

Crime and Establishment Size: Evidence from South America

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February 2015

Abstract

We use the World Bank Enterprise Surveys to document that establishment-level crime is a frequent occurrence and one of the biggest obstacles to business operation in South America. To account for these facts we present a simple theory for the frequency and severity of crime across establishment size. Using establishment-level panel data on crime together with central predictions from our theory, we provide a plausible identification strategy to evaluate the effects of crime on a variety of measures related to establishment size. A high level of perceived crime is associated with a reduction in establishment sales, capital and labor in the range of 9 to 15 percent, and is robust to a variety of controls. We then evaluate the effects of crime across establishment size and relative to other distortions emphasized in the literature. Consistent with our theory, crime is most severe amongst mid-size establishments, and relative to other distortions, eradicating crime maybe one of the most important policy reforms for spurring development in South America.

Keywords: crime, misallocation, establishment-size

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1 Introduction

It is well documented that establishments in developing countries are smaller and less productive than establishments in developed countries (Banerjee and Duflo, 2005; Alfaro *et al.* 2008; Bartelsman *et al.* 2013). An established view is the (mis)allocation of factors used in production across heterogeneous producers is important for understanding these size and productivity differences (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009). Much of the literature has since focused on evaluating the macro implications of specific distortions that contribute to misallocation. In this paper, we focus on the importance of establishment-level crime in South America for explaining these size and productivity differences. In particular, our focus is to estimate the causal effects of crime on inputs used in production, output and their differential effects across establishment size using micro-level data.

We emphasize crime because it is highly prevalent in many developing countries and especially in South America. According to the Enterprise Surveys, over 40 percent of establishments in South America report that crime is a major obstacle to business operation. In fact, more establishments report that crime is a major obstacle to business operation than those who report access to finance, practices of the informal sector or tax administration are major obstacles. Moreover, there is considerable heterogeneity in crime across and within countries in South America. For instance, close to 70 percent of establishments in Brazil report crime is a major obstacle to business operation while in Peru it is 28 percent. Losses attributed to crime also vary considerably. In Brazil close to 40 percent of establishments report at least one incident related to crime in the previous year and average losses are about 7 percent of annual sales. The corresponding values in Colombia are 29 and 1.1 percent. We think the prevalence of crime have important implications for factors used in production, and thus establishment size and productivity. Specifically, when crime is prevalent, establishments have incentives to operate on a smaller scale and invest less (Svensson, 1998). Our goal is to provide a simple framework to analyze these effects and estimate its importance on establishment outcomes using micro-level data.

Our theory incorporates a channel for crime into an otherwise standard framework of heterogeneous establishments. In particular, establishments use capital in production and face an endogenous probability that a fraction of capital is lost due to crime. Establishments that use more capital in production are a bigger target for crime, however, they can lower the probability of facing crime by investing in private protection. Our theory predicts the fraction of capital lost due to crime is hump-shaped in establishment size. Put differently, mid-size establishments are more vulnerable to crime than small and large establishments. This is due to the role of private protection. Large establishments use lots of capital in production and find it profitable to invest in protection, lowering the likelihood of crime. In contrast, small establishments face minimal crime because they use little capital in production. Mid-size establishments are not adequately profitable to buy sufficient protection and lose the most from crime. Differences in the potential for crime generates heterogeneous responses in production whereby establishments strategically under-produce to minimize losses from crime. Our simple theory generates three testable predictions that can be validated empirically: 1) a high potential for crime lowers inputs used in production and establishment output, 2) private protection spending rises with establishment size and 3) crime has the biggest effect in lowering inputs/production amongst mid-size establishments.

To test our theory we use the World Bank Enterprise Surveys which contains micro-level data related establishment characteristics and major obstacles to business operation. Included is information related to arson, robbery, theft and vandalism which we interpret as crime. The dataset contains a variety of measures related to crime: has the establishment experienced crime in the past year, losses attributed to it, spending on private protection and a measure of crime perception (is crime is major, moderate, minor or non-obstacle to business operation). This is particularly relevant for our analysis because measures related to establishment size (including protection spending) and losses from crime are co-dependant variables determined within the model. An implication is that treating losses from crime as an independent variable on establishment outcomes generate biased estimates. We instead

side-step issues related to endogeneity and use an establishment's perception of crime, both as a current and lagged variable, to estimate its effects on sales, capital investment, labor demand and protection spending. Crime perception is a plausible exogenous variable to estimate the severity of crime, as is elaborated below, and we consider several specifications to ensure its validity.

Our estimates are broadly consistent with the central predictions of our theory and are robust to a variety of controls. Establishments that report high crime perception – those who report crime is a major or severe obstacle to business operation – spend more on protection and have lower sales, capital investment and labor demand. According to our preferred specification, which controls for country, industry and establishment-level fixed effects, high crime perception is associated with a 15 percent reduction in sales, 14 percent lower capital investment and 9 percent fewer full-time workers. Spending on private protection is 16 percent higher for those reporting high crime perception. We also evaluate the differential effects of crime perception on production across small, medium and large establishments. Consistent with our theory, medium size establishments are most burdened by crime. Our estimates imply that medium size establishments who report high crime perception reduce capital investment by 24 percent, hire 7 percent fewer full-time workers and have 23 percent lower sales. Corresponding results for small and large establishments are not statistically significant.

Our identification is based on the premise that crime perception is formed independently of actual experiences related to crime. While the correlations between these variables are low, we acknowledge the potential that losses from crime may influence an establishment's perception of crime, which thereby biases our estimates. To address this concern we consider two alternative estimation strategies: using crime perception from a previous period (lagged crime perception) and fixed-effects regressions. The premise underlying the former strategy is that lagged crime perception can affect current establishment decisions related to production, but current decisions have no potential to influence perception from a previous period. Thus,

lagged crime perception has an exogenous effect on current establishment decisions. Our estimates using lagged crime perception are consistent with our theory, predicting lower sales, capital investment and labor demand, though we lose some precision due to smaller sample size. For instance, based on our preferred specification, high lagged crime perception is associated with 22 percent lower capital investment, and for other specifications, investment falls in the range of 30 to 32 percent, sales in the range of 16 to 20 percent and labor in the range of 12 to 13 percent, consistent with our previous estimates using current-period crime perception. The fixed-effects regressions support these results also.

