WPS7560

Policy Research Working Paper 7560

An Exploration of the Relationship between Police Presence, Crime, and Business in Developing Countries

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WORLD BANK GROUP
Development Economics
Global Indicators Group
February 2016

Policy Research Working Paper 7560

Abstract

Economic theory predicts that a rise in police presence will reduce criminal activity. However several studies in the literature have found mixed results. This study adds to the literature by exploring the relationship between the size of the police force and crime experienced by firms. Using survey data for about 12,000 firms in a cross-section of 27 developing countries, the study finds that increasing the size of the police force is negatively associated with crime experienced by firms. The results are confirmed using a panel of firms for a subset of countries for which data are available. The study also finds that this negative relationship is stronger under certain macro-economic circumstances.

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JEL Classification: K42, O10, O50
Key words: Crime, Firms, Development, Police Size

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1. Introduction

Economic theory predicts that a rising police presence - an increase in the total number of police personnel - will reduce criminal activity (Becker, 1968). There are essentially two channels through which this takes place – deterrence and incapacitation. According to the former, greater police presence deters potential criminal activity, and with regards to the latter, more police presence incarcerates more criminals and thus reduces the pool of criminals in the streets. However, the theoretical underpinning of the crime-police relationship has received mixed empirical validation in the literature (see discussions in Dills et al., 2008; Cameron ,1988; Cronwell and Trumbell, 1994; and Moody and Marvell, 1996). For example, Cameron (1988) finds that 18 of 22 papers surveyed by researchers found either a positive effect of police presence on crime or no relationship between these variables. Fajnzylber et al (2002) find that police presence has a negative effect of on violent crime but a positive and significant effect on property crime.

Theoretically the effect of police presence on crime through deterrence or incapacitation has received some criticism. Typically police are not involved directly with crime reduction, and there is evidence that even the most routine policing strategies fail to deter potential offenders (Kovandzic and Sloan, 2002). Furthermore burglars are found to be rational when engaging in criminal activities, and their choices range from type of crime, to frequency of crime, to when and how to commit the crime (Kovandzic and Sloan, 2002; Wright and Decker, 1994). The implication

is that increasing police presence may actually result in more crime, as criminals change from serious (and possibly lucrative) crimes to undertaking less serious crimes more frequently.

Empirically, the positive association between police presence and crime has been blamed on flawed methodology or inadequate consideration of endogeneity issues and omitted variable biases (Marvell and Moody, 1996; Levitt, 2006). Studies that have accounted for this problem have typically found a negative relationship. Levitt (2004) uses instruments for police presence via expenditures allocated to fire fighters and finds a negative relationship between police presence and crime. Evans and Owens (2007) find that an exogenous increase in police due to the enactment of a policing program reduces auto thefts, burglaries, robberies, and aggravated assaults. Di Tella and Schargrodsky (2004) isolate the causal effects of police on crime by examining the impact of an exogenous increase in police presence due to terrorism attacks in Buenos Aires in Argentina, and find a negative relationship between police presence and crime. Mirko et al. (2011) find a similar negative effect by examining the exogenous increase in police presence due to the terror attacks in London.

A natural extension of the literature would be to explore whether the relationship between police and crime experienced by households or in general overall crime rates in the economy also applies specifically to crimes experienced by firms, since overall crime rate results do not give any indication of how the findings reflect what firms experience. The private sector is a key engine of growth in developing economies. Thus, if businesses experience high levels of criminal activities, the detrimental effect on the economy could be significant. For instance Pshiva and Suarez (2010) find that violent crime targeted towards firms in Colombia, specifically kidnapping of owners and managers, results in firms decreasing investments. Yet the determinants of crime experienced by

firms have been under-researched in the literature. Hopkins (2002) finds that in Britain about 24% of retailers and manufacturers were burgled in 1993 in contrast to 5.6% of households, implying a higher rate of victimization for firms. Large firms experience more crime than small firms, although small firms face a larger burden of crime in a sample of Latin American countries (Amin, 2009). Also firms owned by immigrants are more vulnerable to crime than native owned firms (Amin, 2010).

We expect a couple of ways in which crimes experienced by firms may differ from those faced by households. A greater police presence, which is measured simply as the total number of police personnel, may have a stronger deterrence effect on crime experienced by firms than individual crime. This may be because criminals are more likely to displace crime targeting firms with less serious criminal activities when police presence may be greater. The deterrence of crime may come in the form of increased police patrols in business areas, or even increases in the capacity to investigate crimes. However, most firms may have the capacity to utilize private security measures to deter criminal activity, although we do find later in this study that controlling for security costs does not alter our main results. Furthermore, one cannot completely rule out the possibility that the presence of a police force may reflect the existence of criminal activity, but have no correlation with crime experienced by firms. Thus, which mechanism dominates is an empirical question.

Empirical studies on crime in developing economies tend to use cross-country crime data from police reports or household crime data from household surveys in a specific city or country. The difficulty of using police reports is that given the level of mistrust of police in developing economies, police reports typically under-report crime (Soares, 2004; Levitt, 1998). The limitation of the household survey studies is that they do not consider crime faced by firms, which tends to

be more frequent and cause greater damage (Hopkins 2002). Household crime studies are also unable to account for the financial costs incurred by the victim due to the criminal activity, as most of the surveys are unable to account for the value of property loss. Furthermore, even though household-level crime measures are more accurate than police reports, there is still the difficulty of drawing general policy inferences based on household data, as they tend to be country- or city-specific. To elucidate this point, the issue with household surveys is that they tend to be undertaken using different sampling methodologies across different countries, and thus the derived crime rates are not comparable between countries. Thus, crime statistics from household crime surveys in different countries cannot just simply be pooled together. Finally, these household surveys typically collect data for one period of time and thus studies based on these data face the issue of time invariant omitted variables.

Our approach in this paper is to exploit cross-country heterogeneity in levels of police size to explain differences in the losses due to crime experienced by firms. Our framework uses firm-level characteristics and several macro-economic factors as explanatory variables for crime experienced by firms. The empirical strategy is based on combining firm-level survey data that are collected using a similar sampling methodology with country-specific police data from the United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems. Concerns about simultaneity bias are alleviated in our use of aggregate police variables because crime experienced at the firm level should not affect country-level variables such as our measure of police size. However, endogeneity may arise because the mean country-level crime experienced by firms may affect our police measure, and thus we lag our police variable. We find that an increase in police per 100,000 of population by 1 percent is associated with a 0.43 percent reduction in the losses due to crime. The results are strengthened for estimations using firm-level fixed effects for a subset

of panel firms. We find that increasing the police force has a large negative association with crime under high inequality, high voter turnout, in larger cities, and when the firm is owned and managed by women. Expansion of the police force is also negatively associated with crime experienced by firms for slow-growing economies, economies with higher religious fractionalization, and economies with bad governance.

