becker [1968] and its extension by Ehrlich [1973], by economists as well. Applications of economic theories of rational choice tend to explain the observed trends in deviant behavior quite well.[1]

The reason we expect a relationship to exist between military bases and the crime rate is that young men commit the majority of crimes (for a variety of reasons explained in Section 2), and young men comprise the majority of the military-base population. The German armed forces (*Bundeswehr*) is composed primarily of men: women comprise a mere 9 percent.[2] Moreover, there is evidence that conscription could lead men to commit crimes in the future, and Germany is among the few remaining countries in Western Europe to rely on compulsory military service to staff its armed forces. For example, using a natural experiment in the assignment of draft-eligibility status through a lottery system in Argentina, Galiani, Rossi and Schargrodsky [2010] find that participation in military service increases the likelihood of having a criminal record in the future, particularly when the crime involves weapons. It is therefore conceivable that the composition of personnel inside a military base could have an impact on the level of crime observed around the base's surroundings.

Much of the attention to studies of crime is justified by the sheer magnitude of criminal activities and its associated social costs. Take the case of a burglary. One needs to keep in mind that the costs of such a legal breach is not borne simply by the victim. There are also law-enforcement costs related to determining and apprehending the suspect, as well as the cost of

[1] See, e.g., Levitt [1998], Grogger [1998], Jacob and Lefgren [2003], and Öster and Agell [2007].

[2] *Bundeswehr*, "Starke Truppe – Immer mehr Frauen entscheiden sich für die Bundeswehr" [Strong force: more and more women opt for the *Bundeswehr*], January 11, 2010. Accessed September 2, 2010. `http://www.bundeswehr.de/portal/a/bwde/streitkraefte/grundlagen/frauen_in_der_bw`.

having police personnel in the first place to prevent such crimes. Upon arrest, the legal system also comes into play: lawyers' fees must be paid as well as judges' salaries. In jurisdictions with juries, the opportunity costs of members of the jury must also be taken into account. Moreover, there is the expected response of the victim and her neighbors, who will now presumably undertake more security measures such as installing electronic anti-burglary systems or safer windows. Considering the number of crimes committed every year, the associated annual total social cost would be staggering—and this is even without acknowledging the non-pecuniary costs of victimization, such as psychological stress. As a rough measure, Table 1 presents the direct cost of crime as esimated by the Federal Criminal Police Office in Germany.

TABLE 1
COST OF CRIME (GERMANY, 2001–2009)

Year	Amount (in billion EUR)	As share of nominal GDP (in %)
2001	10.927	0.52
2002	9.836	0.46
2003	11.931	0.55
2004	10.431	0.47
2005	8.418	0.38
2006	8.190	0.35
2007	8.042	0.33
2008	9.960	0.40
2009	7.198	0.30

SOURCE.—Polizeiliche Kriminalstatistik: Bundeskriminalamt, 2009 and Statistisches Bundesamt Deutschland, 2010.

Despite having one of the lowest crime rates—even for Western European standards—the federal government in Germany has been consciously addressing the issue of criminality within its borders. The contribution of this study is to examine the effects of the programmed military base realignments and closures (BRACs) in Germany—in particular, the effect on criminal activity surrounding the base.[3] Reducing crime is a matter of public policy, and any initiative that contributes to this goal, whether inadvertently or deliberately, requires careful study to guide policymakers. Within the context of the on-going massive reorganization of the German armed forces, it becomes necessary to evaluate the potential effects of BRACs not only on defense and strategic grounds but also on outcomes that are perhaps less obvious to the casual observer. Accounting for the hidden costs and benefits of such a reorganization is therefore of

[3]Paloyo, Vance and Vorell [N.d.] examine the more obvious economic impacts of such base closures.

paramount importance in order to avoid basing policy decisions on incomplete information.

In this regard, the relationship between military bases and the level of local criminal activity is murky, and one for which there is a dearth of empirical evidence. While the overall impression gleaned from press reports, particularly from the US, is one of elevated crime within the surrounding community owing to the presence of a base[4], academic accounts are often more sanguine. Raphael and Winter-Ebmer [2001], for example, argue that while reduced military expenditure may increase social friction by causing unemployment, it has no immediate impact on crime once other factors, such as demographic composition and alcohol consumption, are controlled for. A case study by Thanner [2006] finds local residents in Maryland even deriving a sense of security from the base and a perceived increase in crime following its closure, attributing this to the loss of the base's deterrence effect.

To contribute to this issue, we assembled data from the Federal Criminal Police Office (*Bundeskriminalamt*), Federal and State Statistical Offices (*Statistische Ämter des Bundes und der Länder*), and the Federal Ministry of Defense (*Bundesministerium der Verteidigung*). The econometric problem is that we cannot observe the counterfactual situation, i.e., we do not know, how crime rates would be if a base would not have been present in the community. The closure and realignment procedure which started in 2001 gives us a unique opportunity to overcome the identification problem, as it provides us with a natural experiment where some bases are shut down solely due to military reasons and requirements without regard to potential outcomes at the community level. A standard fixed-effects regression model is used to account for residual concerns about the potential endogeneity of BRACs, although, as will be emphasized later in Section 5, there is substantial evidence to suggest that planned BRACs were unrelated to the outcome variables of interest. Furthermore, we estimate our regression models over data that have been transformed with geographic information system (GIS) software. More explicitly, we create buffer zones that surround each base to deal with issues associated with using regional data based on politically-delineated borders.

To preview our results, we find that the base realignments and closures had no significant effect on total crime around the periphery of the base. This result holds across different categories of crime and over varying sizes of the surrounding buffer zone. We conclude that

[4]Watson, Bruce, "High crimes: military towns are among the country's most dangerous", Daily Finance, November 16, 2009. Accessed October 5, 2010. `http://goo.gl/2BkK`.

concerns about changes in the level of criminal activity are unwarranted when weighing the costs and benefits to the local community of military base closures.