This paper is closely related to the literature that emphasizes the allocation of resources is important for understanding establishment size and productivity differences in poor countries (Restuccia and Rogerson, 2008; Guner *et al* 2008; Hsieh and Klenow, 2009 and Bartelsman *et al.* 2013). We highlight the importance of crime to show that establishments may strategically operate below optimal capacity in order to avoid losses from crime. Related is Ranasinghe (2014) and Ranasinghe and Restuccia (2015) who study extortion and crime using quantitative macro models that feature heterogeneous producers. Our results are complementary to theirs, though we use micro-level data to estimate the implied effects of crime on establishment production.

Several other papers in the literature have emphasized the effects of access to finance (Buera *et al.*, 2011), the informal sector (La Porta and Shleifer, 2014), corruption (Dusha, forthcoming) and transportation/entry barriers (Adamopoulos, 2011 and Moscoso Boedo and Mukoyama, 2012), as important distortions for understanding establishment underperformance in poor countries. Perception variables related to these distortions in the Enterprise Surveys together with our estimation strategy allow us to compare their importance relative to crime in South America. After controlling for the aforementioned distortions, crime remains one of the most important distortions for explaining establishment size differences, equally as important as the lack of access to finance and the informal sector. Our results indicate that improving the rule of law and eradicating crime maybe one of the most

pertinent policy prescriptions to foster establishment growth and expansion (Johnson *et al.*, 2002).

This paper is organized as follows. Section 2 provides micro-level evidence related to crime in South America and relative to other distortions. In Section 3 we present a simple model that incorporates a channel for crime and generates testable predictions that we take to the data. Section 4 outlines our empirical strategy and Section 5 describes the data source in detail. The effects of crime on establishment outcomes are presented in Section 6 and Section 7 provides concluding remarks.

2 Facts related to crime

The World Bank Business Environment and Enterprise Performance Survey (BEEPS) contains establishment-level data related to the major obstacles businesses face in their day to day operations. Included are questions related to crime: its frequency, losses attributed to it (as a percentage of sales and in absolute terms) and a ranking of its severity. We leave the discussion regarding the particulars of the dataset to a later section and focus on the key facts related to crime at the country-level to motivate our analysis. While crime related data is available for over 100 countries we restrict attention to crime in South America. We do this to limit institutional differences in our cross-country comparisons and because crime is most severe in this continent as we document.

Table 1 reports key measures related to crime in South America. Column 2 reports the percentage of establishments that report incidences related to arson, robbery, theft or vandalism on their premises in the past year (henceforth crime). This definition of crime is related to criminal activity and not petty crime (for example, theft of workplace stationary). Crime is a frequent occurrence in South America. In most countries, over 35 percent of establishments report incidences related to crime – Peru reports the least (24 percent of establishments) and Chile reports the most (48 percent of establishments). A high frequency

of crime however does not imply it is a severe constraint to business operation. To gauge whether crime is a severe obstacle to business operation, establishments are asked to rate whether crime is not a problem, a minor problem, a moderate problem, a major or severe problem.¹ The third column in Table 1 reports the fraction of establishments that report crime is a major or severe (henceforth major) obstacle to business operation. In most South American countries, well over 30 percent of establishments report that crime is a major obstacle to business operation, with values as high as 60 and 70 percent in Venezuela and Brazil. To put these numbers in context, the fraction of establishments that report crime is a major obstacle in Germany, Korea and Ireland (three developed countries in the dataset) range from 1 to 5 percent. Finally, column 4 reports average losses from crime as percentage of sales for all establishments and column 5 reports this same statistic for establishments that experienced crime. Losses due to crime is a non-trivial share of sales, especially among those establishments that experienced crime. For example, in Ecuador, average losses as percentage of sales for establishments that experience crime is 3.4 percent, and for the country as whole it is 1 percent.

Crime is a frequent occurrence, a major obstacle to doing business and a non-trivial share of sales in South America. Next, we ask whether crime is one of the main problems for doing business in South America or simply one of the myriad problems that plagues development in this region. Some of the standard constraints for business performance include access to finance, obtaining licences and permits and functioning of the courts.² The Enterprise Surveys contain data on these distortions which allow us to assess the severity of these constraints (access to finance, permits and courts) relative to crime. Specifically, and similar to the case for crime, establishments are asked to rate whether access to finance, permits and

¹To be precise, establishments are asked to rate whether crime, theft and disorder is a constraint to doing business. We interpret this question as mainly related to crime since it follows immediately after questions pertaining to crime in the survey.

²See for example Banerjee and Duflo (2005) and Restuccia and Rogerson (2008) for a broad discussion related to the obstacles to doing business. See Buera *et al.*, (2011), Midrigan and Xu (2014), Dusha (2014), Mosco-Boedo and Mukoyama (2009), Ranasinghe (2014) and Guner *et al.* (2008) for a macro perspective arising from these business obstacles.

Table 1: Crime across South American Countries

Country	Incidence of crime (% of establishments)	Major obstacle (% of establishments)	Avg. losses (% of sales)	Avg. losses (if > 0) (% of sales)
Argentina	33	29	0.6	2.0
Bolivia	31	45	0.8	3.5
Brazil	38	69	2.5	6.9
Chile	48	38	0.8	1.7
Colombia	29	33	0.3	1.1
Ecuador	31	35	1.0	3.4
Guyana	43	36	1.0	2.5
Paraguay	39	37	1.3	3.7
Peru	24	28	0.6	2.8
Uruguay	38	35	0.3	1.1
Venezuela	44	59	1.4	3.6

The second through fifth columns report the fraction of establishments that report incidences related to crime in the past year, the fraction of establishments that report crime is a major obstacle to business operation, average losses due to crime as percentage of sales for all establishments and lastly, average losses due to crime as percentage of sales for those establishments that report facing crime. All country statistics is from 2010 except for Brazil which is from 2009 (BEEPS, World Bank).

functioning of the courts are a major, moderate, minor or non-obstacle to doing business. Table 2 reports the fraction of establishments that report a given distortion is a major obstacle to business operation. In South America, a high percentage of establishments report that access to finance, permits and functioning of the courts are major obstacles to business operation. However, more establishments report crime as major obstacle to doing business than finance, permits and courts in 7 of the 11 countries, and often by a wide margin. In particular, in 9 of the 11 countries a higher percentage of establishments report crime as a major obstacle to business operation than access to finance. While other distortions have been emphasized in the literature, these descriptive statistics suggest that crime maybe one of the most important distortions for understanding establishment under-performance in South America. We also examine two often cited constraints to business performance in developing countries: tax rates and corruption. As a major obstacle to doing business, crime is on par with tax rates. In fact, in 6 of 11 countries, a higher percentage of establishments report crime is a major obstacle to doing business than those who report tax rates are.