It is worth noting that given the data limitations, our results may underestimate the true effect of police on crime experienced by firms, since we cannot fully limit the issue of simultaneity bias between police presence and crime. However, given the mixed empirical validation in the literature, this result of a negative impact of police on crime experienced by firms is still significant, even if this study presents a lower bound of the effects. We also concede that it may not be possible to completely address empirical issues, such as endogeneity and omitted variable bias, given the data at hand, and we caution against making any causal statements. However our results do not seem farfetched given estimates in the literature between police and overall crime instead of firm-specific crime. We hope that these preliminary findings serve as a starting point for future research in this rather under-researched area.

To summarize, this paper contributes to the literature in the following ways: (i) This study quantifies the effect of police presence on the burden of crime experienced by firms, and thus sidesteps issues of underreporting of crime in country aggregates, and also accounts for the intensity of crime by using losses due to crime as a percentage of sales. (ii) The data used for this study were obtained from the World Bank's Enterprise Analysis unit (Enterprise Surveys), which uses the same survey and sampling methodology across surveys, allowing for cross-country comparisons, and thus addresses the issue of external validity which country specific survey

studies typically face. The data set consists of about 12,000 firms in 27 developing countries.[1] (iii) This study is also able to account for firm- and country-specific time invariant omitted variables using data available for a panel of firms for a subset of countries in the sample. Panel data are available for 664 firms across a subset of 12 Eastern European economies.

An important issue raised in the literature is the choice of control variables in crime estimations (Moody and Marvell, 2010). We are also concerned about several omitted variables, including institutions or the presence of democratic governments that may bias our variable of interest – the size of the police force. We address this using a sensitivity analysis that essentially checks the robustness of our empirical specification. We find that our results are unaffected by the inclusion of several additional institutional and other control variables. Our results are also robust to various other sensitivity checks.

Section 2 describes the data, section 3 provides the estimation and results, and sections 4, 5, 6 and 7 provide instrumental variable estimations, panel data estimations, robustness checks, and conclusions, respectively.

2 Data and Main Variables

The data for firm-level variables are collected by the World Bank's Enterprise Surveys. The Enterprise Surveys (ES) use standard survey instruments to collect firm-level data on a country's business environment from business owners and top managers. The surveys cover a broad range of topics including access to finance, corruption, infrastructure, crime, competition, labor,

[1] Note that although Enterprise Surveys covers a wide range of economies, it is the combination of police data, and the selection of country surveys that follow a consistent sampling methodology that restricts the same to 27 countries. Details are provided in the data section.

obstacles to growth, and performance measures. The survey is designed to be representative of a country's private non-agricultural economy and only registered firms with at least five employees are included in the sample.

The data consist of a random sample of 12,000 firms across 27 developing countries in different regions stratified by firm size, location, and sector. The survey year ranges between 2007 and 2009. This sample of ES data is selected on the basis of consistent sampling methodology. Surveys for previous years do not have the same methodology. Police data is obtained from the United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems. This data set consists of an unbalanced panel covering years between 2003 and 2008 for both developing and developed economies. Due to the unbalanced nature of the data set, about 39 countries match between the ES firm-level data and the UN country-level police data. Accounting for issues such as missing questions and incorrect data, the sample size reduces to a cross-section of 27 developing economies. To account for firm-specific unobservables, we use panel data for 644 firms in a subset of 12 Eastern European economies for 2004 and 2007.[2] We would caution that the firms sampled in 2004 do not use the same sampling methodology as the firms in 2007, and data are only available for Eastern European economies. Details of countries in the sample and their respective survey years can be found in the first column of table A3 in the appendix.

2.1 Dependent variable

The dependent variable used is losses due to crime as a percentage of annual sales of a firm. This variable is derived from the survey question: "In fiscal year [insert fiscal year], what are the

[2] Panel data are not available for the other countries

estimated losses as a result of theft, robbery, vandalism or arson that occurred on establishment's premises calculated as a percent of annual sales or the total annual value of the losses?"

In some instances the total value of losses is reported, and in that case the share of losses due to crime over total sales is manually calculated. The main advantage of having a share of the losses over total sales as a measure of crime is that it provides a unit free measure given the range of measurement issues regarding currency exchange rates and inflation prevalent in crime measures using local currency units. We make no distinction between a firm that has experienced no crime and a firm that has experienced crime but incurred no losses. Both firms get a zero value for the dependent variable. The variable averages 0.72% in the sample with a standard deviation of 3.9%. Using country averages across all firms, Azerbaijan has the lowest amount of crime losses at 0.20% of sales, while El Salvador has the highest with 1.73%. Data source and description of the variable can be found in table A1, with summary statistics in table A2.

2.2 Explanatory variable

The main variable of interest is the number of police per 100,000 of population. The variable is obtained from United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems. The variable is typically lagged by 1 year to reduce potential simultaneity bias between crime losses and police presence, however due to data constraints, for some countries the lag is not exactly one year previous, but a few years previous in certain cases. The specific details of the number of lags are available in table A3 in the appendix. The sample mean for the number of police is 288, while the standard deviation is 108. Macedonia has the highest number of police with 480 police per 100,000 of the population while Hungary has the lowest with 90 police per 100,000 of population. The country average for crime losses and number of police are presented in table A4 for each country in the appendix.

2.3 Other explanatory variables

We control for several firm-level and country-level variables. The degree of crime a firm faces may depend on its size, the sector it belongs to, and its locale (Amin, 2009; Glaeser and Sacerdote, 1999). Big cities tend to provide higher pecuniary benefits for criminals and also criminal activity may involve lower costs due to a high probability of anonymity and low likelihood of arrest. We control for firm size using dummies for small and medium firms. A small firm is defined as a firm with less than 20 employees, while a medium firm has workers between 20 and 99. We also capture the economic sector of the firm by using a dummy variable for manufacturing firms. A priori it is not clear whether a manufacturing firm should have higher crime losses with respect to other sectors. We also include a city size dummy variable which takes the value of 1 if the city has a population of 250,000 of greater, or is a capital city, and 0 otherwise. There is also evidence that female-owned households as well as female-owned firms have a positive association with higher crime rates (Glaeser and Sacerdote, 1999; Islam, 2013; Kelly 2000). We thus include a dummy variable for whether a firm has at least one female owner. All these variables are from the Enterprise Surveys data set.

