

Impact of Crime on Firm Entry: Evidence from South Africa

Godfrey Mahofa¹

Supervisors

Asha Sundaram

Lawrence Edwards

Abstract

In this paper, we analyse the relationship between crime and the entry of firms across local municipalities in South Africa. We use data on the incidence of crime, sourced from the South African Police Service, and a unique database of business registrations over the period 2003 to 2011, to identify the impact of crime on firm entry. Using rainfall, as an instrumental variable for crime, in order to control for potential bias arising from the fact that crime might be a consequence, rather than a cause of the entry of firms, we show that a reduction in total crime rates increases entry of firms across local municipalities. When we look at the effect of disaggregated crime types, we find out that only decreases in property crimes cause entry of firms to increase. We highlight the importance of understanding the effect of a positive business environment that lowers the costs of doing business on business activity. Our study hence has implications for employment and economic growth at the regional level.

¹ PhD Candidate, School of Economics, University of Cape Town, Rondebosch, Cape Town
[.MHFGOD001@myuct.ac.za](mailto:MHFGOD001@myuct.ac.za)

1. Introduction

Private sector development, and in particular entry of new firms is important for sustainable economic growth, job creation and poverty reduction in Sub-Saharan Africa (AFDB, 2013). Theoretical and empirical evidence is available which links new business creation to growth and development of countries. From a theoretical perspective, Schumpeter (1942) cited in Wong et al. (2005) predicted that business creation leads to economic growth, through innovation. Endogenous growth theories also highlighted the importance of innovation which is brought about by competition as a result of entry of new firms (Romer, 1990; Grossman & Helpman, 1991a; Aghion & Howitt, 1992). The innovation may either come from new entrants or the incumbent firms and this may result in improved product quality, new product varieties and creation of new jobs. Empirical studies have also shown that entry of firms is important for economic growth and job creation. For example, Wong et al. (2005) show that the entry of high growth potential firms is important for economic growth across a sample of 37 countries. In another related study, van Stel et al. (2005) found out that entry of new firms across 36 countries increases economic growth, however the effect depend on the level of economic development of the country. Both of these studies included South Africa in the sample. Literature has also shown that firm entry is important for job creation, for example, Haltiwanger (2012) found out that new firms contribute a significant share of new jobs created in United States. Also, Klapper & Richmond (2011) have shown that the job creation rate of new entrants is high in Cote d'Ivoire, although low in absolute value. Shiferaw & Bedi (2009) also show that for the case of Ethiopian manufacturing firms, new entrants create few jobs.

Given the stunted growth and high unemployment levels in most countries of Sub-Saharan Africa (SSA), entry of new firms is of considerable importance for the region. However, the creation of new firms depends on local economic and business environment, which affect the costs of doing business. Many countries in SSA are characterised by high costs of doing business due to low quality infrastructure and institutions. There is evidence which suggests that there is need to understand factors affecting development of the private sector. For example, François Bourguignon, Former Chief Economist and Senior Vice President of The World Bank noted that;

“A good investment climate is central to growth and poverty reduction. A vibrant private sector creates jobs, provides the goods and services needed to improve living standards, and contributes taxes necessary for public investment in health, education, and other services.

But too often governments stunt the size of those contributions by creating unjustified risks, costs, and barriers to competition”.

In this paper, we examine the constraints to business formation across local municipalities in South Africa, particularly because the performance of firms across regions is not uniform as a result of the historical context of apartheid which exacerbates regional inequality. Most of the economic activity in the country is concentrated in three provinces, which are, Gauteng, Western Cape and KwaZulu-Natal and these provinces have since 1996 contributed about two-thirds of the overall economic activity (StatsSA, 2012). However, 60% of the population of South Africa resides in other marginalized areas (World Bank, 2014) and this highlights the importance of identifying constraints to private sector development in such regions. Poverty and unemployment is high in these marginalised regions.

A question one would then ask is what is the effect of the business environment on private sector development? A number of studies have looked at the effect of local business and economic environment on firm entry. Business environment comprises the regulatory business environment and the investment climate. Regulatory environment is the rules and regulations required for starting and operating a business, and affect firms through the costs of compliance. These include direct costs such as licence fees and indirect costs associated with complying with environmental regulations and obtaining licences. Other related regulatory issues are labour regulations, getting credit, contract enforcement, closing a business, paying taxes and property registration (World Bank, 2007). Investment climate is concerned also with issues of regulatory business environment, but in addition it concerns issues such as the quality of infrastructure and institutions in region. It constitutes the *“location-specific factors that shape the opportunities and incentives to invest productively, create jobs and expand”* (World Bank, 2004).

Generally most of the studies have pointed out the poor business environment which is prevalent in most SSA countries and its negative impact on firm performance. Venables (2010), show that SSA’s poor business environment exposes the economies to monopoly markets characterised by high barriers to entry. Elhiraika & Nkurunziza (2006) advocated for an improvement in the overall macroeconomic environment coupled with microeconomic reforms such as simplifying regulations and reducing barriers to registration of new firms in SSA. In a cross-country study, Dyck & Ovaska (2011) have shown that economic freedom, property rights and corruption are the most important determinants of business creation. A review of literature on business entry reforms by Motta et al.(2010) have shown that

generally studies have found out that simplification of business registration procedures through the introduction of an efficient one-stop shop will increase the creation of new firms. These results are also confirmed by another different study of the impact of one-stop shops in Rwanda and other countries by Gathani et al. (2013), which shows that introduction of one stop shops will increase business registration. Using African enterprise survey data, Bigsten & Söderbom (2006) highlighted the importance of access to credit, corruption, labour, risk and infrastructure in determining firm performance. Eifert et al. (2008) shows that Africa suffers from high indirect costs of doing business, mostly emanating from poor infrastructure and services and this had a negative impact on competitiveness of firms. Using data from 2008 World Bank entrepreneurship survey and business registration database from 100 countries, Klapper et al. (2009) show that efficient business registration procedures and better governance increase business registration. In another related study which uses a sample of 91 countries, Klapper & Love (2010) found out that reducing the costs, delays and procedures required to register a new business increases the number of new firms. Other studies that have considered the effect of other aspects of the business environment, for example, work by Lall et al. (2014) found out that infrastructure is one of the local determinants of manufacturing firm location in Uganda.

The focus so far in the literature has been on the effect of local institutions, infrastructure and regulations required for starting and operating a business, and little attention has been paid to understand the effects of crime on firm entry. This is surprising given the evidence that crime has a significant deterring effect on economic activity (Detotto & Otranto, 2010; Ashby & Ramos, 2013; Islam, 2014) and for the case of South Africa, a survey of firms about constraints to private sector investment in the Johannesburg area highlighted crime and safety as one of the constraints to doing business (Rogerson and Rogerson, 2010). Few studies have looked at the effect of crime on firm activity in SSA countries, only a study by Kimou & Gyimah-Brempong (2012) showed that crime reduces private sector investment in Cote d'Ivoire using World Bank enterprise surveys. In South Africa, most of the studies on crime have empirically analysed the determinants of crime but not its effects on economic activity (Demombynes & Ozler, 2002; Tolonen, 2015).