Table 2: Major obstacles to doing business

Country	(percentage of establishments)			
	crime	Finance	Permits	Courts
Argentina	29	44	21	44
Bolivia	45	29	13	35
Brazil	69	45	48	45
Chile	38	18	8	13
Colombia	33	41	11	24
Ecuador	35	19	18	42
Guyana	36	18	13	22
Paraguay	37	20	23	27
Peru	28	9	20	29
Uruguay	35	16	8	12
Venezuela	59	9	23	30

This Table reports the fraction of establishments that respond that a given item is a major obstacle to business operation. These items are (columns 2 through 5) crime, access to finance, obtaining business licences and permits, and the functioning of the court system.

Corruption, however, appears to be one of the biggest obstacles in South America. In 8 of 11 countries, a higher percentage of establishments list corruption as a major obstacle than crime. Nonetheless, we view crime as one of the features underlying corruption and as the preceding two tables show, crime is one of the major obstacles to business performance.

Given the severity of crime in South America, we consider how this may affect business performance. According to the data, not all establishments face crime, and for those that do, the amount lost due to crime varies considerably both across and within countries. Our focus is to examine how crime affects production at the establishment-level and if there are systematic patterns across establishment size. Are large establishments equally likely to experience crime as smaller establishments? And contingent on experiencing crime, how do losses from crime vary by size? Depending on these answers, crime may have important implications for production and for understanding misallocation across establishments. The micro-level data related to crime provided in the Enterprise Surveys are ideal for analyzing the causal effect of crime on production and for evaluating whether there are heterogeneous

effects across size. To do this, we present a simple theory of crime on establishment behavior that will serve useful guide for our empirical analysis.

3 Model

To guide the empirical analysis that follows, we incorporate a channel for crime into an otherwise standard model of heterogeneous establishments that produce a homogeneous good. The decisions facing an establishment is presented first, followed by the decision of an exogenous illegal group (mafia) that can expropriate capital from an establishment. In the model, we focus on a static setting as it more naturally relates to the empirical analysis that follows. Moreover, we assume perfectly competitive markets and introduce crime as the only source of friction in the economy to highlight the importance of this channel.

3.1 Environment

Establishments are heterogenous in productivity, $s_i \in S$, and produce a homogeneous good y . We assume a standard production function for output of the following form: $y_i = s_i k_i^\alpha$, $0 < \alpha < 1$, k_i is the amount of capital used and y_i is the amount of output by an establishment of productivity s_i (we abstract from labor for simplicity).

Next, we allow for the possibility that some fraction of the establishment's output is expropriated by the mafia, which is determined endogenously in the model. There are two factors that affect the likelihood an establishment faces crime: 1) the level of property rights which is economy specific and common across all establishments within an economy and 2) the amount of private protection the establishment buys (paid in units of output), which can vary across establishments within an economy. The probability that a establishment faces expropriation is $1 - F(\lambda, p_i) \in (0, 1)$, where λ is a measure of property rights that is economy specific and p_i is the protection a establishment of type s_i buys. We refer to $F(\lambda, p_i)$ as a establishment's effective rate of protection (ERP). When $F(\lambda, p_i) = 1$, which can occur

if property rights are very high or if the establishment invests in sufficient protection, the establishment does not face crime. In what follows, we assume a functional form for $F(\cdot)$ that is increasing in both arguments; that is, holding all else constant, higher levels of property rights or buying more protection lowers the likelihood of facing crime.

3.2 Establishment and mafia decisions

The static problem for a establishment of type s_i is to choose the amount of capital in production together with the amount of private to protection to buy to maximize profits. The mafia, in turn, observes the decisions made by the establishment and chooses a fraction of output to expropriate. Timing wise, the establishment moves first followed by the mafia. Therefore, production and protection decisions by the establishment are made in anticipation of the response by the mafia. Specifically, the problem for an establishment of type s_i is

$$\begin{aligned}\tilde{\pi}_i &= \max_{k_i \geq 0, p_i \geq 0} F(\lambda, p_i) (s_i k_i^\alpha - r k_i) + (1 - F(\lambda, p_i)) ((1 - e_i) s_i k_i^\alpha - r k_i) - c(p_i), \\ &= \max_{k_i \geq 0, p_i \geq 0} \pi_i - e_i y_i (1 - F(\lambda, p_i)) - c_p(p_i).\end{aligned}\tag{1}$$

Equation (1) states that with a probability $F(\lambda, p_i)$ the establishment does not face crime and receives their full profit from production ($\pi_i = s_i k_i^\alpha - r k_i$), and with a probability $1 - F(\lambda, p_i)$ the establishment faces crime and retains a fraction $1 - e_i$ of output, where e_i is share of output that is expropriated, less the costs of renting capital. $c_p(p_i)$ is the cost of buying protection which is assumed to be increasing in p . In essence, the establishment chooses capital and protection to maximize expected profit from production. The level of property rights λ is exogenous and the establishment can affect the likelihood of facing crime only through buying protection. The expression in (1) simplifies to imply the establishment earns their entire profit from production less the amount of output that is expropriated ($e_i y_i$), which occurs with a probability $1 - F(\lambda, p_i)$. Notice, when property rights are perfect there is no opportunity for crime – a scenario when $F(\lambda, \cdot) = 1$. In this instance, the problem for the

establishment becomes a standard one of choosing capital to maximize profits, the first-best scenario.

Next, we describe the decision of the mafia. For simplicity, we assume a stand-in mafia with monopoly power that can expropriate output from all establishments in the economy.³ The mafia has full information concerning how much output the establishment produces and how much protection is bought, and optimizes by choosing how much to expropriate from each establishment. Specifically, the problem for the mafia is given by

$$\Pi_{mi} = \max_{e_i \geq 0} (1 - F(\lambda, p_i)) e_i y_i - c_e(e_i) \quad (2)$$

The expression in (2) accounts for the fact the mafia expropriates an amount $e_i y_i$ from a establishment of type i and this occurs with a probability $(1 - F(\lambda, p_i))$. With a probability $F(\lambda, p_i)$ crime is unsuccessful which has a return equal to zero.⁴ $c_e(e_i)$ is the cost associated with crime which we assume is increasing in e_i – when a higher fraction of output is stolen, more resources must be spent by the mafia to successfully complete the task.