At the country level, we control for real GDP per capita growth, real GNI per capita, and the Gini index, given their prominence in the literature (Rogers 1989; Fajnzylber et al., 2002; Soares, 2004; Demombynes and Ozler, 2005; Dahlberg and Gustavsson, 2008). Increasing inequality typically increases the rewards of engaging in criminal activity due to a presence of well off potential victims and also increases the proportion of poor who may engage in criminal activity. For cases where the GINI index or GNI per capita information is missing for the year corresponding to the enterprise surveys data, we use the estimate of the most recent year available. The exact year of

data used for GNI per capita and the Gini index are presented in table A3 in the appendix. We also control for country size using the total population of the country. These data are available from the World Bank's World Development Indicators. Data source and description of the variable can be found in table A1, with summary statistics in table A2.

3. Estimation

We estimate following equation using OLS.

$$(1)\quad crimeloss_{ij} = \beta_1 Policelag_j + \beta_2 GDPgr_j + \beta_3 Fem_{ij} + \beta_4 GNIcap_j + \beta_5 GINI_j + \beta_6 Population_j + \beta_7 Small_{ij} + \beta_8 Medium_{ij} + \beta_9 \text{LargeCity}_{ij} + \beta_{10} Manf_{ij} + \varepsilon_{ij}$$

Where *crimeloss* is the losses due to crime as a % of sales for firm i and country j, *Policelag* is the lagged number of police per 100,000 population, *GDPgr* is the real GDP per capita growth, *Fem* is a dummy representing female ownership, *GNIcap* is the real GNI per capita, *GINI* is the gini coefficient, *Population* is the total population of the economy, *Small* and *Medium* are firm size dummies, LargeCity is a dummy for cities with population of 250,000 and greater, or capital cities, and finally *Manf* is a dummy for manufacturing firms.

All estimates are based on standard errors clustered at the country level. In the later sections we add additional variables and interact them with the variable of interest to elucidate several relationships. The usual econometric issues of endogeneity and omitted variable bias are of a concern in the estimation. Concerns about simultaneity bias are alleviated in our use of aggregate police variables because crime experienced at the firm level should not affect country-level variables such as our measure of police size. However, endogeneity may arise because the mean

country-level crime experienced by firms may affect our police measure, and thus we limit the problem of reverse causality by using lags of the number of police. However, under reverse causality we expect a positive correlation between crime and the number of police and thus any negative relationship we uncover would be even stronger if reverse causality was explicitly accounted for. On the other hand omitted variable bias is an issue that is challenging to overcome given data limitations. While we cannot cleanly solve the identification problem with the data at hand, we employ several strategies in an effort to consistently estimate the parameters of interest. First, we use a dataset of 644 panel firms in 12 Eastern European economies for the years 2004 and 2007. We caution that the firms sampled in 2004 do not use the same sampling methodology as the firms in 2007, and data are only available for Eastern European economies. We employ firm-level fixed effects and year effects to account for time invariant firm specific unobservables. Although we cannot completely account for endogeneity, our results do seem consistent with estimates in the literature based on overall crime instead of firm-specific crime.

3.1 Base Regression Results

The base estimation results are presented in column 1 of table 1. The coefficient of the number of police is negative and significant at 5%. In terms of magnitude, a one percent increase in the number of police is associated with a 0.43 percent decline in crime losses. This result indicates that the number of police may effectively be a deterrent for crime experienced by firms, just as studies have shown them to be a deterrent for individual-level crime (Di Tella and Schargrodsky, 2004; Levitt, 1997).[3]

[3] When all controls are excluded from the estimation, a negative relationship between police size and crime persists, but it is not significant unless GNI per capita is controlled for. Thus these results are conditional on the level of income in the country.

A few other results stand out. Both real GDP per capita growth and Real GNI per capita have a negative and highly significant association with losses due to crime.[4] Although the negative coefficient of GDP per capita growth is not surprising considering individual-level crime literature (Fajnzylber et al., 2002; Soares, 2004), the negative relationship between GNI per capita and crime has been less robust in the literature (Soares, 2004).Thus development may not be criminogenic at the firm level. The Gini coefficient and dummy for large or capital city are not significant despite their well-documented effect on individual-level crime (Dutta, 2009; Glaeser and Sacerdote, 1999). The size of the country in terms of population has a positive coefficient implying that firms in larger countries have larger losses due to crime as a percentage of sales.

Certain firm characteristics are found to be significant with regards to losses due to crime. Having a female owner and manager or being a small or medium firm is associated with an increase in the losses suffered due to crime. This also implies that large firms may experience fewer crime losses, perhaps due to security measures they are able to implement. Manufacturing firms are less likely to sustain heavy crime losses than non-manufacturing firms.

We now consider how several country and firm-level factors may influence the association between police expansion and crime experienced by firms. Studies have indicated that the relationship between police size and crime may depend on several variables such as the incentives for corruption, quality of governance, economic development, social disorganization, and the distribution of income (Bourguignon, 1999; Dutta, 2009; Ehrlich, 1973; Fajnzylber et al., 2002;

[4] Due to the lack of continuous data for GNI per capita for some countries, we use the GDP growth rate instead of the GNI growth rate. This is typical in the literature (Fajnzylber et al, 2002).

Islam, 2014; Kelly, 2000; Soares, 2004). There may also be variation of the relationship between police and crime depending on whether it is a rural or urban area. We explore each of these factors by interacting them with our measure of police size.