2 Young men and crime

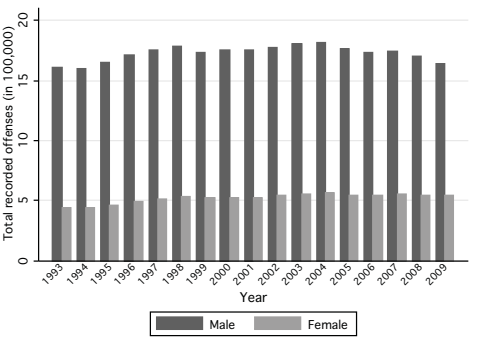
By and large, crime is disproportionately commited by young men. There are a variety of reasons for this phenomenon, including economic ones. For example, when the economy is in recession, one of the areas of the labor market that is typically and severely affected is the segment populated by young, unskilled labor. For instance, given the existing employment laws in Germany, it is easier for firms to shed themselves of younger workers with shorter tenure. Conscripts—usually young men below the age of 25—are also generally earning less than what they could be earning in the civilian labor market. This reduced earnings capacity in the legal labor market may tip the balance between licit and illicit activities towards the latter, making it more profitable for juveniles and young adults to engage in criminal activity.

The *Bundeskriminalamt* in Wiesbaden is responsible for publishing statistics on criminal activity and is the source of our data on crime. In Figures 1(a) and 1(b), we plot the total amount of crime and crimes against life known to law enforcement, respectively, for Germany for the period 1993–2009 and disaggregated by the sex of the offender. With respect to both categories, the number of male offenders dominate the number of female offenders, and even more so when one looks at crimes against life (*Straftaten gegen das Leben*).

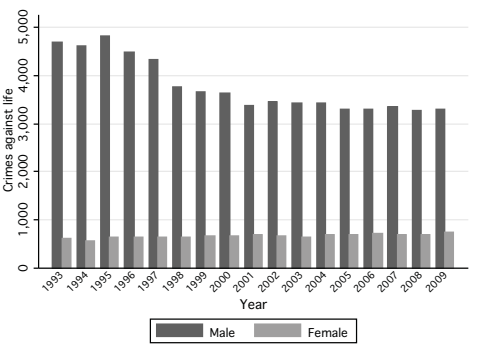
Figures 2(a) to 2(d) show the share of offenders by age group for both total crime and crimes against life and separately calculated for men and women. For both sexes, young people (those below 21 years old) commit a substantial part of total crime (about 25 percent). The percentage is somewhat lower for more violent crimes, such as crimes against life. For those under 25, their share of total offenses hovers a little below 40 percent for both men and women.

Taking into account that criminal activities are, for the most part, supplied by young men, it is therefore worthwhile to ask whether a concentration of such a group, for instance, in a military base, would have an impact on crime in the surrounding community. In terms of convictions for crimes committed by employees of the *Bundeswehr* (among others, conscripts, fixed-term soldiers, and professional soldiers), we obtained data from parliamentary inquiries

FIGURE 1
TOTAL CRIME AND CRIMES AGAINST LIFE BY SEX, 1993–2009 (GERMANY)



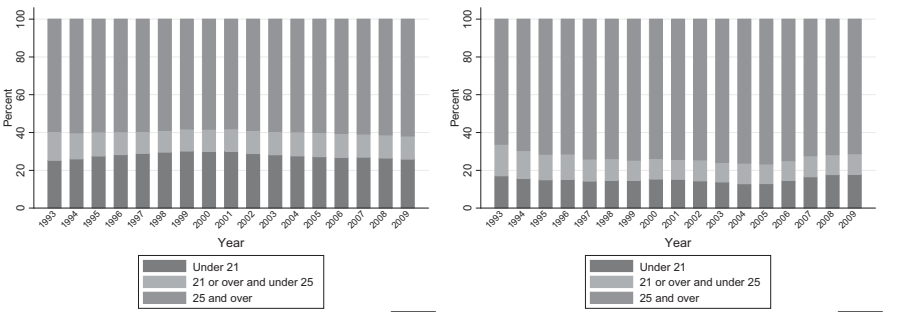
(a) Total crime



(b) Crimes against life

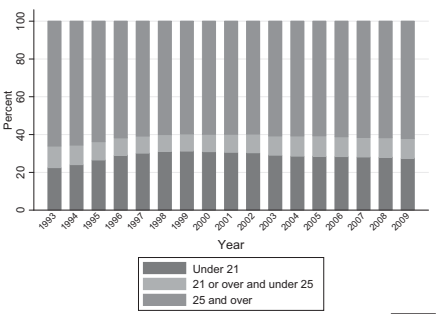
SOURCE.—Polizeiliche Kriminalstatistik: Bundeskriminalamt, 2009.

FIGURE 2
TOTAL CRIME AND CRIMES AGAINST LIFE BY AGE GROUP, 1993–2009 (GERMANY)

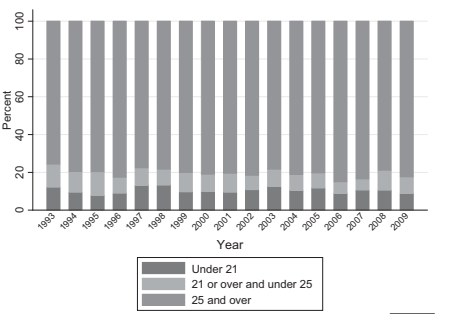


(a) Total crime, male offenders

(b) Crimes against life, male offenders



(c) Total crime, female offenders



(d) Crimes against life, female offenders

SOURCE.—Polizeiliche Kriminalstatistik: Bundeskriminalamt, 2009.

in 2006 and 2008, which are presented in Table 2.[5] Here, we see that the trend in violent crimes committed by employees of the *Bundeswehr* seems to follow a similar pattern depicted in Figure 1(b). We take advantage of structural reforms, described in depth in the next chapter, being undertaken in the German Federal Defense Forces to examine the relationship, if any, between the presence of a military base and criminal activity surrounding the base.