We can now discuss the partial equilibrium implications for establishment-level production. Solving (1) a establishment's optimal capital demand and production is

$$k_i^* = \left(\frac{\alpha s_i}{r} \right)^{\frac{1}{1-\alpha}} (1 - [1 - F(\lambda, p_i)] e_i)^{\frac{1}{1-\alpha}}, \quad (3)$$

$$y_i^* = \left(\frac{\alpha s_i}{r} \right)^{\frac{\alpha}{1-\alpha}} (1 - [1 - F(\lambda, p_i)] e_i)^{\frac{\alpha}{1-\alpha}}, \quad (4)$$

where the term for output was obtained using the given production function. Notice, in an environment that has perfect property rights (where $F(\lambda, \cdot) = 1$ and there is no opportunity for crime), establishment i 's production and capital demand is undistorted and at the first-best level (i.e. $k_i^* = \left(\frac{\alpha s_i}{r} \right)^{\frac{1}{1-\alpha}}$ and $y_i^* = \left(\frac{\alpha s_i}{r} \right)^{\frac{\alpha}{1-\alpha}}$). When property rights are such that

³Typically, there can be several individuals or groups that engage in crime. For our purposes, and in particular the empirical analysis that follows, what matters is total crime a establishment encounters and so we abstract from having multiple groups that expropriate.

⁴We abstract from the possibility that unsuccessful expropriation can lead to an additional cost to the mafia (e.g. fines or jail time) since there is no data to guide our analysis.

crime is possible, an establishment's production will be adversely affected. In fact, assuming a functional form for $F(\lambda, p_i)$ that is increasing in both arguments, our theory makes two key predictions:

- (i) $\frac{dy_i}{dh_i} \leq 0$ where $h_i \equiv [1 - F(\lambda, p_i)]e_i$. An establishment will reduce production if expected crime rises.
- (ii) $\frac{dy_i}{d\lambda} \geq 0$. Higher property rights are associated with increased production.

These results are analogous for establishment capital demand as well. In our empirical analysis we test for the validity of these predictions and pay particular attention to prediction (i), which highlights the main emphasis of the paper: how crime affects production. The term h_i captures this reasonably well and consists of two terms. The first is the probability of facing crime and the second is the fraction of output that will be lost contingent of facing crime. The product of these terms h_i is how much the establishment expects to lose from crime for a given amount of output, what we refer to as 'perceived crime'. Notice, this perception, or expectation, will vary across establishments within and across countries: within countries due to differences in establishment expenditure on protection and across countries due to differences in property rights. Put differently, establishments that buy more protection or operate in economies with higher property rights will have a lower expectation of facing crime, a prediction we test in Section 6. In fact, additional assumptions related to the functional forms allow us to obtain additional predictions from the model, particularly in relation to how perceived crime varies across establishment size, and will serve as additional tests to validate the model. We turn to this next.

3.3 Equilibrium

We have examined the partial equilibrium implications of crime on establishment production. We now examine the equilibrium outcomes implied by the model. To this end, we take a stance on the functional form for the ERP (probability of not facing crime) $F(\lambda, p_i)$, the cost

of buying protection $c_p(p_i)$ and the cost associated with crime for the stand-in mafia $c_e(e_i)$.

Property rights are modelled as a probability with which the state can prevent crime, i.e. $\lambda \in (0, 1)$. Economies with higher property rights have better policing and legal institutions in place which make crime related activity less likely to succeed. We assume the probability a establishment does not face crime is $F(\lambda, p_i) = \lambda + \lambda p_i^\theta$, where $\theta > 0$ and $p_i \in [0, \bar{p}]$. This particular functional form satisfies three convenient properties.⁵ First, and a stance we have already taken, an establishment's ERP is increasing in both property rights and protection expenditure. Second, property rights and protection are complimentary goods. This is to say, protection is more effective towards reducing the likelihood of crime when property rights are higher, and vice versa.⁶ Third, the functional form implies that $F(\lambda, 0) = \lambda$ and $F(0, p_i) = 0$. The latter implies that if property rights are non-existent ($\lambda = 0$), protection is ineffective towards reducing crime, and the former implies that the minimum ERP a establishment has is the property rights provided by the state.

For the cost functions related protection and crime, we assume $c_p(p_i) = bp_i^\psi/\psi$ and $c_e(e_i) = ae_i^\rho/\rho$.

With these functional forms in place, we are now in a position to solve for equilibrium crime and protection across establishments. Noting the timing of events, establishments choose capital and protection anticipating the mafia's best-response. If $\theta = \frac{\psi(\rho-1)}{\rho}$, a closed form solution for the fraction of output expropriated and protection bought in equilibrium exists, and is given by

$$e_i = \left(\frac{(1-\lambda)y_i}{a + \chi^{\rho-1}\lambda^\rho y_i^\rho} \right)^{\frac{1}{\rho-1}}, \quad (5)$$

$$p_i = \left(\frac{\chi^{\rho-1}\lambda^{\rho-1}(1-\lambda)y_i^\rho}{a + \chi^{\rho-1}\lambda^\rho y_i^\rho} \right)^{\frac{1}{\theta}}, \quad (6)$$

⁵We have also considered alternate functional forms. The central predictions from the model are consistent as long as the ERP is increasing in both arguments and complimentary.