3.2 Per capita Economic Growth and Police Size Interaction

The interaction term between number of police force and economic growth is positive and significant at 5% as indicated in column 2 of table 1. The overall association between police and crime losses is still negative at the mean level of real GDP per capita growth when interacting number of police with GDP per capita growth. Increasing the police force by one percent at the mean GDP per capita growth is associated with a 0.481 percent reduction in the dependent variable. However, looking at the extremes of the sample, Police per 100,000 of population has no overall association with crime in fast growing countries. The association of police presence with crime losses triples in magnitude at the minimum level of GDP per capita growth – an increase 0.481 to a 1.513 percent reduction in crime losses. The growth rate turning point, below which the association between police and crime losses is significant, in the sample is 3.7%, which is around the 66^{th} percentile of the sample. These results seem to indicate increasing the police force is associated with a greater reduction in crime experienced by firms in slow-growing economies than fast-growing economies. While the data do not allow us to identify the reason why increasing police size is more effective in slow-growing economies, there are a couple of potential explanations. One is that in fast-growing economies, the labor market may absorb potential criminals due to increasing opportunities (Becker, 1968; Machin and Meghir, 2004; Donohue and Levitt, 2001). Thus, increasing economic growth may reduce crime, thereby limiting the impact of increasing police size. Furthermore, in fast-growing economies, firms may have the resources to adopt security measures that serve as a deterrent for crime regardless of the degree of police

presence. Similarly, in slow-growing economies, there may be a larger pool of criminals, and firms may have fewer resources to allocate towards security measures, making police expansion as the most effective route to limit criminal activity against firms. A developing theme is that in economies that have conditions enabling a greater degree of crime, increasing the police force tends to be more effective in reducing crime, specifically for firms.

3.3 Inequality and City Size Interaction with Police Size

There is substantial literature linking inequality to crime (Ehrlich, 1973; Fajnzylber et al., 2002) and city size to crime (Glaeser and Sacerdote, 1999). This literature finds a positive relationship between both inequality and crime, and city size and crime. The former is because high inequality can lower opportunity cost of crime for the most disfavored citizen and also increase the returns to crime, as measured by the income of potential victims. The latter is due to lower probabilities of arrest and recognition in bigger cities than smaller ones.

The interaction of inequality and police is negative and significant at 5% as indicated in column 3 of table 1. A 1 percent increase in the police force is associated with a reduction in crime losses by 0.5 percent. This figure increases to a 1.3 percent decline in crime losses with a significance of 1% for the highest level of Gini in the sample. Above a Gini value of 37, which is the Gini value for Lithuania and the 42nd percentile value of the sample, the association between police and crime becomes significant at all conventional levels. A potential explanation may be that in countries with high levels of inequality, there are more opportunities for crime, and thus an expansion of the police force is more effective. This is consistent with the theme that expanding the police force is more effective in economies that have conditions encouraging criminal activity.

The interaction between the number of police and city size is negative and significant at 1%. That is, increasing the police force has a significant association with crime for larger or capital cities than smaller cities as indicated in column 4 of table 1. A one percent increase in the police force in larger cities is associated with a 0.7 percent reduction in the dependent variable, significant at 1%. In contrast, increasing police by one percent in small cities has an insignificant association with crime. One possible reason could be that small cities have strong community networks, which may increase the cost of committing crime. In contrast large cities may have weaker community ties, and thus the anonymity makes crime more feasible, therefore resulting in a significant association between police and crime experienced by firms.

3.4 Firms with Female Ownership & Management and Police Size Interaction

The interaction between firms that have a female owner and manager, and the number of police is negative and significant at 1% as shown in column 1 of table 2. Expanding the police size is significantly associated with a reduction in crime losses for firms that are owned and managed by females with regards to crime losses. Increasing the police force by 1 percent is associated with a decrease in crime losses by 1.4 percent. There is some evidence that firms with a significant female presence in terms of ownership and management are more likely to be victims of criminal activity (Islam, 2013). Thus, a larger share of female-owned or female-managed firms in an economy, the greater the prevalence of crime against firms. Thus the finding that increasing the police force is more effective in reducing crime for female owned and managed firms is consistent with the theme that under situations where crime is more likely to be prevalent, expanding the police force may be an effective tool in combating crime.

3.5 Quality of Governance and Police Size Interaction

We use ICRG's Quality of government as a governance indicator, with higher values of the variable indicating better governance. The interaction term between the number of police and the quality of government is positive and significant at 10% as shown in column 2 in table 2. A one percent increase in the police force is associated with a 0.65 percent reduction in crime losses at the mean level of the Quality of Governance index, significant at 1%. This result is magnified at the minimum level of governance whereby the elasticity doubles to 1.23 %. These results seem to indicate that police expansion is more strongly associated with crime reduction in countries with a low level of governance. It is also important to note that the inclusion of governance indicators or institutional or political controls in the estimations, as indicated in the robustness section, do not affect the significance of the police size - crime losses relationship. This finding is consistent that expanding the police force may be effective in reducing crime under more crime-enabling environments.

3.6 Voter Turnout and Fractionalization

Social disorganization theories indicate that factors that diminish the effectiveness of informal social controls increase criminal activity (Kelly, 2000). Here we consider two indicators of social disorganization – voter turnout in elections, and religious fractionalization. A higher voter turnout may indicate lower social disorganization. Similarly, larger religious fractionalization would make social organization more difficult due the difficulty of interactions and building consensus among diverse groups. Thus for economies with higher levels of voter turnout, implying lower social disorganization, an expansion of the police force may be more effective in lowering crime. Similarly, under low levels of religious fractionalization, which may imply lower social disorganization, police expansion may be more effective in reducing crime.

Columns 4 and 5 of table 2 confirm the results. The interaction between voter turnout and police is negative and significant at 1%. At the sample mean value of voter turnout, an increase in the police force by one percent is negatively associated with the dependent variable - a 0.39 percent reduction in crime losses. The result is significant at the 5% level. At the sample minimum of voter turnout, police has no significant association with crime losses. However, the relationship between police and crime losses increases in magnitude and retains or increases significance at the maximum sample value of voter turnout. The magnitude is a 0.68 percent reduction in crimes losses for the sample maximum of voter turnout, statistically significant at the 1% level. The turning point where the association between police size and crime losses ceases to be significant is a voter turnout below 0.7, right below the mean of the sample, around the 46^{th} percentile.

Similarly, the interaction between religious fractionalization and police is positive and significant at 10%. At the sample mean values of religious fractionalization, an increase in the police force by one percent is negatively associated with the dependent variable - a 0.43 percent reduction in crime losses, statistically significant at the 5% level. At the sample maximum of religious fractionalization, police has no significant association with crime losses. However, the relationship between police and crime losses increases in magnitude at the minimum sample value of religious fractionalization. The magnitude is a 0.77 percent reduction in crime losses for the sample minimum of religious fractionalization, statistically significant at the 1% level. The turning point beyond which the association between police size and crime losses ceases to be significant is a religious fractionalization of 0.43 (62^{nd} percentile).