TABLE 2
CONVICTIONS FOR VIOLENT CRIMES OF MILITARY PERSONNEL

Year	Number of convictions			
	Murder	Manslaughter	Sex crime	Violent crime
1990	0	3	35	764
1991	2	0	33	620
1992	1	4	33	634
1993	4	1	31	634
1994	0	1	77	719
1995	0	0	28	649
1996	4	3	18	513
1997	1	2	25	507
1998	1	0	26	483
1999	1	1	28	586
2000	2	1	29	480
2001	1	0	18	354
2002	1	2	36	369
2003	2	0	35	339
2004	1	1	32	345
2005	1	0	34	266
2006	0	1	38	281
2007	1	1	28	262

NOTE.—The convictions may refer to offenses committed while not associated with the *Bundeswehr*.
SOURCE.—Deutscher Bundestag Drucksache 16/3168, 16/10164.

3 The transformation of the German armed forces

For Germany, the threat of a border invasion has all but dissipated. This is due to a number of factors but primarily because the Cold War has ended, and the European Union has established itself as a viable political and economic agglomeration of countries. The security threats faced by Germany (and many other countries in the Western world) now come from substate and stateless terrorist organizations from as far away as Afghanistan and Pakistan. The military deployment strategy that was appropriate to defend Germany against an inva-

[5] It is important to note here that the table lists crimes associated with members of the armed forces at the time of the trial. These crimes were not necessarily committed while the accused was in the armed forces.

sion originating from the other side of the Iron Curtain is now acknowledged to be insufficient to protect Germany and its citizens from organizations that threaten it today.[6]

In response to these changes, new Defense Policy Guidelines (*Verteidigungspolitische Richtlinien*) were adopted by the German Parliament in 2003. These guidelines emphasized the transition of the German armed forces from a territorial defense force into one that could be deployed rapidly and internationally to address security concerns abroad. The task of the *Bundeswehr* now involves "multinational conflict prevention and crisis management operations" while everything else "not conducive to this goal is of secondary importance."[7] The results of such a transformation of the *Bundeswehr* are evident in the contribution of Germany to multinational military operations. For instance, the Commander of the Regional Command North of the International Security Assistance Force (ISAF) in Afghanistan is German. Next to the US and the UK, Germany is the largest contributor of military personnel to the ISAF. This represents a dramatic shift in Germany's security policy.

Before the new Defense Policy Guidelines, however, Germany was already embarking on the path to rationalize the *Bundeswehr*. This is embodied in the proposal of the Federal Ministry of Defense called the Departmental Deployment Concept (*Ressortkonzept Stationierung*), which was adopted in 2001. This new deployment plan involved a substantial military drawdown, including the reduction of military personnel and the reduction of the military bases located within Germany. The program, which spans the period 2003–2011, dictates the closure of 187 bases and the reduction of personnel in 177 other bases. With this planned reorganization, the federal government ultimately intends to reduce the total number of active bases from 575 in 2003 to 388 in the year 2011.

More recently, the current Defense Minister, Karl-Theodor zu Guttenberg, has proposed a plan to even more drastically reduce the size of the *Bundeswehr*. From its current complement of 245,000 soldiers, zu Guttenberg intends to cut it down to 163,500 over the next few years. The plan also includes the suspension of compulsory military service and the transformation of the *Bundeswehr* into a professional army composed of an all-volunteer force, which is presum-

[6] To be fair, such an invasion cannot be completely ruled out. Therefore, the *Bundeswehr* is being transformed today with this possibility taken into account, which means that should such a "conventional attack" become imminent, the armed forces can be reconstituted quickly to respond to and neutralize the threat. The whole point of the new defense concept can be seen as one that emphasizes flexibility of the *Bundeswehr* to respond to multiple threats.

[7] *Bundeswehr*, "The *Bundeswehr* on a new course", February 28, 2005. Accessed September 2, 2010. `http://tinyurl.com/bw-new-course`.

ably more effective. The plan also includes raising the average number of military personnel in a base to 900, which means the realignment of personnel and the closure of redundant bases.[8]

The impetus for this new proposal from the Federal Ministry of Defense is the global economic and financial crisis that erupted in 2007. To cope with the crisis, Germany embarked on policies that stimulated aggregate demand. However, such policies, of course, exert pressure on a country's budget. Today, Germany must endure some expenditure compression to maintain fiscal balance. To contribute to this effort, the Defense Ministry and zu Guttenberg has come up with their proposal, which aims to save €8.3 billion over the next four years. Abolishing conscription alone will save about €500 million per year.[9]

For some bases, downsizing the military complement might prove difficult. Consider the top 10 *Gemeinden* (municipalities or towns) by military personnel presented in Table 3. In 2003, the base in Koblenz employed 8,830 persons, which represented about 8 percent of the population in that area in 2003. However, in the same year, the average military complement for a base is about 324 individuals. Thus, to achieve Minister zu Guttenberg's target, the realignment of personnel will have to be substantial.

TABLE 3
TOP 10 *Gemeinden* BY MILITARY PERSONNEL COMPLEMENT IN 2003

Gemeinde	*Kreis*	Personnel		Share in population	
		2003	2007	2003	2007
Koblenz	Koblenz	8,830	8,830	0.0819	0.0832
Düsseldorf	Düsseldorf	3,020	3,020	0.0053	0.0052
Hammelburg	Bad Kissingen	2,490	1,830	0.0228	0.0172
Penzing	Landsberg am Lech	2,360	2,360	0.0215	0.0208
Sigmaringen	Sigmaringen	2,200	1,670	0.0164	0.0126
Strausberg	Märkisch-Oderland	2,200	2,200	0.0115	0.0115
Regensburg	Regensburg	2,140	2,140	0.0167	0.0162
Stetten am kalten Markt	Sigmaringen	2,080	2,080	0.0155	0.0157
Memmingerberg	Unterallgäu	2,036	0	0.0150	0.0000
Kappeln	Schleswig-Flensburg	1,950	0	0.0098	0.0000

SOURCE.—Stationierungskonzept der Bundeswehr 2004.

[8]Müller, Albrecht, "Changes coming as Bundeswehr faces budget cuts", Defense News, May 27, 2010. Accessed September 3, 2010. `http://www.defensenews.com/story.php?i=4646605`.

[9]Joyner, James, "Germany can't afford military conscription", Atlantic Council, July 29, 2010. Accessed September 3, 2010. `http://www.acus.org/new_atlanticist/germany-cant-afford-military-conscription`.