⁶Economies with higher property rights have better legal institutions, more effective policing and judicial systems, and are less prone to corruption/bribery, which make protection all the more effective towards reducing the likelihood of crime.

where $\chi = \frac{\theta}{b} \frac{\rho}{\rho-1}$ and $p_i < \bar{p}$. Moreover, if $\rho > 1$, Equation (5) and (6) lead to the following two propositions:

Proposition 1: *When $\lambda < 1$, protection expenditure is increasing in output and larger establishments (as measured by output) are less susceptible to crime.*

Proposition 2: *When $\lambda < 1$, but not too close to zero, crime is hump-shaped in establishment output. There is an output threshold $y(\lambda)$, such that crime is increasing in output if $y_i \leq y(\lambda)$ and decreasing otherwise. This output threshold is decreasing in property rights (i.e. $\frac{dy(\lambda)}{d\lambda} \leq 0$). Moreover, combined with Proposition 1, this implies that expected losses from crime are also hump-shaped in output..*

These two propositions are related to the size of an establishment (measured in output). The first proposition states that establishments that have higher output spend more on protection and become less susceptible to crime. The second proposition states the fraction of output expropriated is hump-shaped in output. That is to say, the highest fraction of output expropriated occurs among medium-size establishments. In fact, expected losses from crime (either $[1 - F(\lambda, p_i)]e_i$ or $[1 - F(\lambda, p_i)]e_i$) are also hump-shaped in output (as long as λ is not too close to 0). Our theory predicts that medium-size establishments are most affected by crime, more so than small or large establishments. This is because small establishments have little output to expropriate and large establishments buy sufficient protection which limits crime. and minimize crime. In the analysis that follows we test for the validity of these predictions.

4 Empirical strategy

Two central predictions from the model presented in Section 3 is that crime induces establishments to operate on a smaller scale and its severity varies across measures related to

establishment size. We now introduce our main empirical specification to test this theory. Our estimating equations are versions of (3) and (4), which imply output, capital and labor are positively related to protection spending and establishment specific productivity factors, and negatively related to crime. It is clear from the model that output, capital/labor, protection and crime are endogenous variables which makes identifying the causal effect of crime on establishment outcomes challenging. We therefore work under a simpler premise and estimate the effects of ‘crime perception’ on establishment outcomes of interest. As noted earlier, establishments are asked to rate whether crime is not an obstacle, a minor obstacle, a moderate obstacle, a major obstacle or a severe obstacle to business operation. We define crime perception as an indicator-variable that is equal to one if an establishment reports crime is a major or severe obstacle to business operation. Our estimating equation is

$$\ln(y_{ijk}) = \beta_1 s_{ijk} + \beta_2 cp_{ijk} + X_j + Z_k + \epsilon_{ijk} \quad (7)$$

where y_{ijk} is an outcome of interest – establishment output/sales, labor, capital investment or protection spending – for establishment i in country j in industry k , s_{ijk} are establishment specific characteristics to proxy productivity, cp_{ijk} is an indicator for establishment crime perception, X_j are for country-level fixed effects and Z_k are for industry-level fixed effects. The variable of interest is cp_{ijk} . Based on the model we expect that β_2 is negative and in particular, that β_2 has a larger negative value for mid-size establishments than small and large establishments.

As highlighted in the model, protection spending, output and losses from crime are co-dependent variables. Obtaining reasonable instruments for crime and protection at the establishment-level within the confines of the dataset are not feasible. Hence, we side-step the issue of identification by using crime perception as the independent variable of interest instead of realized losses from crime. In fact, crime perception is ideal because it captures an establishment’s belief, or perception, that crime affects their business operation, irrespective of whether they have faced crime, allowing us to isolate the full effect of crime on establish-

ment outcomes.⁷ Our estimation strategy is plausible and unbiased if crime perception is not related to establishment losses from crime – that is, if an establishment’s own experience of crime does not influence whether they report if crime is a major or severe obstacle to business operation (crime perception). In the data, the correlation between crime perception and whether an establishment experienced crime is 0.15, and the correlation between crime perception and losses attributed to crime is 0.05. This is suggestive evidence that an establishment’s perception of crime maybe primarily driven by other factors – friends/family experiences with crime, media coverage, cultural norms, for example – and less so by actual losses they have experienced due to crime. In this case cr_{ij} would serve as a reasonable proxy to measure the perceived effects of crime on establishment outcomes.

While the above framework serves as our main empirical framework, we recognize the potential that crime perception can be influenced and formed by an establishment’s own experience with crime. Therefore, we estimate the effects of *lagged* crime perception on establishment outcomes. In particular, we use panel data for years 2006 and 2010 (though it comes at the cost of sample size) and estimate the effect of establishment crime perception in 2006 on outcome variables in 2010. The underlying motivation is that while crime perception in 2006 can be related to crime in that year, it should have no effect on establishment-level crime in 2010. By using lagged crime perception as a regressor we are estimating the effect of crime perception from a previous period on current establishment outcomes. A limitation of this approach is the time-lag in the data spans four years. It is plausible that more recent incidences related to crime, within the four year span, may alter establishment perception of crime and decisions relating to capital and production. Nonetheless, we think that using both lagged and current crime perception are reasonable to understand its effects on establishment behaviour.

⁷For example, an establishment may reduce purchases if they anticipate a high likelihood of crime (crime perception) even though they may not have experienced incidents related to crime. In this case, crime perception is preferred because it captures the wider effects of crime that actual losses from crime fail to account for.

5 Data

5.1 Enterprise Survey

We use data from the Business Environment and Enterprise Performance Survey (BEEPS) by the World Bank. The data is collected via face-to-face interviews, typically with the manager, with a view to understand the major obstacles establishments face in their day-to-day operation. A convenient feature is the survey is administered in a similar form across Africa, Eastern Europe and South America which allows for suitable comparison. Nonetheless, we restrict our empirical analysis to countries in South America to limit variation in institutional and cultural differences. The initial rollout of the survey was conducted in 2006 with subsequent rollouts conducted within a three-year span. To be comparable across countries we use the 2006 survey.

The dataset includes establishments in manufacturing, service and other sectors (mostly construction and transport). The manufacturing sector accounts for over 50 percent of establishments and the service sector accounts for more than 20 percent. About 85 percent of businesses are stand-alone (i.e. do not belong a larger establishment). Included is general data specific to the establishment as well as more specific data related to business impediments the establishment faces. General information includes the year the establishment was formed, number of employees when established, manager experience in the industry and legal status. We think of these as characteristics specific to the establishment. Data related to annual sales, cost of labor, cost of capital and the more standard questions related to production are included. We use sales as a proxy for output. The dataset provides further details relating to infrastructure (section C), sales and supplies (section D), capacity and use (section F), the role of courts and crime (section H and I), business and government relations (section J), finance (section K) and labor (section L). This includes measures of distortions specific to the establishment.