4. Instrumental Variables

Even though we concede the difficulty in accounting for endogeneity issues in our estimations given the data at hand, as a robustness we present instrumental variables estimations that may not be compelling, but do provide some insight that may be beneficial for future research. We use two instruments for police strength– a dummy variable indicating whether the party of the chief executive is right-wing or not and the stock of international migrants as a % of the population. The right-wing indicator is obtained from the database of political institutions (DPI) and is defined as conservative, religious or right-wing. On the one hand right, wing governments may prefer less government intervention and are thus more likely to decrease the police force. On the other hand, although right wing governments may be in favor of budget cuts, they may also prefer a larger crackdown of police on criminal activity, consequently increasing the police budget. A priori, it is difficult to see which effect will dominate. Furthermore, it has been shown that conservative voters typically perceive immigrants as illegal, and thus a larger migrant stock may push conservative governments to spend more on increasing the police force (Fennelly and Federico, 2008). Thus we expect the international migrant stock in the country to be positively correlated with the size of the police force.

The first-stage estimates are presented in column 2 of table 3, with a negative coefficient for right wing governments and a positive coefficient for migration stocks, both with a significance of at least 5%. This shows some support of a negative association of right wing governments with police size for the sample of countries in this study. We report the second-stage results using instrumental variables in table 3, column 1. The coefficient of police per 100,000 of population using instrumental variables retains the sign and significance of the base estimations. The magnitude increases in absolute terms from -0.0011 in the base estimations to -0.0025 in the estimations using the instrumental variables. As indicated in the bottom of table 3, the Sargen-Hansen test of

overidentifying restrictions is not rejected for all conventional levels of significance, thus we cannot reject the null that all the instruments are valid. We also reject that the estimation is underidentified at 5% level of significance.

However, the results should be treated with caution. It is possible that the instruments may not satisfy the exclusion restriction. Selection of right-wing politicians may not be random; consequently preferences of citizens for right-wing politicians may be correlated with unobservables that are related to crime, since crime typically ranks high in the list of voter concerns. Similarly, a higher migrant stock may be correlated with several country-level unobservables that are also correlated with crime. Although the IV results are retained after controlling for corruption and the quality of government, the potential endogeneity of our instruments cannot be ruled out completely.

5. Panel Estimation

Thus far, all estimates provided have been cross-sectional. The implication is that it is hard to account for certain country-specific of firm-specific unobservable variables. However, panel data are available for a few surveys. The Enterprise Surveys typically re-interview a subset of firms across multiple waves of surveys. This is typically done for two waves of surveys given the especially high attrition rates that occur in a span of 3 to 4 years. In order to account for firm specific unobservables, we use panel data for 644 firms in a subset of 12 Eastern European economies for 2004 and 2007. Column 1 of table 4 presents these results using country and year fixed effects, while column 2 of table 4 presents firm and year fixed effects estimation. We use

country fixed effects so that we may retain the coefficients of firm characteristics.[5] The main results are consistent with the cross-section results in terms of sign and significance of the coefficient of police size. The results indicate that a one percent increase in police size is associated with a 2.29 percent reduction in losses due to crime for the country and year fixed effects estimation, and 2.01 percent reduction in losses due to crime for the firm and year fixed effects estimation. The magnitude is almost six times larger than what we found with the cross-section estimates. However, given the data restrictions, one should use caution when interpreting the results. Furthermore, there are potentially time varying unobservables which are difficult to address given the data at hand.

6. Robustness

We check for the robustness in terms of model specification. Several studies have shown that female population (Di Tella and Schargrodsky), corruption (Gaviria, 2002), fractionalization (fajnzylber et al., 2000), trade (Ghosh et al., 2011), and government spending (Naidoo, 2006) are factors that influence crime. We add variables that proxy for the aforementioned factors and present the results in table A5. We also include firm-level variables such as total employees and security costs as a % of total sales and check if they affect our main estimation results. We also control for various institutional proxies such as the log of settler mortality and legal origins in case our police measure is in fact capturing prevailing institutions. As shown in table A5, including these sets of variables neither improves the goodness of fit, and thus does not improve explanatory power of the model, nor reduce the significance of the variable of interest. With regards to security

[5] Please note that income inequality is omitted from the specification due to a lack of data over time, while city size dummy variable is not retained as it does not vary over time.

costs, the stability of the results for police on crime may rule out the possibility that security measures undertaken by private firms substitute for police presence.

We also worry that extreme observations in the sample may be driving the results discussed above. Thus we omit the top 1%, bottom 1 %, and top and bottom 1% observations of losses due to crime as well police size. As indicated in table A6, our main results remain quantitatively unchanged from above.

Finally, we worry that our results may be dominated by certain countries. However, we do not want to drop too many observations. Thus we drop countries with less than 1,000 observations, one at a time, from the sample and see if the coefficient of police is affected. As indicated by figure 1, the results are not dominated by any particular country in the sample as we retain the sign and significance at 10%.

7. Discussion and Conclusion

This study adds to the literature by exploring the relationship between police presence and crime against firms. We find a negative association between an increase in police size and crime against firms. We find that a 1 percent increase in the police force per 100,000 of population is associated with a decrease in losses due to crime by 0.43 percent. This finding is robust to several control variables, including private security spending, and is also replicable for a subset of panel firms in Eastern European economies.

Apart from contributing to the literature which has been empirically ambiguous about the relationship between police size and crime, this study also has important policy implications. This

study shows that the police-crime relationship varies under certain contexts. More importantly, a larger theme emerges in the empirical findings indicating that when certain conditions in an economy make firms more vulnerable to crime, expanding the police force seems effective in reducing it. To be more specific, low quality of governance; high inequality, slow economic growth; and the anonymity of big cities have all been found to be crime inducing. And it is under these circumstances that expanding the police force is most effective in reducing crime. Thus, the policy prescription may be that the presence of bad governance, high inequality, or slow economic growth should not necessarily be a deterrent for policies that expand the police force. This is especially important for developing economies, as they are typically plagued by bad governance and slow economic growth. Finally, the results also indicate that police expansion is most effective when there are lower levels of social disorganization, as measured by voter turnout and religious fractionalization. These are all important policy results, and we leave it for future research to identify and explore each of these relationships in a more rigorous manner. This paper should be seen as a first step in highlighting the relationship between crime experienced by firms and police expansion in developing economies.