TABLE 4
TIMELINE OF BASE CLOSURES BY FEDERAL STATE

Federal State	Bases	Number of base closures by year					Bases closed
		2003	2004	2005	2006	2007	
Bayern	50	0	2	2	7	6	17
Nordrhein-Westfalen	43	0	1	6	6	3	16
Schleswig Holstein	39	0	3	4	2	5	14
Rheinland-Pfalz	36	0	0	1	9	7	17
Niedersachsen	35	0	0	3	2	6	11
Baden-Württemberg	29	0	0	0	3	5	8
Hessen	23	0	2	1	2	4	9
Mecklenburg-Vorpommern	19	0	1	0	0	4	5
Brandenburg	13	0	2	1	1	0	4
Thüringen	6	0	0	0	0	2	2
Saarland	4	0	0	1	0	0	1
Sachsen	1	0	0	0	0	1	1
Total	298	0	11	19	32	43	105

SOURCE.—Stationierungskonzept der Bundeswehr 2004.

4 Data description

The dataset used in our analysis contains 298 bases, of which 105 were eventually closed.[10] Table 4 presents a timeline of base closures by federal state. The number of base closures per year was increasing since the start of the program and culminated in 2007, when 43 bases were closed. Bayern had the most number of bases at 50 and also the most number of base closures at 17.

The data on crime were obtained from the *Polizeiliche Kriminalstatistik* published annually by the Federal Criminal Police Office [Bundeskriminalamt 2009].[11] Apart from the total criminal offenses known to law enforcement, the publication also has crime disaggregated by the type of crime. Other socioeconomic variables were drawn from the Federal and State Statistical Offices [Statistische Ämter des Bundes und der Länder 2008]. All data is recorded at the *Kreis* level (NUTS 3), which is an administrative region in Germany with an average area of 814 sq. km. Information pertaining to the military bases was collected from the Deployment Concept of the Federal Armed Forces of Germany [Bundesministerium der Verteidigung 2004]. The location information of the bases are provided at the *Gemeinde* level (LAU 2, formerly NUTS

[10] Missing information in any of the covariates used later in the regression analyis necessitated dropping certain bases from the dataset.

[11] The crime statistics are collected by the German Federal Police. It is possible that the ruling government may have an influence on how and which type of crimes are recorded. However, we do not feel that this is significant enough to change any of our results.

5), which is smaller than the *Kreis* to which it belongs. Each *Gemeinde* is located in only one *Kreis* (i.e., the former's border does not cross the latter's).

The classification of criminal offenses into various categories is done by the Federal Criminal Police Office. In this study, we use the following specific categories: (i) total crimes (*Straftaten insgesamt*) comprise all crimes but without offenses against residence, asylum, or free-movement-of-persons regulations (for instance, staying illegally in Germany, having no passport, etc.); (ii) drug-related crimes (*Rauschgiftdelikte*) are all direct offenses related to illicit drugs: selling, buying, possessing with intent, as well as indirect offenses like robbery and breaking and entering to gain access to drugs or to finance a drug addiction, and driving under the influence of drugs; (iii) violent crimes (*Körperverletzung*) are murder, manslaughter, rape, assault, threatning with assault or bodily harm, hostage-taking and in general all violent exchanges between persons, normally with intent; (iv) breaking and entering (*Wohnungseinbruchdiebstahl*) includes breaking and entering, stealing or its attempt, and all related offenses, like damaging windows, doors, etc.; (v) stealing from cars (*Diebstahl in/aus Kraftfahrzeuge*) is actual stealing of cars and stealing from cars with intent (but not related to drugs; otherwise, it would be recorded in drug-related crimes).

In general, violent crime is reserved for more serious cases. The categories are exclusive, i.e., crimes are not counted in more than one group. If a person commits a combination of crimes, say, running over someone to get money for drugs, the most serious offense is recorded. Typically, when a violent crime is committed together with a property crime, the event is counted under the latter category.[12] The list of crimes in the dataset is not exhaustive, and in all cases, the sum of the different crime variables that are available does not equal the total number of crimes for a particular area.

The data are spatial in nature, which we take into account by transforming the data first before assembling and preparing it for estimation. The transformation involves the use of GIS software to create buffer zones—circular areas with the base at its center—that surround a base and which take into account the information from the surrounding *Kreise*. To do this, we first draw a buffer zone around the centroid of the *Gemeinde* where the base is located.[13] The area of overlap for each *Kreise* contained in this buffer zone is calculated and then divided by the total

[12]The most prominent example is theft in combination with assault, which is recorded as a property crime.
[13]We therefore assume that the base is located in the center of a *Gemeinde*.

area of the buffer zone. The resulting ratio is used to weight the information assigned to that *Kreis*. This allows us to compute a weighted sum that summarizes the available information from the surrounding *Kreise* of a particular base. This approach, also favored by Banzhaf and Walsh [2008] for applications to US census data, incorporates the information from the home and surrounding *Kreise*. It ameliorates some of the difficulties associated with the so-called modifiable areal unit problem [Openshaw 1984], such as the use of varying and arbitrarily sized spatial units of analysis.

Consider, for instance, the case depicted in Figure 3. Here, the *Gemeinde* (crosshatch pattern) is located at the edge of its home *Kreis* (gray). If we were to take into account—using the method described above—that it shares the border with two other *Kreise*, we would calculate total crime associated with that military base as follows:

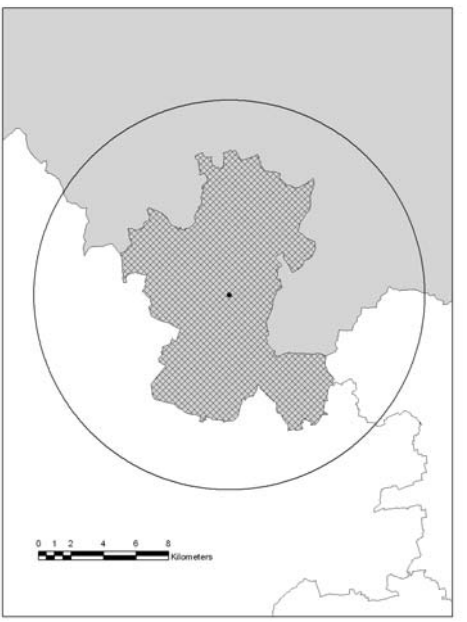
$$total\_crime_j^{\text{weighted}} = \sum_{i=1}^{3} \left(\frac{overlap\_area_i}{total\_area\_buffer_j} \times total\_crime_i \right),$$

where i and j are the *Kreis* (where the base is located) and buffer zone, respectively. For our purposes, we set the radius of the buffer zones to 12 km and 20 km. This allows us to roughly determine how far from the centroid the effect, if any, travels.