In this paper, we use the regional and time variation in crime to investigate its effects on entry of firms across local municipalities in South Africa. The argument here is that crime imposes fixed costs on firms and this in turn inhibits entry of small (less productive) firms and also deterring their growth and survival in the industry. This might have implications for the labour market, since high fixed costs as a result of high crime levels, might force small firms

that employ a large pool of unskilled labour not to enter the market. Also high crime may lead to reduced competition in the industry and this might have welfare implications. Literature on agglomeration economies has also pointed to the fact that the absence of crime is an important determinant of economic growth in cities (Kahn, 2010). This is mainly attributed to the increasing costs of hiring and retaining skilled workforce in high crime areas that may lead to declines in productivity.

Using rainfall as an instrumental variable for crime, to control for the potential endogeneity bias that arise from the fact that crime might be a consequent rather than a cause of business activity, we show that decreases in total crime rates have a positive impact on entry of firms, after controlling for other factors such income and infrastructure. Considering the effect of different crime types, we found out that decreases in property crimes increase business registration. This paper complements existing literature on the effects of business environment on private sector development, by considering crime which has received little attention in the literature. We expand this literature and explore this issue for South Africa. We believe this is an important contribution to the literature and in particular, for the case of South Africa, historical discriminatory laws of apartheid have created high levels of inequality and this has led to high crime rates in the country.

2. Background

2.1 Crime in South Africa

Crime in South Africa is a key constraint to doing business and the costs of crime in the country as a percentage of revenue are high relative to other emerging economies (World Bank, 2010). Comparing South Africa with one of the violent developed country in the world, Stone(2006), shows that crime rates in all South African provinces are higher as compared to crime rates in U.S. states with the highest rates of crime². A recent survey of business climate in South Africa has shown that crime and corruption ranks third as one of the constraints to registering a business in the country (Tutwa Consulting, 2014). However, South African Police Service (SAPS) crime statistics shown in figure A1 in the appendix shows a decline in most crime categories. Total crime declined by an annual average of 0.83 per cent during the period 2003 to 2011. Robbery³ decreased on average by 3.2 percent per

² Robbery and assault were only considered

³ Robbery include: Common robbery, Robbery with aggravating circumstance, carjacking, truck hijacking, and robbery at residential and non-residential areas.

annum, whereas property related crime rates⁴ and assault decreased by an annual average of 0.5 and 3.6 per cent respectively⁵. There is also significant variation in crime across regions in the country. Figure A2 shows the spatial distribution of average 2003-2011 crime rates in South Africa. Regions in blue are on average high crime areas over the period 2003 to 2011. Overall, total crime is high in some municipalities in the Eastern Cape, some in the Western Cape, Northern Cape and also in Gauteng localities. Some of the municipalities include Blue Crane Route Local Municipality, Makana Local Municipality, in Eastern Cape; Bellville, and Mitchells Plain in Western Cape; Mier and //Khara Hais local municipalities in Northern Cape; and Germiston and surrounding areas, and Midvaal in Gauteng. These differences across regions may be attributed to the historical policies of apartheid. During this period the government introduced homeland policies and Group Areas Act which encouraged deindustrialisation of some areas and industrialisation of other areas (Kaplan et al., 2014). Thus in regions with targeted industrialisation proper infrastructure were put in place to support economic activity and these regions developed at the expense of other periphery regions. This resulted in high income inequality in the country that has led to high and differential levels of crime rates across regions (Demombynes & Ozler, 2002).

2.2 Crime and Firm Entry in South Africa

Before embarking on investigating the impacts of crime on firm entry, it is necessary to look at the implications of high crime for firm activity. Crime imposes heavy burden to society, since the costs associated with crime reallocate government resources from investing in infrastructure and institutions that improve the business environment to spending on security and the criminal justice system (Stone, 2006). High crime increases fixed costs because, firms have to incur precautionary or security costs, firms loose goods/money through theft, also firms incur higher costs of obtaining and retaining skilled labour. Some studies have shown that smaller firms are the ones who are actually hard hit by high crime levels in South Africa and most entrepreneurs have noted that they fear to start a new business because of violent crimes (McDonald, et al., 2008).

Using the crime statistics from SAPS, one can get a sense of the implication of high crime on firm activity in the country. Figure A3 shows trends in entry and entry rates of firms over

⁴ Property and related include: Arson, Malicious damage to property, Burglary residential and non-residential, Theft out of motor vehicles, Motor vehicle theft.

⁵ Assault include: Murder, total sexual crimes, attempted murder, assault with the intent to inflict grievous bodily harm, Common assault.

high and low crime regions. Overall, it can be seen that regions with low crime have both high entry rates and entry of firms as compared to high crime regions. However, the situation is reversing from 2008 onwards. Looking at the spatial distribution of business entry (figure 1), one can see that there is regional disparity in terms of firm entry. Municipalities in Pretoria, Johannesburg, and some in Eastern Cape have witnessed greater entry of firms. Also it can be seen that some of those municipalities that had shown high crime levels in areas in the Eastern Cape and Gauteng are also indicated to have a lot of firm activity. This suggests that there are some other factors which might be at work to lure firms in these areas. There is therefore need to consider other business environment factors such as market accessibility and skills availability of the region. Thus any advanced statistical analysis will need to consider such controls when identifying the effects of crime on firm activity.