5.2 Data on crime, protection, capital and measures of distortions

A unique feature of the data, and particularly useful for our purposes, is that it contains information related to crime at the establishment-level. There are two main questions in regards to this: in fiscal year X, has this establishment experienced losses as a result of theft, robbery, vandalism or arson (yes/no question) and, in fiscal year X, what are the estimated losses from theft, robbery, vandalism and arson that occurred on the establishment's premises (either as percentage of annual sales or total value of losses). From this information we know who experienced crime in a given year and the losses attributable to it. Also included in the survey is a broader question relating to crime: is crime, theft and disorder not an obstacle, a minor obstacle, a moderate obstacle, major obstacle or a very severe obstacle to the operation of this establishment. The survey also contains two questions related to private protection: In fiscal year X, did this establishment pay for security, for example equipment, personnel or professional security service? and, in fiscal year X, what percent of total annual sales is paid for security, or what is the total cost of security? This information tells us who spends on security and how much.

For the value of capital we use the total value of the establishments machinery, vehicles, equipment, building and land value.⁸ We include building and land value in capital because they signal profitability and subject to acts of arson or vandalism. There are several measures of capital value. They include net-book value, replacement cost and last years expenditure on capital. We use the replacement cost of capital as it naturally relates to the value a criminal group would obtain from crime.

A further convenience of this dataset is it includes a variety of questions related to distortions establishments encounter. We focus on several of them relevant to our analysis, in particular whether the practices of competitors in the informal sector, functioning of the courts and access to finance are not an obstacle, a minor, moderate, major or very severe obstacle to business performance. We use these measures of distortions in conjunction with

⁸We exclude establishments that do not use (or report) capital in production or those who do not report sales values.

our measure of distortions related to crime to evaluate the contribution of each in influencing establishment-level production.

6 Results

We begin by presenting the effects of crime perception on measures related to establishment size. We then account for the possibility that crime perception itself maybe dependant on establishment size and report the effects of lagged crime perception on establishment size measures. Finally, we report the effects of crime perception relative to other perceived distortions at the establishment-level that are emphasized in the literature – in particular, access to finance, tax administration/rates, practises of the informal sector, transportation development – to evaluate the relative importance of crime on establishment size in South America.

6.1 Effects of crime perception

Table 3 reports estimates of crime perception, the coefficient β_2 from equation 7. Reported are the effects of crime perception on four dependant variables related to measures of establishment size: sales, labor (number of full-time employees), capital (current expenditures) and protection spending, all in logs. In column (1) we include only country fixed effects; in column (2) we add industry fixed effects and in column (3) we include establishment specific controls.

The point estimates of crime perception on establishment sales, labor and capital are negative and significant. According to our preferred specification, column (3), crime perception is associated with a 15, 9 and 14 percent reduction in sales, labor demand and capital expenditures. That is to say, establishments who report crime is a major or severe obstacle to business operation, on average have lower sales, hire fewer workers and spend less on capital. Crime perception has a lower effect on labor primarily because it is measured in

employees while sales and capital are based on dollar values. When we use log annual cost of labor as the dependant variable, the coefficient on crime perception is -0.187 , similar to estimates for sales and capital. When protection is the dependant variable the coefficient for crime perception is positive, consistent with our theory, but is significant only in column (3). Our baseline estimates imply crime perception has large negative effects related to measures of establishment size in South America in the range of 9 to 20 percent. Given that close to one-third of establishments have a non-zero value for crime perception, this implies aggregate output losses in the range of 3 to 7 percent relative to a crime-free economy (Ranasinghe, 2014; Ranasinghe and Restuccia, 2015).⁹

A central prediction from our theory in Section 3 is the severity of crime is heterogeneous across size and most prominent amongst mid-size establishments. For example, the fraction of capital lost due to crime is initially rising in establishment capital and falls after passing a critical threshold. We now test the validity of this prediction. We re-run the specification in column (3) – controlling for country, industry and establishment specific effects – separately for small, medium and large establishments. The definition for size is from the Enterprise Survey which classifies an establishment as small, medium or large if the number of full-time employees is between 5 to 19, 20 to 99 and greater than 99. Based on our theory, we expect the coefficient on crime perception, β_2 , to be larger (more negative) for mid-size establishments relative to small and large establishments when sales, labor and capital are dependant variables. For protection expenditure, we expect that β_2 is positive and increasing in size. Higher crime perception should lead to a larger response in protection expenditure for large establishments since they have more to lose from crime.

Table 4 reports the results from the estimation for the four dependant variables in consideration. The coefficient for crime perception is negative and significant for mid-size establishments, but is positive and non-significant for small and large establishments, which is

⁹Treating sales as output, crime lowers output 15 percent for one-third of establishments. Relative to an undistorted economy and absent any effects along the extensive margin, this implies output losses of about five percent ($1 - 0.33 \times 0.15$).

broadly in-line with the predictions from our theory. When sales and capital are dependant variables the coefficient for crime perception for mid-size establishments is higher than the estimates when all establishments are considered (see Table 3). This implies that crime is especially severe amongst mid-size establishments and leads to larger reductions in capital expenditure and sales than otherwise predicted. Also relevant is that higher crime perception is associated higher capital expenditure in the range of 8 to 18 percent for small and large establishments, though it is not statistically significant. A potential explanation is that large establishments have adequate resources to spend on protection and their decisions pertaining to capital are less affected by crime. Finally, the coefficient for crime perception is positive across all establishment size specifications when protection is the dependant variable, however, the coefficient is smallest for mid-size establishments. A unified interpretation of these results is mid-size establishments lower their measures of size to reduce losses from crime instead of raising protection spending, while large establishments increase protection spending to negate losses from crime and do not alter decisions related to size .¹⁰

6.2 Lagged crime perception

Our results are based on the premise that crime perception affects measures related to establishment size but not the other way around. While we provide suggestive evidence that this is indeed the case, it remains plausible that measures of establishment size can in fact influence crime perception. To account for this we exploit establishment-level panel data in the Enterprise Surveys and use *lagged* crime perception as the independant variable of interest. Specifically, we evaluate the effects of crime perception in 2006 on establishment outcomes in 2010. The underlying premise is that lagged crime perception is one-directional: crime perception in 2006 can influence future establishment outcomes (in 2010), but these establishment outcomes would have no bearing on past crime perception (lagged).