One drawback in processing the data this way is the assumption that the surfaces are isotropic, i.e., that the magnitude of the effect emanating from the centroid is invariant with respect to direction. This is problematic when the politically delineated borders are the result of natural features such as mountains and rivers, over which the effects may not necessarily propagate as easily as over plains. Therefore, we also estimate our model using untransformed data, i.e., without the buffer-zone transformation, to check the robustness of our results.

While we have every reason to believe that the decision pertaining to which bases will be closed is based purely on strategic grounds, we nevertheless perform an equality-of-means test between areas where bases closed and areas where bases stayed open to show that these bases do not differ in their observed characteristics. This implies that, at least in terms of the observables, the places with base closures are comparable to those places without base closures. We perform the test for two years: specifically, 2003, where the bases are first observed in the dataset, and 2007, where they are last observed. The results are displayed in Table 5. They indicate that there is no substantial difference between the areas where a base closed and the

FIGURE 3
GIS-BASED CALCULATION OF THE VARIABLES, 12-KM BUFFER



NOTE.—This base is located in Hammelburg, Bad Kissingen in the state of Bayern.

areas where bases remained open, which makes a comparison between the two groups more credible.

5 Estimation strategy and results

To identify the impact of adjustments in the size of military bases, including closures, we estimate the following regression model:

$$\ln y_{it} = \alpha + \delta DP_{it} + \boldsymbol{\beta}' \mathbf{x}_{it} + \boldsymbol{\theta}' \mathbf{z}_t + e_{it}, \tag{1}$$

where y_{it} is a generic outcome variable (here, total crime and its subcategories) for unit i in year t, DP_{it} is the number of military personnel in thousands (*Dienstposten*), $\mathbf{x}_{it}$ is a vector of control variables, $\mathbf{z}_t$ is a vector of unit-invariant year fixed effects, and e_{it} a stochastic disturbance term with the usual properties. The coefficients α, δ, $\boldsymbol{\beta}$, and $\boldsymbol{\theta}$ are a set of parameters and parameter vectors to be estimated. The coefficient of interest is δ, which represents the causal effect of BRACs on criminal activity surrounding the base.

We exploit the panel structure of the dataset by augmenting Equation (1) with a time-invariant and buffer-specific (or, in the case of the untransformed data, *Kreis*-specific) fixed effect:

$$\ln y_{it} = \alpha + \delta DP_{it} + \boldsymbol{\beta}' \mathbf{x}_{it} + \boldsymbol{\theta}' \mathbf{z}_t + \phi_i + e_{it}. \tag{2}$$

The term ϕ_i represents unobserved community-specific characteristics that affect the outcome variable but do not change over time. For instance, certain geographic characteristics are captured by ϕ_i. Allowing for the possibility that this term is correlated with e_{it}, we proceed to apply a fixed-effect transformation to the data to eliminate any residual biases.

As noted in the introduction, one important institutional aspect is that the decision to close or downsize a military base was made purely on strategic grounds that were unrelated to the intensity of criminal activity surrounding the selected base. As opposed to the US experience, where the execution of the base closures was substantially influenced by the demands of the local communities in which bases were located [Brauer and Marlin 1992], the military drawdown in Germany was not altered by popular or political considerations. The planning period of the scheme covered two government periods and both major political parties. No planned

TABLE 5
EQUALITY-OF-MEANS TEST, 2003 AND 2007

Variable	2003		p-value	2007		p-value
	With closure	No closure		With closure	No closure	
Panel A: 12-km buffer zone						
Crime rate (all crimes) $\times 10,000$	635.70	648.65	0.5521	621.50	628.32	0.7319
Annual real household income	17,074.11	17,330.70	0.2698	19,941.70	20,299.21	0.3812
Unemployed ÷ population	0.0454	0.0483	0.3026	0.0389	0.0410	0.3604
Foreigners ÷ population	0.0615	0.0646	0.4352	0.0611	0.0639	0.4625
Males aged 15–25 ÷ population	0.0603	0.0602	0.9173	0.0605	0.0599	0.2064
Real GNP (in 100,000)	50.2975	54.6876	0.4588	47.0718	51.0428	0.4691
Panel B: 20-km buffer zone						
Crime rate (all crimes) $\times 10,000$	624.98	636.08	0.5842	610.62	617.69	0.6994
Annual real household income	17,007.65	17,263.16	0.2571	19,940.65	20,248.93	0.4286
Unemployed ÷ population	0.0451	0.0479	0.3013	0.0388	0.0408	0.3879
Foreigners ÷ population	0.0608	0.0633	0.4978	0.0606	0.0627	0.5519
Males aged 15–25 ÷ population	0.0601	0.0602	0.9088	0.0605	0.0601	0.2935
Real GNP (in 100,000)	51.3316	54.9975	0.5034	48.3141	51.4668	0.5354
Panel C: Untransformed data						
Crime rate (all crimes) $\times 10,000$	680.49	684.45	0.8989	669.22	659.80	0.7412
Annual real household income	17,116.79	17,429.73	0.2308	19,897.89	20,327.90	0.3386
Unemployed ÷ population	0.0462	0.0489	0.3422	0.0396	0.0419	0.3480
Foreigners ÷ population	0.0665	0.0668	0.9485	0.0662	0.0661	0.9886
Males aged 15–25 ÷ population	0.0602	0.0601	0.9315	0.0605	0.0599	0.2599
Real GNP (in 100,000)	45.1935	50.1877	0.3111	42.4847	46.6024	0.3616
Observations	105	193		105	193	

NOTES.—Income and GNP are in euro. The p-values are based on two-sided t-tests.
SOURCE.—Authors' calculation.

base closure was taken back or altered. This peculiar aspect of the implementation of the Deployment Concept of the armed forces in Germany enables us to recover the causal impact of BRACs.