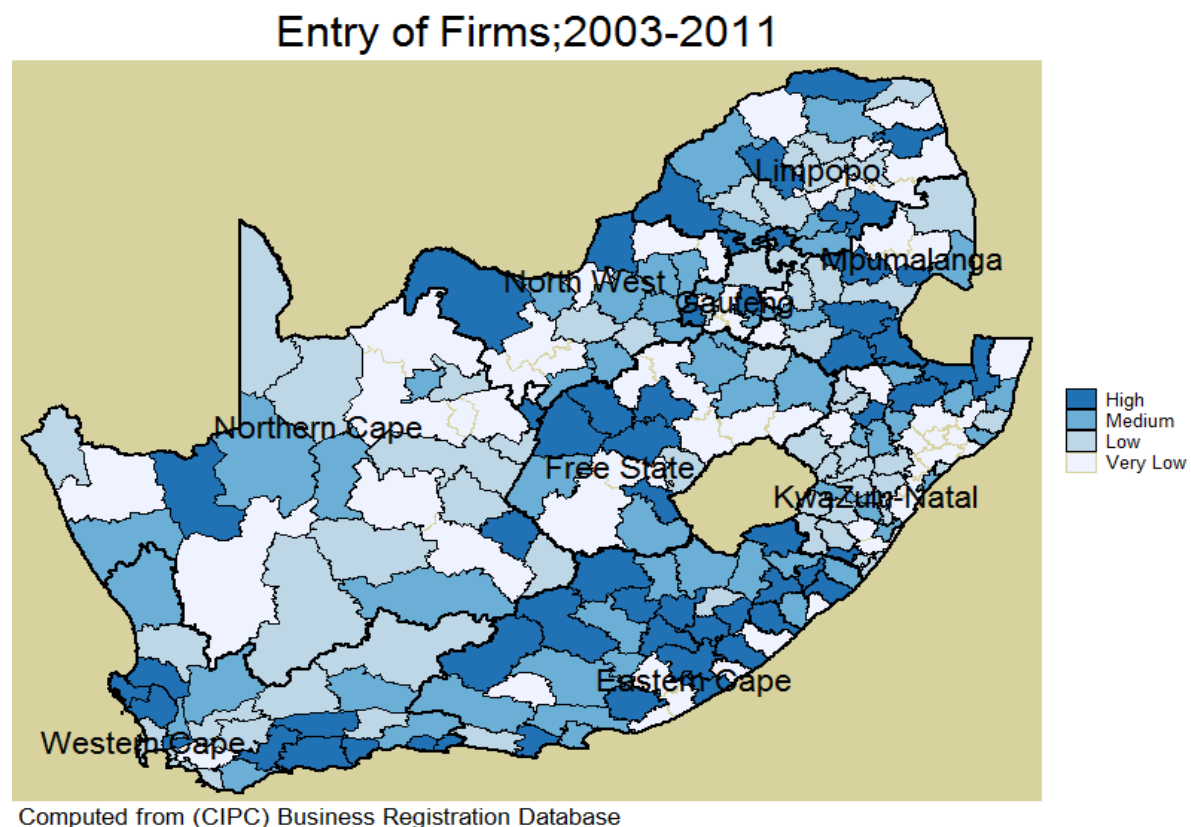


Figure 1: Spatial Distribution of Firm Entry (average entry over the period)

3. Theoretical Framework

This study builds upon the seminal contribution of Melitz (2003) model that incorporates firm heterogeneity in terms of productivity and fixed entry costs. High fixed cost of entry in regions with high crime rates will lead to fewer firms entering the market, because only more

productive (hence, larger) firms will have expected profits high enough to justify paying entry costs⁶. The Melitz (2003) model assumes a representative consumer with constant elasticity of substitution (CES) preferences. Consumer preferences are defined over a continuum of differentiated varieties indexed by ω . We assume to have a mass of M_i monopolistically competitive firms that pays a fixed cost to enter the market and upon entry; a firm draws its random productivity μ from a Pareto distribution with lower bound b and parameter β :

$$G(\mu) = 1 - \left[\frac{b}{\mu} \right]^\beta, \mu > b \quad (1)$$

Firm Entry

In this model labour is the only factor of production and market is characterised by monopolistic competition. Thus in this market there are lots of firms, each producing a unique variety of a differentiated product, with freedom of entry and exit. Firm technology is represented by a cost function;

$$L(q) = f + \frac{q}{\mu} \quad (2)$$

Where $f > 0$ is the fixed cost of production which is identical across firms, q is output and $\mu > 0$ is productivity differences for each firm. Equation (2) says that total cost of the firm is given by fixed cost and constant marginal costs. The optimal pricing strategy is obtained from the profit maximizing behaviour of firms. From (2) above, profits are defined as;

$$\pi = pq - \frac{q}{\mu} - f \quad (3)$$

Where the wage rate is normalised to one and p is the price of output. Solving this problem yield the optimal pricing rule, this is the proportional mark-up over costs. In equilibrium consumers face an exogenous number of varieties (n), but we expect firms to enter the market as long as incumbent firms earn positive profits. This free entry condition (FE) and zero cut-off profit condition (ZCP) defines the productivity cut-off μ^* and in turn determines

⁶ Crime induces fixed costs in terms of capital expenditures in security (cost of prevention), cost of hiring and retaining highly skilled workers. This makes the Melitz (2003) model suitable for this empirical analysis, since firms have to make an initial investment modelled as fixed entry costs.

the number of surviving firms. Those firms with productivity less than μ^* will exit the industry⁷:

$$\bar{\pi} = fk(\mu^*) \quad (\text{ZCP})$$

$$\bar{\pi} = \frac{\delta f_e}{1-G(\mu^*)} \quad (\text{FE})$$

Where $1 - G(\mu^*)$ is the probability of successful entry in which we define as p_{in} , δ is probability of a firm being hit by a bad shock that would force it to exit and f_e is the fixed cost of entry. $k(\mu^*)$ is the relationship between average profit per firm and cut-off productivity μ^* . In equilibrium there is a mass of M_e firms entering in every period and for steady state equilibrium this requires that the mass of all successful entrants be equal to the mass of incumbent firms exiting:

$$p_{in}M_e = \delta M \quad (4)$$

The labour market clearing condition is given by;

$$L = L_p + L_e \quad (5)$$

This identity states that aggregate labour (L) is comprised of labour used for production (L_p) and labour used for investment by new entrants (L_e). Also payments to labour in production must reflect the difference between revenue and aggregate profit (Π) :

$$L_p = R - \Pi \quad (6)$$

Finally the labour used by entrants should satisfy the following equation;

$$L_e = M_e f_e \quad (7)$$

Equation (7) says that aggregate labour used for investment by new entrants should equal the product of the mass of entrants and fixed costs of entry. From equation (4) and FE condition, we can re-write (7) and obtain the following;

$$L_e = \frac{\delta M}{p_{in}} f_e = \frac{M \delta f_e}{1-G(\mu^*)} = M \bar{\pi} = \Pi \quad (8)$$

Thus from (6) aggregate revenue is given by;

$$R = L_p + \Pi = L_p + L_e = L \quad (9)$$

⁷ For derivation of ZCP and FE conditions please refer to the Melitz (2003) paper.

Hence;

$$R = L$$

Given that average revenues per firm are given by; $\bar{r} = \frac{R}{M}$, the mass of firms at any period can be expressed as, using the average profit function;

$$M = \frac{R}{\bar{r}} = \frac{L}{\sigma(\bar{\pi}+f)} \quad (10)$$

This shows that there is an inverse relationship between mass of firms in an industry and fixed costs (f). σ is the elasticity of substitution between varieties. Since entry of firms at any given period is given by comparing the mass of firms between two subsequent periods, we can derive entry of firms as function of crime and other variables. In general we can write entry of firms as;

$$Entry = F(f_c, X) \quad (11)$$

Where f_c represents crime induced fixed costs and X is a vector of control variables, which may include, population of a region as a proxy for labour, variables affecting profitability of firms such as market accessibility, infrastructure and institutions (business environment factors).