Developing economies typically face scarce resources, and there is much temptation to abandon the provision of public goods, especially when an economy faces adverse circumstances. This study proposes the possibility that it is precisely under adverse conditions that governments in developing economies should consider increasing the provision of a public good such as the expansion of the police force, as it is under such scenarios that an increase in the police force could be most effective.

TABLE 1: POLICE AND CRIME AGAINST FIRMS (LOSSES DUE TO CRIME/SALES)

	% of Losses Due to Crime Over Sales	% of Losses Due to Crime Over Sales	% of Losses Due to Crime Over Sales	% of Losses Due to Crime Over Sales
	1	2	3	4
Police per 100,000 persons	-0.0011**	-0.0020**	0.0052*	0.0004
	[0.0005]	[0.0009]	[0.0027]	[0.0006]
Police x GDP per Capita Growth		0.0003**		
		[0.0001]		
Police x GINI			-0.0002**	
			[0.0001]	
Police x Large City or Capital				-0.0022***
				[0.0005]
GDP per Capita Growth	-0.0808***	-0.1679***	-0.0706***	-0.0821***
	[0.0208]	[0.0471]	[0.0230]	[0.0199]
Firm with Female Owner	0.1181*	0.1078*	0.1143*	0.1069*
	[0.0632]	[0.0630]	[0.0616]	[0.0622]
Real GNI per capita (in 100s)	-0.0058***	-0.0061***	-0.0056***	-0.0060***
	[0.0012]	[0.0012]	[0.0011]	[0.0010]
GINI	-0.0065	-0.0066	0.0455*	-0.0069
	[0.0113]	[0.0114]	[0.0258]	[0.0101]
Population in Millions, Total	0.0034*	0.0025	0.0022	0.0042***
	[0.0017]	[0.0019]	[0.0015]	[0.0014]
Small firms	0.4023***	0.3979***	0.3955***	0.4040***
	[0.0940]	[0.0937]	[0.0936]	[0.0937]
Medium firms	0.1664**	0.1654**	0.1592**	0.1631**
	[0.0658]	[0.0654]	[0.0655]	[0.0654]
Large or Capital city	0.0331	0.0454	0.0398	0.6432***
	[0.0953]	[0.0944]	[0.0982]	[0.1681]
Manufacturing	-0.2238**	-0.2312***	-0.2225**	-0.2219**
	[0.0813]	[0.0815]	[0.0822]	[0.0827]
Number of Countries	27	27	27	27
Number of Observations	12274	12274	12274	12207

* significant at 10%; ** significant at 5%; *** significant at 1%, Standard errors in brackets clustered at the country level

TABLE 2: POLICE AND CRIME AGAINST FIRMS (LOSSES DUE TO CRIME/SALES)

	% of Losses Due to Crime Over Sales	% of Losses Due to Crime Over Sales	% of Losses Due to Crime Over Sales	% of Losses Due to Crime Over Sales
	1	2	3	4
Police per 100,000 persons	-0.0008 [0.0005]	-0.0060** [0.0026]	0.0065** [0.0025]	-0.0019*** [0.0004]
Police x firm with female owner and manager	-0.0028*** [0.0006]			
Firm with female owner and manager	1.0427*** [0.2078]			
Police x Quality of Government		0.0083* [0.0043]		
Quality of Government		-3.4696** [1.5425]		
Police x Voter Turnout			-0.0104*** [0.0033]	
Voter Turnout			2.5419** [1.0928]	
Police x Religious Fractionalization				0.0025* [0.0014]
Religious Fractionalization				-0.6244 [0.4729]
GDP per Capita Growth	-0.0856*** [0.0237]	-0.0970*** [0.0211]	-0.0829*** [0.0199]	-0.0762*** [0.0221]
Firm with Female Owner		0.1202* [0.0661]	0.1168* [0.0626]	0.1180* [0.0625]
Real GNI per capita	-0.0056*** [0.0011]	-0.0041*** [0.0013]	-0.0054*** [0.0013]	-0.0052*** [0.0013]
GINI	-0.0093 [0.0128]	-0.0181 [0.0114]	-0.0098 [0.0113]	-0.0024 [0.0119]
Population in Millions, Total	0.0029* [0.0016]	0.0028* [0.0016]	0.0049*** [0.0016]	0.0041** [0.0015]
Small firms	0.3513*** [0.0990]	0.4069*** [0.1032]	0.4033*** [0.0952]	0.4020*** [0.0943]
Medium firms	0.1328* [0.0754]	0.1755** [0.0674]	0.1683** [0.0664]	0.1653** [0.0657]
Large or Capital city	0.0579 [0.0901]	0.0354 [0.1018]	0.0567 [0.0983]	0.0516 [0.0957]
Manufacturing	-0.2275**	-0.2251**	-0.2172**	-0.2224**

	[0.0880]	[0.0907]	[0.0846]	[0.0816]
Number of Countries	27	24	27	27
Number of Observations	12449	11242	12274	12274

TABLE 3: POLICE AND CRIME AGAINST FIRMS (LOSSES DUE TO CRIME/SALES)– INSTRUMENTAL VARIABLES

	% of Losses Due to Crime Over Sales IV Estimates	Police per 100,000 persons lagged
	Second Stage Results	**First Stage Results**
	1	**2**
Police per 100,000 persons lagged	-0.0025**	
	[0.0012]	
Real GDP per Capita Growth	-0.0889***	-4.6990
	[0.0250]	[7.7187]
Right wing government		-107.1931**
		[47.0149]
International migrant stock (% of population)		8.8599***
		[3.2290]
Firm with Female Owner	0.1107*	-2.7705
	[0.0594]	[6.5694]
Real GNI per capita in 100s	-0.0056***	0.8227
	[0.0013]	[0.6320]
GINI	-0.015	0.1940
	[0.0156]	[4.3247]
Population in Millions, Total	0.0029*	-0.4467
	[0.0016]	[1.1525]
Small firms	0.4002***	-1.3706
	[0.0928]	[2.7090]
Medium firms	0.1681***	0.4318
	[0.0643]	[2.0697]
Large or Capital city	0.0949	34.4200*
	[0.1244]	[19.8669]
Manufacturing	-0.2027**	-13.8239***
	[0.0853]	[4.5140]
Number of Countries	27	27
Number of Observations	12274	12274
Instruments	Right wing government, International migrant stock (% of population)	
F Statistics for the First Stage		15.00
Under-identification test (Kleibergen-Paap LM statistic) P-value:	0.0322	
Hansen J statistic (over-identification test of all instruments) p-value:	0.7219	