The outcome variables used in this study are the following: total crime, breaking and entering, automobile-related crime, violent crime, and drug-related crime. These are all logarithmized so that the coefficients can be directly interpreted as semi-elasticities. The control variables contained in $\mathbf{x}_{it}$ are an indicator variable that equals 1 for East Germany and 0 otherwise (this is eliminated in the fixed-effects model through the within transformation), real GNP in million euro (lagged one year), the share of the unemployed in the community, the share of foreigners in the community, the share of young men (aged 15–25 years old) in the community, household disposable income relative to the national mean (lagged one year), and population in ten thousands. All control variables are measured at the level of the *Kreis*.

In light of the seminal studies of Becker [1968] and Ehrlich [1973], we hypothesize that variables that increase either economic well-being or the likelihood of arrest serve as deterrents to crime. More precisely, anything that increases the returns to licit activities relative to illicit activities should reduce the propensity to commit crime. These include real GNP and relative disposable income. Conversely, variables that undermine social cohesion or economic security are hypothesized to increase the crime level, such as the share of foreigners and of the unemployed. In addition, we expect positive relationships between (i) the share of foreigners and crime and (ii) the share of young men and crime owing to a higher incidence of economic duress and exclusion from the labor market within these groups. Being located in East Germany is also hypothesized to be associated with higher levels of crime given a sustained period of depressed economic conditions in that region. Finally, as large populations have generally been found to be associated with higher crime, we expect a positive coefficient for this variable [United States Department of Justice 2009].

Estimates of the coefficients based on Equations (1) and (2) are presented in Tables 6 and 7, respectively. Both tables use the GIS-transformed data with the 12-kilometer buffer. The appendix presents results using a 20-kilometer buffer as well as the untransformed data.

Based on OLS regressions, we note that the presence of military personnel has no evident impact on crime levels across most of the measured categories. The one exception is

TABLE 6
OLS REGRESSION RESULTS (12-KM BUFFER)

	Dependent variables (logarithmized)				
	Total crime	Breaking and entering	Auto-related crime	Violent crime	Drug-related crime
Military personnel ÷ 1,000	0.021	0.026	0.040	0.017	0.041*
	[0.013]	[0.024]	[0.025]	[0.015]	[0.022]
Real GNP ÷ 1,000,000 (lagged)	−0.031***	−0.080***	−0.081***	−0.020**	0.002
	[0.011]	[0.018]	[0.018]	[0.009]	[0.011]
Household relative income (lagged)	−0.976***	−1.168***	−1.164***	−0.761***	−1.672***
	[0.223]	[0.399]	[0.430]	[0.194]	[0.348]
Share of foreigners	3.805***	3.389**	4.364***	2.601***	8.452***
	[0.975]	[1.558]	[1.624]	[0.817]	[1.139]
Share of unemployed	5.338***	10.200***	13.416***	5.396***	−4.546**
	[1.469]	[2.659]	[3.035]	[1.219]	[1.996]
Share of men aged 15–25	−21.804***	−58.139***	−40.227***	−19.192***	−3.144
	[3.722]	[6.336]	[7.733]	[3.301]	[4.899]
Population ÷ 10,000	0.059***	0.091***	0.095***	0.048***	0.041***
	[0.004]	[0.006]	[0.006]	[0.003]	[0.005]
East Germany	0.102	−0.078	−0.237	−0.167**	0.046
	[0.100]	[0.171]	[0.215]	[0.082]	[0.128]
Constant	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
F-statistic	80.88	72.19	87.51	126.49	100.70
R^2	0.8562	0.7552	0.7519	0.8317	0.6834
Observations	1,192	1,192	1,192	1,192	1,192

NOTES.—The dependent variables are the number of offenses per crime category and are expressed in logarithm. Bracketed numbers are robust standard errors clustered at the buffer level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
SOURCE.—Authors' calculation.

drug-related crimes, with a point estimate [standard error] of 0.041 [0.022]. Specifically, the coefficient suggests that a 1,000-person increase in military personnel is associated with a 4.1-percent increase in drug-related crimes—a seemingly small effect that, as presented below, is not robust to the inclusion of fixed effects. Of the remaining coefficient estimates, the majority that are statistically significant have signs that are consistent with expectations based on the existing literature. Economic well-being, as measured by real GNP and relative disposable income, is negatively associated with crime, while higher unemployment has a positive association. Also confirming expectations, regions with a higher share of foreigners have higher crime levels. [Entorf and Spengler 2000]

The fixed-effects estimates presented in Table 7 mitigate biases arising from time-invariant unobservable variables that are contemporaneously correlated with the error term. On the whole, the qualitative findings do not vary markedly. With regard to military personnel, the results confirm the impression gleaned from the OLS estimates that this variable is not significantly correlated with crime. The most notable discrepancy is seen for the coefficient estimate for the share of young men, which now has the expected positive coefficient in each of the models.

6 Conclusion

The ongoing reorganization of the German armed forces is arguably the most massive reconfiguration of the country's military since World War II, with potentially profound implications both geopolitically and at the local level in communities where military bases are located. Among the effects plausibly instigated by a base closure is a change in the intensity of criminal activities. To the extent that the personnel who populate the bases are largely comprised of young men—the demographic segment most prone to criminal activity—it is conceivable that the closures would reduce crime rates. Given the substantial financial and psychic costs of crime, such an outcome would register as a clear benefit to communities otherwise concerned about the economic impacts of the closures. This paper has attempted to empirically address this issue by assembling a panel dataset that links regional crime rates to military base complements and socioeconomic variables.