Hypothesis: Higher fixed costs of operation in regions with more crime will lead to fewer firms entering the market, because only more productive (large) firms will have expected profits high enough to justify paying the entry costs.

3.1 Data

This paper uses Business Registration database from the Companies and Intellectual Property Commission (CIPC). The registration database has information on company name, unique registration number, company status (e.g. in business, deregistered, dissolved, etc.), date of registration, physical and postal address as well as the postal code. It contains information for over 3 million business enterprises and registration dates from as far as 1801. From this dataset we can create number of active firms, and then calculate entry of firms in a particular municipality. Also the limitation of this data is that it is available at the enterprise level and not at the subsidiary plant level, and this is a major issue for most of the major supermarket chains. The implication of this for our study is that it may distort the regional concentration of industry. However, these problems are common in most firm level databases of emerging economies and besides our results still confirm that firms do not register in high crime areas.

We also use crime data obtained from South African Police Service (SAPS). SAPS have data on number of cases reported in a particular police station per crime type. The data has information on various crime categories, including contact crime against a person, car and truck hijacking, and theft of motor vehicles. The data covers the period from 2003 to 2012. Since the data is available at police station level, we aggregated the data to the local municipal level, our unit of analysis. Using the postal codes for each police station, we were able to map each police station to the corresponding local municipality, using a postal code mapping for Quantec municipalities which was created earlier (Edwards & Sundaram, 2013). The crime variables we used were transformed to crime rates by dividing by thousands of 2001 population and should be interpreted as crime rates per 1000 population.

We also used other variables to control for the effect of market accessibility and level of infrastructure in a region. The data was obtained from Quantec Research Ltd. Quantec has constructed a spatially disaggregated database of regional indicators and the data is available up to local main place area as defined by the South Africa census. From the regional development indicators database we used data on disposable current household income, population, total households in a region, and total number of households with electricity, with access to telecommunications, with access to utilities such as toilets, water and refuse collection. In order to also capture skills availability in a region we used the education variable in the database. The education variable is measured as the number of households with; no school, primary, and tertiary education. We converted these variables by dividing by the corresponding population in the region to get a share of households. For household income we divided with the number of households in a region to get per capita income.

Rainfall

As a source of exogenous variation we rely on rainfall data obtained from National Aeronautics and Space Administration (NASA)'s Tropical Rainfall Measuring Mission (TRMM) for the period 2003 to 2012. The TRMM data is reanalysis data which combined data from ground rain gauge stations and satellites, to get estimates of rain rates at 0.25 latitude and longitude degree intervals. We used this dataset compared to other data like Global Precipitation Climatology Project (GPCP) database, because of the finer spatial resolution which allows us to get rainfall estimates at lower disaggregated spatial level, like police station area. The data has also the advantage of correcting for errors by not using values which are distant from any gauges and using a method called inverse error variance

weighting (Huffman & Bolvin, 2014). With police station spatial data (latitudes and longitudes grid points) obtained from South African Police Service (SAPS) website, one can get an average rain rate of the area covered by the police station in mm/hr.

The data is then converted to mm/day by multiplying the rain rate by the number of hours in a day and we obtained the average daily rainfall in a year for each region. We also computed monthly and annual rainfall, by multiplying the daily rate by the number of days in a month and summing over the year to get annual rainfall. To aggregate the data to municipality level we get the unweighted average for the police station areas falling within each municipality. We also computed various measures of rainfall shocks, like the absolute value of the standard deviation of each municipality, standardised z –scores, a dummy variable indicator where 1 is positive deviations around the mean and 0 otherwise. However, most of these measures had low correlations with various crime categories. We tried rainfall shock measures for a number of reasons. Firstly, given the wide climatic variation in South Africa, a drop of rainfall is expected to have different economic effects across municipalities. Second, we transform the data so that we even out abnormal rainfall periods. So, to handle seasonality of rainfall, we standardized rainfall measurements by month. That is, for each municipality, compute mean and standard deviation for all January observations, all Februarys, etc. Then we summed those by year to get an annual rainfall score for each municipality. Finally, we use rainfall shocks (deviations) as opposed to just the mean because we want to capture unanticipated changes in rainfall which will not have an effect on firm activity. Following debate in literature on whether to use rainfall levels or shocks as instruments (Miguel & Satyanath, 2011), we also estimated separate models with rainfall shocks for robustness checks. The other measure we use of rainfall shocks, follow the approach used by Hidalgo et al. (2010), is;

$$x_{it} = \sum_{m=1}^{12} \frac{x_{mit} - \bar{x}_{im}}{s_{im}}, \quad (11)$$

where x_{mit} is monthly rainfall observation for each municipality, \bar{x}_{im} is the average monthly rainfall for each municipality for the 2003-2011 period, and s_{im} is monthly standard deviation for each municipality over the period. Table 1 below shows some summary statistics of the variables used in the estimation model. Descriptive statistics show that there is some variation in the rainfall variable in the sample used for estimation. Entry of firms averaged 40 firms with also some considerable variation. Robbery crime rates averaged 4 per 1000 individuals and there was wide variation of robbery rates, whereas property and related

crime rates averaged 30 per 1000 individuals. Assault crime rates averaged about 15 per 1000 individuals, however, there was little variation. One thing we also noted is that the within variation of crime was very low for all crime categories (table A1 in the appendix). This will have an effect in our efforts in trying to estimate the impact of crime on entry, if we lack substantial variation over time, however, the variation across municipalities is relatively high.