* significant at 10%; ** significant at 5%; *** significant at 1%, Standard errors in brackets clustered at the country level

TABLE 4: POLICE AND CRIME AGAINST FIRMS (LOSSES DUE TO CRIME/SALES)– PANEL ESTIMATION

	Country and Year Fixed Effects	Firm and Year Fixed Effects
	% of Losses Due to Crime Over Sales	% of Losses Due to Crime Over Sales
	1	2
Police per 100,000 persons	-0.0053***	-0.0045***
	[0.0015]	[0.0013]
GDP per Capita Growth	-0.1202	-0.0526
	[0.0703]	[0.0610]
Firm with Female Owner	0.1828	
	[0.1705]	
Real GNI per capita (in 100s)	0.0374	0.021
	[0.0294]	[0.0268]
Population in Millions, Total	0.1096	
	[0.0815]	
Small firms	0.2542	
	[0.2832]	
Medium firms	0.2567	
	[0.2219]	
Manufacturing	-0.3787	
	[0.2484]	
Number of Firms	664	664
Number of Countries	12	12
Number of Observations	1097	1097

* significant at 10%; ** significant at 5%; *** significant at 1%, Standard errors in brackets clustered at the country level

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TABLE A1: VARIABLE DEFINITIONS

Variable	Definition	Data Source
Losses Due to Crime (% of sales)	Response to the Question: "In fiscal year [insert fiscal year], what are the estimated losses as a result of theft, robbery, vandalism or arson that occurred on establishment's premises calculated as a percent of annual sales or the total annual value of the losses?" For actual values, % of sales was calculated.	Enterprise Surveys, World Bank
Real GDP per Capita Growth	Real GDP per Capita Growth Rate, constant 2000 USD	Word Development Indicators (WDI), World Bank
Police per 100,000 persons lagged	Police per 100,000 persons lagged. Due to data constraints, for some countries the lag is not exactly lagged by one year. Specifics of all lag years can be found in the appendix.	United Nations Survey on Crime Trends and the Operations of Criminal Justice Systems
Firm with Female Owner	Yes Response to Question: "Are any of the owners female?"	Enterprise Surveys, World Bank
Female Owner and Manager	Yes Response to Questions: "Is the Top Manager female?" and "Are any of the owners female?"	Enterprise Surveys, World Bank
Real GNI per capita (in 100s)	Gross National Income per Capita, Constant 2000 USD	Word Development Indicators (WDI), World Bank
GINI	Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	WDI, World Bank, Development Research Group
Population, Total in millions	Total Population	Word Development Indicators (WDI), World Bank
Small firms	Dummy is 1 if firm is small (<20)	Enterprise Surveys, World Bank
Medium firms	Dummy is 1 if firm is medium (20-99)	Enterprise Surveys, World Bank
Large City or Capital	Dummy is 1 if city is either the capital or has more than 250,000 population	Enterprise Surveys, World Bank
Manufacturing	Dummy is 1 for manufacturing firms	Enterprise Surveys, World Bank
Quality of Government	Mean value of the ICRG governance variables "Corruption", "Law and Order", and "Bureaucracy Quality", scaled 0-1. Higher values indicate better quality of government. 1990-2007 average used.	International Country Risk Guide – The PRS Group
Voter Turnout	Turnout in parliamentary elections measured as the total number of votes cast divided by the number of registered voters.	IDEA: International Institute for Democracy and Electoral Assistance http://www.idea.int/vt/index.cfm
Years of Schooling	Average Years of Schooling of Population over 15. 1990-2007 average used. 1990-2007 average used.	Barro and Lee (2010)
Corruption	Corruption Perception Index: 10 point scale where higher values indicate less corruption. 1995-2009 average used.	Transparency International ww.transparency.org
Religion Fractionalization	Probability that two randomly selected people from a given country belong to different religions	Alesina, Devleeschauwer, Easterly, Kurlat, and Wacziarg (2003)
Employees	Response to Question: "At the end of fiscal year [insert last complete fiscal year], how many permanent, full-time employees did this establishment employ?"	Enterprise Surveys, World Bank
Ethnic Fractionalization	Probability that two randomly selected people from a given country will not belong to the same ethnic group	Alesina, Devleeschauwer, Easterly, Kurlat, and Wacziarg (2003)

Language Fractionalization	Probability that two randomly selected people from a given country do not speak the same language	Alesina, Devleeschauwer, Easterly, Kurlat, and Wacziarg (2003)
Security Costs as a % of sales		Enterprise Surveys, World Bank
Polity 2	Index of Democracy (Polity 2). Score between -10 and 10 that indicate how democratic a country. Values increase with greater democracy. 1990-2007 average used.	Polity IV, http://www.systemicpeace.org/polity/polity4.htm
Proportion of Female Population	Population, female (% of total)	WDI, World Bank
Life Expectancy		WDI, World Bank
Tax over GDP		Government Financial Statistics (GFS), International Monetary Fund
Investment over GDP	Total government consumption over GDP	Penn World Tables
Government Consumption over GDP	Total public and private investment over GDP	Penn World Tables
Government Spending on Public Order & Safety over Total Spending	Includes spending on police, fire protection services, law courts, and prisons	Government Financial Statistics (GFS), International Monetary Fund
Inflation		WDI, World Bank
Trade	Exports plus imports as a % of GDP	WDI, World Bank
Right Wing Government Dummy	For parties that are defined as conservative, Christian democratic, or rightwing	Database of Political Institutions (DPI)
International Migrant Stock as % of Population	International migrant stock is the number of people born in a country other than that in which they live, including refugees.	WDI, World Bank
Legal Origin Dummies	Dummies for legal origin include: English Common Law. French Commercial Code, Socialist/Communist Laws, German Commercial Code, Scandinavian Commercial Code	La Porta et al. (1998)
Log Settler Mortality	Log of European Settler Mortality during Colonization	Acemoglu et al. (2001)