While our analysis confirms the significance of many of the correlates of crime identi-

TABLE 7
FE REGRESSION RESULTS (12-KM BUFFER)

	Dependent variables (logarithmized)				
	Total crime	Breaking and entering	Auto-related crime	Violent crime	Drug-related crime
Military personnel ÷ 1,000	−0.016	−0.030	−0.022	0.005	0.057
	[0.016]	[0.058]	[0.069]	[0.013]	[0.042]
Real GNP ÷ 1,000,000 (lagged)	−0.014	−0.152***	−0.098*	0.033*	0.087**
	[0.015]	[0.053]	[0.058]	[0.020]	[0.036]
Household relative income (lagged)	−0.446	−1.643*	−1.823*	−0.092	−4.129***
	[0.283]	[0.976]	[1.059]	[0.375]	[1.158]
Share of foreigners	3.677**	16.788***	6.762	3.688**	16.734***
	[1.542]	[5.310]	[5.725]	[1.766]	[5.730]
Share of unemployed	2.021***	−1.136	2.420	2.931***	3.346
	[0.745]	[2.788]	[2.829]	[1.018]	[3.149]
Share of men aged 15–25	6.608***	3.205**	11.863**	3.768**	7.468
	[1.394]	[5.097]	[5.155]	[1.995]	[5.384]
Population ÷ 10,000	0.019***	0.090***	0.086***	−0.003	−0.083***
	[0.010]	[0.028]	[0.034]	[0.021]	[0.025]
Constant	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
F-statistic	20.05	18.58	58.99	40.13	16.91
Within R^2	0.1861	0.1046	0.3284	0.2585	0.1908
Observations	1,192	1,192	1,192	1,192	1,192

NOTES.—The dependent variables are the number of offenses per crime category and are expressed in logarithm. Bracketed numbers are robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
SOURCE.—Authors' calculation.

fied elsewhere in the literature, including the population, unemployment rate, the presence of young men, and measures of local economic well-being, we find no evidence for an association of crime with the military bases. This conclusion holds over different estimation methods and different scales of analysis.

In deriving policy implications from these findings, we would avoid making claims about any relationship between criminal behavior and military service at the individual level; such questions could only be addressed with micro-level data. Nevertheless, as a matter of regional public policy, our findings strongly suggest that base closures or the reallocation of military personnel across bases, will have no effect on the crime level in the communities affected.

References

Banzhaf, H. Spencer and Randall P. Walsh. 2008. "Do people vote with their feet? An empirical test of Tiebout's mechanism." *American Economic Review* 98(3):843–863.

Becker, Gary S. 1968. "Crime and punishment: an economic approach." *Journal of Political Economy* 76(2):169–217.

Brauer, Jurgen and John Tepper Marlin. 1992. "Converting resources from military to non-military uses." *Journal of Economic Perspectives* 6(4):145–164.

Bundeskriminalamt. 2009. *Polizeiliche Kriminalstatistik 2009*. Wiesbaden: Bundeskriminalamt.

Bundesministerium der Verteidigung. 2004. *Die Stationierung der Bundeswehr in Deutschland*. Berlin: Bundesministerium der Verteidigung.

Ehrlich, Isaac. 1973. "Participation in illegitimate activities: a theoretical and empirical investigation." *Journal of Political Economy* 81(3):521–568.

Entorf, Horst and Hannes Spengler. 2000. "Socioeconomic and demographic factors of crime in Germany: evidence from panel data of the German states." *International Review of Law and Economics* 20(1):75–106.

Galiani, Sebastian, Martin Rossi and Ernesto Schargrodsky. 2010. "Conscription and crime: evidence from the Argentine draft lottery." Fondazioni Eni Enrico Mattei Working Paper No. 2010.55.

Grogger, Jeff. 1998. "Market wages and youth crime." *Journal of Labor Economics* 16(4):756–791.

Jacob, Brian A. and Lars Lefgren. 2003. "Are idle hands the devil's workshop? Incapacitation, concentration, and juvenile crime." *American Economic Review* 93(5):1560–1577.

Levitt, Steven D. 1998. "Juvenile crime and punishment." *Journal of Political Economy* 106(6):1156–1185.

Openshaw, Stan. 1984. *The Modifiable Areal Unit Problem*. Norwich, UK: Geo Books.

Öster, Anna and Jonas Agell. 2007. "Crime and unemployment in turbulent times." *Journal of the European Economic Association* 5(4):752–775.

Paloyo, Alfredo R., Colin Vance and Matthias Vorell. N.d. "The regional economic effects of military base realignments and closures in Germany." *Defence and Peace Economics*. Forthcoming.

Raphael, Steven and Rudolf Winter-Ebmer. 2001. "Identifying the effect of unemployment on crime." *Journal of Law and Economics* 44(1):259–283.

Statistische Ämter des Bundes und der Länder. 2008. *Statistik Regional 2008 (DVD)*. Statistische Ämter des Bundes und der Länder.

Thanner, Meredith Hill. 2006. "Military base closure effects on a community: the case of Fort Ritchie Army Garrison and Cascade, Maryland." PhD Thesis. University of Maryland. College Park, MD.

United States Department of Justice, Federal Bureau of Investigation. 2009. "Crime in the United States, 2008." URL: `http://www.fbi.gov/ucr/cius2008/index.html`.

Appendix

A.1 Supplemental regression tables

TABLE A1
OLS REGRESSION RESULTS (20-KM BUFFER)

	Dependent variables (logarithmized)				
	Total crime	Breaking and entering	Auto-related crime	Violent crime	Drug-related crime
Military personnel ÷ 1,000	0.014	0.021	0.019	0.016	0.046**
	[0.013]	[0.022]	[0.022]	[0.014]	[0.023]
Real GNP ÷ 1,000,000 (lagged)	−0.033***	−0.084***	−0.092***	−0.024**	0.001
	[0.012]	[0.017]	[0.016]	[0.011]	[0.010]
Household relative income (lagged)	−0.580*	−0.674	−0.497	−0.198	−1.366***
	[0.322]	[0.441]	[0.546]	[0.303]	[0.409]
Share of foreigners	3.112***	3.103**	3.445**	1.237	8.066***
	[1.030]	[1.542]	[1.660]	[0.840]	[1.240]
Share of unemployed	6.667***	13.435***	17.189***	5.898***	−3.878**
	[1.651	[2.723]	[3.209]	[1.434]	[1.946]
Share of men aged 15–25	−18.045***	−54.022***	−37.907***	−16.625***	1.241
	[4.468]	[6.308]	[8.238]	[3.858]	[4.697]
Population ÷ 10,000	0.060***	0.091***	0.097***	0.051***	0.041***
	[0.003]	[0.005]	[0.006]	[0.003]	[0.004]
East Germany	0.017	−0.303*	−0.446**	−0.151	−0.006
	[0.109]	[0.172]	[0.217]	[0.099]	[0.115]
Constant	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
F-statistic	127.81	102.07	119.73	199.94	134.27
R^2	0.8794	0.7831	0.7830	0.8591	0.7240
Observations	1,192	1,192	1,192	1,192	1,192

NOTES.—The dependent variables are the number of offenses per crime category and are expressed in logarithm. Bracketed numbers are robust standard errors clustered at the buffer level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
SOURCE.—Authors' calculation.