Table 1: Summary statistics for variables used in the estimation

VARIABLES	2003-2011		
	N	Mean	SD
Log(entry of firms)	1,663	3.713	1.864
Rain deviation	1,663	0.123	4.187
Annual rain(mm/year)	1,663	690.0	222.4
Average rain (mm/day)	1,663	1.891	0.610
Log (per capita household income)	1,663	-2.708	0.501
Log (share of households with access to electricity)	1,663	-1.604	0.381
Log (share of households with access to telecomms)	1,663	-1.317	0.156
Log (share of households without education)	1,663	-2.233	0.459
Log (share of households with primary education)	1,663	-0.354	0.0702
Log (share of households with tertiary education)	1,663	-1.727	0.184
Principal component utilities	1,663	-1.14e-09	1.527
Log (robbery)	1,663	1.374	1.194
Log (property)	1,663	3.393	1.029
Log (assault)	1,663	2.731	0.839
Number of id	185	185	185

4. Econometric Model and Identification Strategy

In this study we are interested in estimating the causal relationship between crime and entry of firms across municipal regions in South Africa. In equation (11) above we specified a general function without writing out a functional form. We specify our model as a simple log-linear model, since economic theory does not give us a specific function for firm entry;

$$\ln \text{Entry}_{it} = \beta_0 + \beta_1 \ln \text{Crime}_{it} + \beta_2 \ln \text{Controls}_{it} + \alpha_i + \alpha_{it} + \varepsilon_{it} \quad (12)$$

Firm entry, which is the dependent variable, is measured as the number of firms registering in a particular municipality (i) and year (t). Crime, which comes in the right hand side of the equation, is measured as crime rate (divided by thousands of 2001 population) in a municipality (β_1 is expected to be negative). To identify the effect of crime on firm entry, one need to control for other factors (Controls_{it}), which affect profitability and hence incentive to

enter into the market. We included controls such as per capita household income and infrastructure variables as discussed above. We also included municipal fixed effects (α_i) and municipality specific time trends (α_{it}). This is because we are concerned with the municipal level unobserved factors that are time invariant which may affect crime and firm entry simultaneously and also municipality specific time trends which affect crime and entry jointly. In this case β_1 , is identified using within municipality variation over time, after controlling for municipality fixed effects and differential shocks (α_{it}). The assumption is that there may be shocks which affect each region differently in each year given the 2003-2011 time period being studied. For example, shocks associated with the 2008 global financial crisis and also the hosting of the World Cup might have impacted municipalities differently. Some municipalities did not host the world and others did and also the global financial crisis had a large impact on commodity and mining companies, which are not located in all municipalities. So, including year effects (dummy) will only capture the time shocks which are common to all municipalities, but not differential shocks and this will bias our estimated parameters. Some studies have controlled for such unobservables by including region specific time trends (Miguel, Satyanath, & Sergenti, 2004; Dinkelman, 2011). Also, Dell, Jones, & Olken (2013) pointed out to the importance of *“including time fixed effects that enter separately as subgroups of different spatial areas to allow for differential trends in subsamples of the data. An alternative (and potentially complimentary) approach to capturing spatially-specific trends is to include a spatially-specific time trend”*. Summary statistics also reveal that our explanatory variables of interest (table A1 in the appendix), do not vary that much over time within a municipality, whilst firm entry is changing over time and this also provides a case for using a region specific linear trend (Thomas, 2006). For robustness checks, we also estimated models using either year dummies or a common trend instead of municipality specific trends. Other robustness checks include running models of our preferred specification with different time periods. Results for these robustness checks are presented in the appendix.

One of the major problems of identifying the relationship between crime and entry of firms is endogeneity arising from reverse causation. Direction of causality may run either way since firm entry may attract more criminals as the potential returns from crime rise with increased business activity. Measurement error is also a big concern when it comes to crime data, because crime suffers from serious under-reporting in South Africa like many other countries. Besides, previous validations of the SAPS crime data by comparing it with the Victims of

Crime Survey conducted by Statistics South Africa, by Demombynes & Ozler (2002), a concern still remain about the validity of crime data in South Africa (Bruce, 2010).

To identify the relationship between crime and firm entry, we instrument crime rate by rainfall shocks. We explore the relationship between crime and firm entry using the two stage least squares method as shown below;

$$\ln\text{Crime}_{it} = \alpha_0 + \alpha_1 Z_{it} + \alpha_2 \ln\text{Controls}_{it} + \delta_i + \delta_{it} + \mu_{it} \quad (13)$$

$$\ln\text{Entry}_{it} = \beta_0 + \beta_1 \ln\text{Crime}_{it} + \beta_2 \ln\text{Controls}_{it} + \gamma_i + \gamma_{it} + \varepsilon_{mt} \quad (14)$$

We assume that the exogeneity of rainfall is correlated with crime, since high rainfall is expected to reduce crime rates were heavy rainfall would limit movement of people (i.e. victim and the criminal). It is highly unlikely for rainfall shocks to directly impact entry of firms in a region. One threat of using rainfall shocks as an instrumental variable is that, positive and negative rainfall shocks may affect agricultural outcomes in rural areas and this might affect crime and firm activity, through migration of people from rural areas to urban regions. To avoid this violation of the exclusion restriction, we included only municipalities in urban areas. Also, by using rainfall shocks, it is impossible for both extremely high and low rainfall to similarly increase (or reduce) the probability of new firm registration, except through their effect on crime in urban areas. Studies have also shown that rainfall shocks in poor countries have no direct effect on industrial production (Dell et al. 2012). We proceed to estimate the system of equation above by first of all modelling the relationship between crime and rainfall shocks. Our first stage equation is given by (13), where we include average daily rainfall in a year (Z_{it}), (δ_i) municipality fixed effects and municipality specific time trends (δ_{it}). μ_{it} is random error term. Crime, which comes in the right hand side of the equation, is measured either as natural log of robbery, property or assault crime rates in a municipality and year t . The second stage regression estimates the impact of crime on firm entry. Conditional on the validity of our instrument, $\beta_{1,IV}$ captures the Local Average Treatment Effect (LATE) of crime on firm entry.

5. Results and Discussion: OLS and IV

Basic pooled OLS and fixed effects regression results of total crime and various crime categories are shown in table 2 below. Using principal component of crime, show that crime the relationship between crime and business registration is negative and statistically significant (column 1 of table 2). Total crime, robbery and property crime rates are positively and significantly associated with entry of firms, which is against our intuition and theoretical predictions. However, the relationship between assault crime rates and business registration is negative and statistically significant (column 9 in table 2). Pooled OLS results are likely to be biased because they treat crime rates to be exogenous and also do not control for omitted unobserved variables which affect crime and entry jointly. Fixed effects estimates (columns 2, 4, 6, 8 and 10 in table 2) show a negative and significant relationship between total crime, robbery, property and assault crime rates, and firm entry. Comparing OLS and fixed effects estimates, we find out that all crime categories are of the expected sign in a fixed effects framework. These results are an indication of the classical omitted variable bias of using pooled OLS estimates. Per capita household income has the expected positive sign, but only significant in fixed effects framework. If we take income as a measure of market size of a region, the result would make intuitive sense, since firms would register in regions with a big market for their products. We also control for other aspects of the business environment, which may affect market accessibility and hence firm registration. For example, to capture infrastructure, we used variables such as share of households with access to telecommunication, electricity and a principal component for utilities (share of households with toilet, access to water and refuse collection). The variables had an expected positive and significant relationship with firm entry in most specifications. To account for the availability and quality of skills in a region, we use the education variable, and results indicate that there is a negative and significant relationship with entry of firms in an OLS framework. One would expect a negative relationship between share of households without education and firm entry, since firms will not register in a region where they will not find any skilled labour. The coefficient on tertiary education is also not as expected. An increase in the availability of skilled labour is expected to induce firm entry in that region as predicted by economic geography models. Controlling for unobserved factors in a fixed effects framework, we find expected results for both primary and tertiary education. However, OLS and fixed effects estimates presented in table 2 may be biased due to the problem of endogeneity in our crime variable as discussed above. For instance, crime may

follow where most businesses are, implying that there is reverse causation between crime and firm entry. The other potential bias may arise from measurement error in our crime variable due to under-reporting. These problems will result in our modelling strategy underestimating the effect of crime on firm entry, that is, our estimates will be biased downwards. To control for these problems, we instrumented crime with rainfall shocks and employed a two stage least squares estimation technique.