¹⁰To verify this interpretation we include protection spending as a control and evaluate crime perception on capital across small, medium and large establishments. Notwithstanding issues related to endogeneity, once we control for protection expenditure the coefficient for crime perception becomes smaller and negative for small and large establishments.

Table 5 presents the point estimates of lagged crime perception on establishment sales, labor, capital and protection. We consider three specifications, the first which controls for country-level controls, the second adds industry-level controls and the third adds establishment specific controls, similar to before. The coefficient on crime perception is uniformly negative across all dependant variables examined but not statistically significant in all instances. Lagged crime perception is negative and significant for all dependant variables in the first specification (only country-level controls) and significant for labor and capital when industry-level controls are added. However, for our preferred specification – which controls for country, industry and establishment-level controls effects – crime perception is negative and significant only for capital. Much of this is driven by sample size. When using establishment-level panel data the sample size falls by over 2/3 (from over 6000 observations to 1800 when sales and labor are dependant variables, and from over 3500 observations to about 1150 when capital and protection are dependant variables). This is particularly relevant since we have nine country controls and over 30 industry-specific controls that affect statistical significance. Nonetheless, the coefficients for crime perception are similar to those from our previous estimates reported in Table 3. Lagged crime perception lowers sales in range of 8 to 20 percent, lowers labor demand by 6 to 13 percent and capital expenditure by 21 to over 30 percent (which is higher than before).

Given the data limitations, we re-estimate the results of lagged crime perception on establishment outcomes using a much coarser classification of industry: manufacturing, services and other.

6.3 Crime and other establishment-level distortions

As the preceding sections shows, crime perception is associated with substantial negative effects on establishment outcomes, lowering capital, for example, in the range of 20 percent. While crime is a severe problem in South America, it is merely one distortion among myriad distortions establishments face in day-to-day operations. Several of these distortions include

functioning of the courts system, access to finance, practises of the informal sector, tax rates, transportation/roads and corruption, among others. For instance, access to finance is identified as a major impediment to business expansion and operation (Banerjee and Dufflo, 2012; Buera *et al.* 2014). Likewise, the informal sector can be a drag on formal establishments (D’Erasmus and Moscoso Boedo, 2012; La Porta and Shleifer, 2014), corruption in the form of paying-off bureaucrats to obtain permits can limit growth potential (Dusha, forthcoming), high barriers to entry including transportation development can distort selection (Adamopoulos, 2011; Gollin and Rogerson, 2014; Moscoso Boedo and Mukoyama, 2012) and high tax rates can impede growth (Gollin, 2006). While crime is a severe distortion, it naturally follows to ask how severe a distortion is crime relative to these distortions that have received much attention in the literature.

Ideal for our analysis is the Enterprise Survey provides comparable data on these distortions which allows us to tackle this question. In particular, establishments are asked, across a wide-array of specific distortions, to report whether a given distortion is a severe, major, moderate, minor or non-obstacle to business operation. We focus on functioning of the courts system, access to finance, the informal sector, tax rates, transportation and corruption, which have been analyzed in the literature, and examine their effects on establishment outcomes relative to those for crime. We define ‘perception’ variables for these distortions similar to crime perception; for example, we set ‘courts perception’ equal to one if an establishment reports the functioning of the courts is a major or severe obstacle to business operation, and zero otherwise. We then re-estimate equation 7 by including these additional ‘perception’ distortions together with crime.

Table 6 reports the effects of each of these perceptions (non-lagged) on sales, labor, capital and protection, after controlling for country, industry and establishment specific controls as before. There are several key results that stand-out. Crime, finance and informal sector perception negatively affects sales, labor and capital, while functioning of courts and transportation positively affects these dependant variables and protection. We discuss the

implications of each these in turn.

Crime perception is associated with an 18 percent reduction in sales and capital, and a 8 percent reduction in labor demand. Importantly, the coefficients for crime are larger after controlling for these additional distortions than those reported in our baseline estimates (Table 3, column 3). Finance perception, which are establishments who report access to finance is a major or severe obstacle to business operation, is associated with a 22 and 10 percent reduction in sales and labor. The coefficients on finance perception for sales and labor are larger than those for crime perception, but not by much. Our results imply that crime is an equally important obstacle to business operation, at least in South America. Given that improving access to finance is a policy tool for development emphasized across the literature, our results suggest that policies that aim to lower crime can be an equally important for spurring enterprise as well. In fact, when capital is the dependant variable the coefficient on crime perception is twice as large (and significant) than the coefficient on finance perception (-0.18 and -0.09). One explanation is that establishments choose not to expand, particularly invest in capital, when crime is prevalent and are therefore not overly constrained by the lack of access to finance (Johnson *et al.*, 2002; Ranasinghe and Restuccia, 2014). The coefficients for informal sector perception are negative, lowering sales and labor in the range of 16 and 6 percent; lower than the coefficients for crime and finance, but substantial nonetheless. We also re-estimate the effects of these ‘perceptions’ separately for small, medium and large establishments. A general trend from these estimates are that crime is most problematic amongst medium size establishments and access to finance is most problematic amongst large establishments.

Also of interest is the coefficients for courts and transportation perception are uniformly positive (and significant in all but one instance) across the four dependant variables. That is to say, establishments that view the functioning of the courts or transportation as a major or severe obstacle to business operation on average have higher sales, labor, capital and protection. Moreover, the coefficients are large – courts and transportation perception in-

creases sales by 33 and 25 percent. This maybe due to courts and transportation picking-up establishments that patent, innovate and/or export; essentially high growth establishments. However, since we control across 30 industries it is not clear which effects are being isolated. We also re-estimate by controlling for export status, spend on R&D, and as well across small, medium and large establishments, however, we do not find systematic patterns to suggest a particular view.

7 Conclusion

In this paper, we document that crime is a frequent occurrence and one of the biggest obstacles to doing business in South America. To account for the effects of crime we present a simple theory to highlight that establishments strategically under-produce in order to mitigate the losses from crime. Our theory implies that losses from crime and establishment size are co-dependant variables, and also generates testable predictions that we validate against the data. We use crime perception as a plausible exogenous measure for crime and show that our results are robust to variety of controls and specifications. Crime lowers sales and capital investment in the range of 13 to 15 percent, and labor by 9 percent. Consistent with our theory, crime is most problematic amongst medium size establishments. We also evaluate the importance of crime relative to other distortions emphasized in the literature, notably access to finance, the informal sector and corruption. Our results confirm that crime is one of the biggest obstacles to business performance and eradicating crime may be one of the more relevant policy reform for spurring development.