TABLE A2
FE REGRESSION RESULTS (20-KM BUFFER)

	Dependent variables (logarithmized)				
	Total crime	Breaking and entering	Auto-related crime	Violent crime	Drug-related crime
Military personnel ÷ 1,000	−0.010	−0.021	−0.012	0.002	0.036
	[0.014]	[0.053]	[0.064]	[0.011]	[0.037]
Real GNP ÷ 1,000,000 (lagged)	−0.003	−0.095*	−0.079	0.065***	0.054*
	[0.016]	[0.050]	[0.055]	[0.013]	[0.030]
Household relative income (lagged)	−0.445	2.510**	−1.742	−0.208	−5.374***
	[0.298]	[1.025]	[1.190]	[0.373]	[1.080]
Share of foreigners	4.416***	19.783***	4.257	5.463***	19.747***
	[1.430]	[4.582]	[5.182]	[1.592]	[5.053]
Share of unemployed	2.381***	−0.547	4.019	3.764***	2.142
	[0.702]	[2.628]	[2.884]	[0.886]	[2.962]
Share of men aged 15–25	5.776***	2.979	8.900*	3.017*	11.123**
	[1.342]	[4.913]	[5.000]	[1.797]	[4.922]
Population ÷ 10,000	0.036***	0.024***	0.052***	−0.015**	−0.010
	[0.005]	[0.009]	[0.015]	[0.006]	[0.010]
Constant	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
F-statistic	38.28	30.67	77.48	58.41	19.27
Within R^2	0.3094	0.1260	0.3619	0.3140	0.2646
Observations	1,192	1,192	1,192	1,192	1,192

NOTES.—The dependent variables are the number of offenses per crime category and are expressed in logarithm. Bracketed numbers are robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
SOURCE.—Authors' calculation.

TABLE A3
OLS REGRESSION RESULTS (UNTRANSFORMED DATA)

	Dependent variables (logarithmized)				
	Total crime	Breaking and entering	Auto-related crime	Violent crime	Drug-related crime
Military personnel ÷ 1,000	0.042*	0.030	0.079**	0.031*	0.063**
	[0.021]	[0.032]	[0.039]	[0.018]	[0.025]
Real GNP ÷ 1,000,000 (lagged)	0.001	0.019	−0.011	−0.002	−0.007
	[0.007]	[0.012]	[0.010]	[0.007]	[0.012]
Household relative income (lagged)	−0.734***	−0.583*	−0.671**	−0.846***	−1.359***
	[0.156]	[0.334]	[0.335]	[0.166]	[0.294]
Share of foreigners	2.366***	1.055	1.616	2.268***	6.751***
	[0.527]	[1.106]	[1.103]	[0.638]	[1.102]
Share of unemployed	7.053***	10.812***	13.819***	6.913***	−2.253
	[1.620]	[2.843]	[3.045]	[1.492]	[2.079]
Share of men aged 15–25	−11.845***	−42.054***	−22.976***	−11.877***	1.510
	[3.261]	[6.563]	[7.015]	[3.498]	[5.637]
Population ÷ 10,000	0.048***	0.073***	0.074***	0.042***	0.040***
	[0.003]	[0.005]	[0.005]	[0.003]	[0.005]
East Germany	−0.050	−0.209	−0.393*	−0.330**	−0.108*
	[0.111]	[0.199]	[0.219]	[0.102]	[0.152]
Constant	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
F-statistic	68.65	53.55	78.70	66.73	38.92
R^2	0.7973	0.6830	0.6859	0.7497	0.5360
Observations	1,192	1,192	1,192	1,192	1,192

NOTES.—The dependent variables are the number of offenses per crime category and are expressed in logarithm. Bracketed numbers are robust standard errors clustered at the buffer level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
SOURCE.—Authors' calculation.

TABLE A4
FE REGRESSION RESULTS (UNTRANSFORMED DATA)

	Dependent variables (logarithmized)				
	Total crime	Breaking and entering	Auto-related crime	Violent crime	Drug-related crime
Military personnel ÷ 1,000	−0.015	−0.043	−0.007	0.000	0.079
	[0.019]	[0.060]	[0.081]	[0.015]	[0.048]
Real GNP ÷ 1,000,000 (lagged)	−0.012	−0.052	−0.019	−0.032*	0.023
	[0.012]	[0.047]	[0.051]	[0.019]	[0.035]
Household relative income (lagged)	−0.246	−0.810	−0.794	−0.360	−2.408**
	[0.205]	[0.948]	[1.002]	[0.358]	[1.010]
Share of foreigners	3.243*	13.372**	8.145	2.178	10.496
	[1.740]	[6.323]	[6.156]	[1.718]	[6.676]
Share of unemployed	1.686**	−0.968	1.959	3.152***	1.806
	[0.828]	[3.051]	[3.026]	[0.988]	[3.119]
Share of men aged 15–25	6.680***	5.251	13.380**	4.462**	6.589
	[1.757]	[5.960]	[6.237]	[1.899]	[5.882]
Population ÷ 10,000	0.011	0.063	−0.002	0.014	−0.139**
	[0.019]	[0.062]	[0.071]	[0.025]	[0.058]
Constant	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
F-statistic	15.03	9.85	34.97	21.62	10.57
Within R^2	0.1349	0.0729	0.2649	0.1674	0.1197
Observations	1,192	1,192	1,192	1,192	1,192

NOTES.—The dependent variables are the number of offenses per crime category and are expressed in logarithm. Bracketed numbers are robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
SOURCE.—Authors' calculation.