First stage relationship between rainfall deviations and crime are shown in Table 3 below. The dependent variable in this case is the natural logarithm of total crime, robbery, property, and assaults. Results show that there is a negative and significant relationship between rainfall, and total crimes and property crime rates. Results also show a negative and insignificant relationship between rainfall and assault crime rates, however, we found a positive and insignificant relationship between rainfall and robbery crime rates. These findings are consistent with existing literature and predictions of economic models of crime. For example, Blakeslee & Fishman (2014) also found a negative and significant relationship between rainfall shocks and most types of crime rates in India, with larger effects for property crimes. Miguel (2005) also show that negative rainfall shocks increases murder rates in rural Tanzania. F-statistics for all models are reported in the second last row of table 3. For total crime, the F-statistics is very low (about 4.89, column 1 of table 3). This suggests that rainfall is a weak instrument for total crime rates in this framework. However, F-statistics for property crime is above 10 (about 11.83, column 3 of table 3). This suggest rainfall is a strong instrument for property crime in this case (Stock, Wright, & Yogo, 2002). Compared to other studies which have used rainfall as an instrumental variable, Hidalgo et al. (2010) obtained strong rainfall instruments, whereas Miguel, Satyanath, & Sergenti (2004) suffered from weak instrumentation strategy. The main reason for this is that the study by Miguel, Satyanath, & Sergenti (2004) used aggregated data at the country level where there is little variation. In our case and Hidalgo et al. (2010) study we use disaggregated data at the municipality level. The other possibility may be that, these studies used rainfall shocks as an instrument for income in a rural setting and at a country level, whereas, in our case we instrument it for crime in urban municipalities only.

Results for other variables used in the estimations show that, the relationship between household income and total crime, property, and assault crime rates is negative and statistically significant, but this is not the case for robbery. We also see that access to electricity is negatively related to all crime categories, but the result is slightly significant and not significant in some cases (columns 2 and 4 of table 3) . Our education variables are all

negatively related to crime, but one would expect that crime to increase in regions where the level of education is low since income opportunities for the general population is low, so they would resort to crime as a source of income, and for crime to decline when education levels are very high, which is the case for the coefficient of tertiary education. To also control for the effect of infrastructure development in a region, we included a principal component variable for utilities, which comprised the share of households with access to refuse collection, toilets and water. The variable is negatively related to total crime and property crime rates, but statistically insignificant. It is positively related with robbery and assault, but insignificant. Results also show that there is negative and insignificant relationship between share of households with access to telecommunication, and total crime, property and assault crimes.

Table 2: Pooled OLS and Fixed Effects Regression: Crime and Firm Entry

	Principal component crime		Total crime		Robbery		Property		Assault	
	OLS (1)	FE(2)	OLS (3)	FE (4)	OLS (5)	FE (6)	OLS (7)	FE (8)	OLS (9)	FE (10)
Principal component crime	-0.101*** (0.00949)	0.0231 (0.0200)								
Total crime			0.115* (0.0697)	-0.544*** (0.179)						
Robbery					0.383*** (0.0582)	-0.199*** (0.0595)				
Property							0.275*** (0.0684)	-0.748*** (0.169)		
Assault									-0.531*** (0.0548)	-0.395*** (0.115)
Per capita household income	0.0672 (0.103)	2.456*** (0.499)	0.0764 (0.110)	2.227*** (0.507)	0.124 (0.105)	2.397*** (0.514)	0.0223 (0.110)	2.021*** (0.485)	0.227** (0.105)	2.309*** (0.516)
Share with electricity	-0.0413 (0.260)	3.038** (1.196)	0.0170 (0.257)	2.636** (1.142)	-0.0826 (0.236)	2.997** (1.183)	-0.00645 (0.251)	2.499** (1.119)	0.140 (0.265)	2.804** (1.158)
Share no school	-1.038*** (0.179)	6.485*** (2.194)	-0.855*** (0.200)	5.131** (2.022)	-0.683*** (0.203)	5.516*** (2.114)	-0.754*** (0.205)	4.310** (1.844)	-1.036*** (0.175)	5.646*** (2.127)
Share with primary	-8.919*** (1.320)	47.80*** (9.935)	-8.973*** (1.385)	45.44*** (9.120)	-7.192*** (1.384)	46.61*** (9.541)	-8.733*** (1.385)	43.50*** (8.550)	-9.084*** (1.303)	46.29*** (9.482)
Share with tertiary	-2.643*** (0.525)	17.84*** (2.829)	-2.673*** (0.549)	16.22*** (2.689)	-1.984*** (0.549)	16.84*** (2.706)	-2.548*** (0.553)	15.48*** (2.538)	-2.938*** (0.515)	16.71*** (2.754)
Principal component utilities	0.196* (0.108)	0.0823 (0.117)	0.196* (0.107)	0.0759 (0.104)	0.166* (0.100)	0.0915 (0.111)	0.222** (0.105)	0.0612 (0.105)	0.125 (0.111)	0.0934 (0.108)
Share with telecomms	-0.831 (0.827)	17.73** (7.002)	-1.331 (0.847)	17.51** (6.988)	-1.763** (0.785)	17.91** (7.100)	-1.870** (0.836)	17.42** (6.849)	0.197 (0.852)	17.00** (7.040)
Constant	-7.302*** (1.897)	986.9*** (88.96)	-7.961*** (2.033)	1,007*** (85.09)	-6.427*** (1.928)	1,015*** (88.10)	-8.806*** (2.025)	1,013*** (82.31)	-4.338** (1.950)	1,003*** (86.56)
R-squared	0.060	0.480	0.026	0.500	0.078	0.487	0.043	0.514	0.073	0.488
Number of municipalities		185		185		185		185		185

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variable is natural log of entry. All explanatory variables are in natural logs with the exception of principal component of crime. Fixed effects estimates include municipality fixed effects and municipality specific time trends. Total number of observations is 1663.