TABLE A2: SUMMARY STATISTICS

Variable	Mean	Std. Dev.	Min	Max	Data Unit
Losses Due to Crime (% of sales)	0.716	3.942	0.000	100.000	Firm
GDP per Capita Growth	2.656	4.213	-5.529	10.192	Country
Police per 100,000 persons lagged	287.894	108.187	90.110	480.013	Country
Firm with Female Owner	0.419		0.000	1.000	Firm
Female Owner and Manager	0.152		0.000	1.000	Firm
Real GNI per capita (in 100s)	37.345	31.014	2.257	141.816	Country
GINI	39.826	7.768	25.810	52.330	Country
Population, Total in millions	28.615	27.065	1.353	141.816	Country
Small firms	0.369		0.000	1.000	Firm
Medium firms	0.378		0.000	1.000	Firm
Large City or Capital	0.627		0.000	1.000	Firm
Manufacturing	0.537		0.000	1.000	Firm
Quality of Government	0.525	0.101	0.351	0.791	Country
Voter Turnout	0.718	0.089	0.460	0.893	Country
Years of Schooling	8.066	1.816	2.850	11.689	Country
Corruption	3.369	0.960	1.982	6.091	Country
Religion Fractionalization	0.335	0.201	0.005	0.685	Country
Employees	121.246	478.223	1.000	20843	Firm
Ethnic Fractionalization	0.383	0.173	0.118	0.663	Country
Language Fractionalization	0.372	0.254	0.030	0.836	Country
Security Costs as a % of sales	1.575	5.798	0.000	384.615	Firm
Polity 2	6.560	4.526	-7.000	10.000	Country
Proportion of Female Population	51.040	1.437	49.165	54.020	Country
Life Expectancy	71.303	3.213	64.123	78.314	Country
Tax over GDP	0.150	0.031	0.089	0.210	Country
Investment over GDP	0.210	0.039	0.150	0.311	Country
Government Consumption over GDP	0.081	0.038	0.047	0.213	Country
Government Spending on Public Order & Safety over Total Spending	0.061	0.021	0.039	0.116	Country
Inflation	10.912	8.687	2.358	50.705	Country
Trade over GDP	86.790	35.835	37.354	168.314	Country
Right Wing Government Dummy	0.259		0.000	1.000	Country
International Migrant Stock as % of Population	4.733	5.350	0.149	19.631	Country

TABLE A3: POLICE, GINI, AND GNI PER CAPITA DATA AND SURVEY YEAR

Country Survey Year	**Police per 100,000 persons lagged Year**	**GINI**	**GNI per Capita**	**Inclusion in Panel Sample**
Argentina 2009	2008	2009	2009	No
Azerbaijan 2008	2006	2008	2008	No
Belarus 2007	2004	2007	2004	No
Bosnia and Herzegovina 2008	2007	2007	2007	No
Costa Rica 2009	2006	2009	2009	No
Czech Republic 2008	2007	1996	2008	Yes
Ecuador 2009	2006	2009	2009	No
El Salvador 2009	2006	2007	2009	No
Estonia 2008	2007	2004	2008	Yes
Fyr Macedonia 2008	2006	2008	2005	No
Hungary 2008	2007	2007	2008	Yes
Kazakhstan 2008	2007	2007	2008	Yes
Latvia 2008	2007	2008	2008	Yes
Lithuania 2008	2007	2008	2008	Yes
Moldova 2008	2007	2008	2008	Yes
Mongolia 2008	2004	2008	2000	No
Nepal 2008	2006	2004	2000	No
Nicaragua 2009	2006	2005	2009	No
Paraguay 2009	2006	2008	2009	No
Peru 2009	2004	2009	2009	No
Philippines 2008	2007	2006	2008	No
Poland 2008	2007	2008	2008	Yes
Romania 2008	2007	2008	2008	Yes
Slovak Republic 2008	2007	1996	2008	Yes
Slovenia 2008	2007	2004	2008	Yes
Turkey 2007	2006	2008	2007	No
Ukraine 2007	2006	2008	2007	Yes

TABLE A4: CRIME AND GENDER - COUNTRY AVERAGES

Country	% of Losses Due to Crime Over Sales	Police per 100,000 of Population
Argentina	0.63	206.79
Azerbaijan	0.20	136.98
Belarus	0.72	325.46
Bosnia and Herzegovina	0.44	157.02
Costa Rica	0.54	275.27
Czech Republic	0.48	429.49
Ecuador	1.11	292.58
El Salvador	1.73	275.20
Estonia	1.69	241.87
Fyr Macedonia	0.50	480.01
Hungary	0.25	90.11
Kazakhstan	0.60	449.43
Latvia	0.42	407.88
Lithuania	0.43	332.91
Moldova	0.54	256.50
Mongolia	0.52	277.27
Nepal	0.87	201.97
Nicaragua	1.68	166.81
Paraguay	1.54	331.48
Peru	0.64	323.03
Philippines	1.32	135.16
Poland	0.45	257.89
Romania	0.36	235.21
Slovak Republic	0.64	374.92
Slovenia	0.26	396.54
Turkey	0.38	451.86
Ukraine	0.45	358.16

TABLE A5: ROBUSTNESS – ADDED CONTROLS

	Coefficient of Police per 100,000 of Population	Adjusted R Squared
BASE	-0.0011* [0.0005]	0.01
Fractionalization Ethnic, Language	-0.0008* [0.0004]	0.01
Employees and Security Total Employees, Security Costs as a % of sales	-0.0012** [0.0005]	0.01
Corruption and Democracy Corruption (Transparency International), Polity 2 Score	-0.0011** [0.0005]	0.01
Female Population Proportion of Female Population	-0.0010* [0.0005]	0.01
Government Spending and Inflation Government Spending on Public Order & Safety, Government Consumption & Investment over GDP, Taxes over GDP, Inflation	-0.0020** [0.0009]	0.01
Trade Trade as a % of GDP	-0.0009* [0.0005]	0.01
Legal Origin Dummies for legal origins	-0.0011* [0.0005]	0.01
Settler Mortality Log of European Settler Mortality during Colonization	-0.0013* [0.0012]	0.01

TABLE A6: ROBUSTNESS – EXTREME OBSERVATION DOMINANCE

	Coefficient of Police per 100,000 Population
Dropping Extreme Crime Loss Observations	
Bottom 1%	-0.001* [0.001]
Top 1%	-0.001** [0.001]
Top and Bottom 1%	-0.001** [0.001]
Dropping Extreme Police Observations	
Bottom 1%	-0.001* [0.001]
Top 1%	-0.001** [0.000]
Top and Bottom 1%	-0.001** [0.000]

FIGURE 1: COUNTRY DOMINANCE, LESS THAN 1000 OBSERVATIONS