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Table 3: Effect of crime perception on establishment outcomes

	(1)	(2)	(3)
Dependant: sales (logs)			
crime perception	-0.213*** (0.0620)	-0.208*** (0.0612)	-0.148** (0.0585)
Observations	6032	6032	6032
Dependant: labor (logs)			
crime perception	-0.159*** (0.0330)	-0.134*** (0.0325)	-0.087*** (0.0291)
Observations	6031	6031	6031
Dependant: capital (logs)			
crime perception	-0.216*** (0.0809)	-0.193** (0.0800)	-0.135* (0.0775)
Observations	3685	3685	3685
Dependant: protection (logs)			
crime perception	0.100 (0.0881)	0.093 (0.0867)	0.161* (0.0835)
Observations	3685	3685	3685
Country-level controls	Y	Y	Y
Industry-level controls	N	Y	Y
Establishment specific controls	N	N	Y

Notes: This table reports the estimates of crime perception on establishment sales, labor (number of full-time employees), capital expenditure (in the given year) and protection expenditure, in logs. Each cell reports the point estimates from a separate regression. Crime perception is an indicator for whether an establishment reports that crime is a major or severe obstacle to business operation. establishment-specific controls are related manager experience, number employees at inception, if formally registered at inception and if the establishment is part of a larger establishment. ***, **, * denote significance at the 1, 5 and 10 percent level. The R^2 for specification (3) is 0.4 for sales and capital, 0.25 for labor and 0.31 for protection.

Table 4: Effect of crime perception on establishment outcomes, by size

	Dependant variable (in logs)			
	Sales	Labor	Capital	Protection
Sample: small establishments				
crime perception	0.0213 (0.0741)	0.007 (0.0246)	0.078 (0.1085)	0.358*** (0.1022)
Observations	2668	2668	1317	1317
Sample: mid-size establishments				
crime perception	-0.228*** (0.0763)	-0.073*** (0.0263)	-0.241** (0.1057)	0.134 (0.1223)
Observations	2407	2407	1613	1613
Sample: large establishments				
crime perception	0.005 (0.1358)	-0.045 (0.0644)	0.181 (0.1829)	0.299 (0.2012)
Observations	957	957	755	755
Country-level controls	Y	Y	Y	Y
Industry-level controls	Y	Y	Y	Y
Establishment specific controls	Y	Y	Y	Y

Notes: This table reports the estimates of crime perception on establishment sales, labor (number of full-time employees), capital expenditure (in the given year) and protection expenditure, for small, medium and large establishments. Each cell reports the point estimates from a separate regression. An establishment is small, medium or large if the number of employees is between 5 to 19, 20 to 99 or greater than 100, respectively. Crime perception is an indicator for whether an establishment reports that crime is a major or severe obstacle to business operation. ***, **, * denote significance at the 1, 5 and 10 percent level. The R^2 for each of the regressions related to sales, capital and protection are above 0.3. The R^2 when labor is the dependant variable has a range from 0.08 – 0.18.

Table 5: Effect of lagged crime perception on establishment outcomes

	(1)	(2)	(3)
Dependant: sales (logs)			
Lagged crime perception	-0.196*	-0.157	-0.080
	(0.1102)	(0.1087)	(0.1037)
Observations	1852	1852	1852
Dependant: labor (logs)			
Lagged crime perception	-0.134**	-0.116*	-0.057
	(0.0606)	(0.0604)	(0.0562)
Observations	1851	1851	1851
Dependant: capital (logs)			
Lagged crime perception	-0.316**	-0.289**	-0.215*
	(0.1431)	(0.1433)	(0.1405)
Observations	1143	1143	1143
Dependant: protection (logs)			
Lagged crime perception	-0.152	-0.114	-0.030
	(0.1576)	(0.1601)	(0.1561)
Observations	1143	1143	1143
Country-level controls	Y	Y	Y
Industry-level controls	N	Y	Y
Establishment specific controls	N	N	Y

Notes: This table reports the estimates of lagged crime perception on establishment sales, labor (number of full-time employees), capital expenditure (in the given year) and protection expenditure, in logs. Each cell reports the point estimates from a separate regression. Crime perception is an indicator for whether an establishment reports that crime is a major or severe obstacle to business operation. establishment-specific controls are related manager experience, number employees at inception, if formally registered at inception and if the establishment is part of a larger establishment. ***, **, * denote significance at the 1, 5 and 10 percent level. The R^2 for specification (3) is 0.4 for sales and capital, 0.25 for labor and 0.31 for protection.

Table 6: Effects of crime relative to other distortions

	Dependant variable (in logs)			
	Sales	Labor	Capital	Protection
Crime perception	-0.184*** (0.062)	-0.081*** (0.0304)	-0.181** (0.0827)	0.064 (0.0887)
Courts perception	0.333*** (0.0724)	0.073** (0.0352)	0.433*** (0.0940)	0.441*** (0.1047)
Finance perception	-0.219*** (0.0598)	-0.100*** (0.0302)	-0.088 (0.0802)	-0.092 (0.0882)
Informal sector perception	-0.162*** (0.0538)	-0.063** (0.0276)	-0.094 (0.0712)	-0.128* (0.0778)
Tax-rate perception	0.050 (0.0578)	0.011 (0.0319)	-0.030 (0.0752)	0.115 (0.0800)
Transportation perception	0.254*** (0.0686)	0.142*** (0.0344)	0.072 (0.0865)	0.206** (0.0953)
Corruption perception	-0.036 (0.0558)	-0.075*** (0.0297)	0.181 (0.0739)	0.005 (0.0791)
Country-level controls	Y	Y	Y	Y
Industry-level controls	Y	Y	Y	Y
Establishment specific controls	Y	Y	Y	Y
Observations	6032	6031	3685	3685
R^2	0.40	0.26	0.41	0.32

Notes: This table reports the estimates of various distortions on establishment sales, labor (number of full-time employees), capital expenditure (in the given year) and protection expenditure. Each of the perception variables is an indicator for whether an establishment reports the given perception is a major or severe obstacle to business operation. ***, **, * denote significance at the 1, 5 and 10 percent level.