Reduced form and second-stage estimates are shown in table 4 below, and these results show a positive and significant relationship between rainfall and firm entry in the reduced form

(column 6 of table 4). High rainfall levels are associated with significantly more firm entry, with an estimated coefficient of 0.109 (column). These results indicate that higher rainfall induces entry of firms in urban municipalities. We assume that this effect is through its effect on crime rates as shown in first stage regressions (table 3). As discussed earlier, higher rainfall reduces criminality, because movement of people is limited, since there are no victims, and hence the reduction in crime increases firm registration in a region.

Table 3: First stage regression rainfall and crime

	(1) Total crime	(2) Robbery	(3) Property	(4) Assault
Rainfall (mm/day)	-0.0260** (0.0118)	0.00189 (0.0178)	-0.0347*** (0.0101)	-0.0150 (0.0118)
Per capita household income	-0.376*** (0.136)	-0.260 (0.265)	-0.529*** (0.137)	-0.334** (0.158)
Share with electricity	-0.737* (0.429)	-0.297 (0.619)	-0.697* (0.387)	-0.615 (0.460)
Share no school	-2.038*** (0.749)	-4.236*** (1.058)	-2.449*** (0.855)	-1.672** (0.667)
Share with primary	-3.295 (3.369)	-4.390 (4.268)	-4.717 (3.499)	-2.757 (3.033)
Share with tertiary	-2.486*** (0.907)	-4.270*** (1.467)	-2.682*** (1.006)	-2.355*** (0.888)
Principal component utilities	-0.0132 (0.0442)	0.0458 (0.0617)	-0.0298 (0.0335)	0.0271 (0.0412)
Share with telecomms	-0.342 (1.675)	0.996 (2.870)	-0.347 (1.649)	-1.794 (1.781)
R-squared	0.574	0.388	0.552	0.626
Number of municipalities	185	185	185	185
F-test	4.885	0.0113	11.83	1.633
Prob>F	0.0283	0.915	0.000720	0.203

Notes: Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the natural log of total crime, robbery, assault and property crime rates. Total crimes include robbery, assault and property crimes. All variables are in natural logs. Municipality fixed effects and municipality specific time trends are included in all estimations. Total number of observations is 1663.

Second-stage equation 13 examines the impact of total crime and property crime rates on business registration. We did not proceed to estimate the second-stage for robbery and assault crime, since the F-statistics on first-stage regression are low and not significant (about 0.011 and 1.63, column 2 and 4 of table 3). Results show that decreases in total crime and property crime rates, instrumented by rainfall, cause entry of firms to increase (table 4, column 1 and 2), with a point estimate of about 4.2 and 3.15 for total crime and property crimes respectively. This implies that a reduction in total crime and property crime rates by 1 % will increase business registration by about 4.2 % and 3.15 % respectively. This suggests business

registration is highly responsive to changes in both total crime and property crime rates. These results suggest that, although total crime reduces business registration, a disaggregated analysis of the effect of various crime types on firm entry reveal that only property crimes have a significant impact.

These findings are consistent with predictions of our theoretical model and the hypothesis that higher fixed costs of entry and operation in regions with more crime will lead to fewer firms entering the market, because only more productive (large) firms will have expected profits high enough to justify paying the entry costs. Studies about constraints to business activity in South Africa, have also highlighted that most entrepreneurs fail to start their business because of their fear of crime (McDonald et al. 2008). Our results are also in support of findings from studies that have examined barriers to entry of small firms in large townships of the country. For example, Cichello et al. (2011), found out that the fear of crime is a dominant factor in hindering formation of new business in Khayelitsha, a large township in Cape Town, where crime is high. Other studies in literature have also shown that crimes have a negative effect on economic activity. Studies in the U.S have shown that property and violent crimes reduce property values (Gibbons, 2004; Ihlanfeldt & Mayock, 2009).

Comparing our two-stage least squares estimates with OLS estimates, we show that there is a downward bias in our OLS estimates (column 3 and 4 of table 4). Thus not controlling for endogeneity of crime rates will underestimate the impact of crime on firm entry. The differences between the estimates are very large and a possible explanation for this may be as a result of measurement error in crime rates as a result of under-reporting of most crime types. Bruce (2010), documented that there is serious under-recording of crime statistics in South Africa. However, we do not know any study that has quantified the magnitude of the measurement error in South Africa's crime statistics, so we cannot say exactly whether the endogeneity bias is smaller or larger in magnitude than the measurement error.

Table 4 : Impact of Crime on Firm entry (IV-2SLS)

	IV-2SLS		OLS		Reduced form (5)
	Total crime (1)	Property (2)	Total crime (3)	Property (4)	
Total crime	-4.196** (1.781)		-0.544*** (0.179)		
Property crime		-3.145*** (0.992)		-0.748*** (0.169)	
Rainfall (mm/day)					0.109*** (0.0271)
Number of municipalities	185	185	185	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the natural log of entry. Control variables included. Municipal fixed effects and municipal specific trends included in all estimations. Total number of observations is 1663.

5.1 Robustness checks

In this study, we also run several robustness tests to check the validity of our modelling strategy and, results are presented in the appendix (table A2 and A18). As pointed out earlier, there is little variation over time within a municipality, for all of the key explanatory variables used in the estimation (table A1) and the implication for this is that, one would not be able to identify the parameters of the model in a two-way fixed effects framework with time dummies. Including a full set of year dummies in a model where the key explanatory variables are not changing much over time, will wipe out the effect of such variables since the presence of aggregate year dummies cannot be distinguished from changes in explanatory variables (Wooldridge, 2012). We estimated models with common and province specific trends, and year dummies. Using province specific trends, OLS regression estimates of crime on firm entry are given in table A2. Fixed effects estimates of crime are robust to using province specific time trends. First stage regression of the relationship between rainfall and assault crime rates now shows a negative and significant association (table A3). F-statistics is high for all models, suggesting a strong instrument in this framework. Reduced form estimates are also positive and significant. Second stage regression estimates of the impact of crime are all negative and statistically significant for property and assault crimes (table A4). However, in this specification, rainfall deviation is also a powerful in instrumenting crime rates. We also show results for the specification where we have common time trends in the model (table A6-A8). The relationship between robbery crime rates and rainfall is now significant in the first stage. Second stage results now show that robbery has a negative and significant impact on business registration. We also show results for the specification where

we have time dummies in the model instead of trends (table A9-A11). In this case results change, and first stage estimates are only significant for robbery crime rates, however, second stage results show no impact of most crime categories on entry, with the effect of robbery positive. We also combined robbery and assault crime, so that we have an aggregated category of contact crimes. Results for OLS and fixed effects, show that the effect of contact crime rates are (table A12) not significant and of the opposite sign in some specifications, suggesting our results are sensitive to the issue of aggregation of crime categories. First stage relationship between aggregated contact crime and rainfall are also not statistically significant in most cases, except when we instrument contact related crime with average rain and control for time varying shocks with province specific trends (column 3 in table A13). F-statistics for all models are greater than 10. Second stage estimates for the effect of contact related crime on entry are negative and slightly significant ($p < 0.1$), however the coefficient is very large (8.06, column 1 in table A14). Suggesting that a reduction in contact related crimes by 1% will increase firm entry by 8.06 %.

Since assault include crimes such as murder and attempted murder, which are categorised as violent crimes, increases in such crimes will induce fear and the costs associated with violent crimes are very high, so firms will not register in such regions. One of the possible explanations offered in the literature is that violent/contact crimes cause more harm to the victims. Also, there are less effective measures of dealing with contact crimes. The best option to protect against contact crimes is the option which is supported by our results (table A14), is to avoid regions with high rates of assault crime rates. Robustness checks were also performed using our preferred specification, but now considering different time periods. We first of all split our sample into two, period before the global financial crisis (2003-2007) and the period after the crisis (2008-2011). The global financial crisis of 2007-2009 had a significant impact on business and economic activity and this led to the 2008-2012 global economic downturn. Our main results are sensitive to using different time periods (table A15). Results are negative and insignificant, when we restrict our sample to the 2003-2007 period, suggesting that something else besides crime was driving business activity in South Africa, during the 2008-2011. The coefficient is higher for the 2008-2011 period. One other issue is that this period is also when the South African government was making preparations to host the FIFA world cup and one would expect a lot of business activity in terms of construction and related industries. So we have two competing shocks with different effects on business activity. During the period of the global financial crisis and also the world cup preparations, entry of firms was not largely driven by crime rates in the region, but by other

factors. If one has to assume that new investments in South Africa are mainly coming from abroad (European Union or United States) or other major markets, then one would expect crime not to matter most as a determinant of investing in the country, during the global financial crisis period. Although crime was deterring business registration, it was not an important factor during the crisis. We also combined all crime categories using principal component analysis and results are shown in tables A16-A18.

5.2 Potential Threats to the Exclusion Restriction

While rainfall variable is exogenous, it must satisfy the exclusion restriction that, rainfall should affect business registration, only through its effects on crime rates, not through any other channel. First, studies have hypothesized that the main channel through which rainfall affect crime is through income, where negative rainfall shocks will lead to decline in agricultural productivity and will in turn affect incomes in rural agricultural areas. Also, negative rainfall shocks in rural areas will induce migration of people into urban areas, which could in turn affect crime and firm performance in urban areas. To avoid this channel, we restrict our sample to only urban municipalities, so that the predominant channel will be through limiting movement of people. Literature has also pointed to the fact that rainfall has a direct effect on conflict, through limiting movement of armed forces (Rogall & Guariso, 2013).

Another potential threat to the exclusion restriction is that rainfall might have an effect on business activity independent of crime, through its effect on institutional quality. For example, high rainfall may reduce the capacity of municipalities to provide services such as refuse collection, building toilets and may also destroy telecommunications and electricity infrastructure. Also high rainfall may improve service delivery in terms of power supply, since generation capacity would have been increased by the availability of water. We rule out these possibilities in our study, by showing that there is no relationship between rainfall and various institutional variables at the municipality level (table 5). The first three columns of table 5 shows the relationship between rainfall and various institutional variables, without controlling for income, but controlling for all other municipality level controls and fixed effects. The coefficient on the relationship between rainfall and, utilities and telecommunication variable are very small (0.0026 and 0.00013) and insignificant. The point estimate on the electricity equation is slightly significant and also very small (0.0018). Controlling for income, coefficients become smaller (columns 4, 5 and 6 of table 6). Also,

one should note that the first theory, that high rainfall would damage infrastructure or reduce capacity of municipalities to deliver services, and this in turn could reduce entry of firms, is not a serious threat to our identification strategy. This is because, empirically, higher rainfall is associated with increased entry of firms in the reduced form estimation (column 6 of table 4). Despite this, we acknowledge that the study is not able to definitely rule out the possibility that rainfall could have some independent effect on business formation beyond its effect going through crime, though we believe the other effects are small. For example, the effect of electricity is small (0.0018), compared to the crime effects (0.03).

Table 5: OLS Regression estimates of rainfall and institutional variables.

	(1)	(2)	(3)	(4)	(5)	(6)
	Utilities	Telecommunication	Electricity	Utilities	Telecomms	Electricity
Rainfall (mm/day)	-0.00257 (0.00406)	0.000125 (0.000254)	0.00179* (0.000910)	-0.00335 (0.00441)	0.00008 (0.000241)	0.00162* (0.000890)
R-squared	0.893	0.982	0.988	0.893	0.982	0.988
Number of municipalities	185	185	185	185	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

OLS regression of institutional variables on rainfall and all municipality level controls. Column (1), the outcome variable is principal component of utilities (access to water, access to total refuse collection, access to toilets). In column (2) and (3), outcome variable is access to telecommunications and electricity. Column (4), (5), and (6) we include per capita household income as a control.

6. Conclusions

Improving the business environment, particularly reducing crime rates, is important for the development of the private sector in local marginalised municipalities of South Africa. South Africa has one of the highest crime rates in the world and this is a major concern for business activity. This study set to examine the causal impacts of crime on firm entry across local municipalities in South Africa. Using rainfall shocks as an instrumental variable for crime, we find a negative and significant impact of total crime rates on entry of firms. A 1 % percent decrease in total crime rates causes business registration to increase by about 4.2 %. Also, disaggregating the analysis to crime types, we found out that, an increase in property crime rates by 1 % cause business registration to increase by 3.2 %. These results are consistent with the findings from business climate surveys, which highlights that the fear of high crime rates discourage business registration in South Africa. However, our main results are sensitive to restricting our sample to different time periods. During the period prior to the global financial recession the effect of total crime rates were negative and significant.

Restricting our analysis to the 2008-2011, estimates are negative but insignificant, suggesting that crime was not a major factor in determining business activity during this period.

Empirical research on the effect of business environment is growing and few studies have looked at the impact of crime, in particular. This study is an important contribution to the literature on understanding the effect of crime on firm entry, an area of study which is limited in SSA countries, and particularly for countries with high crime rates such as South Africa. Thus any industrial policy strategy aimed at improving local economic growth and job creation, should also consider strategies for improving policing and security in the country in order to reduce crime rates. The study also documents the importance of 'hidden' costs associated with crime, which are hindering business growth and expansion plans in South Africa.

7. References

- Aghion, P., & Howitt, P. (1992). A Model of Growth through Creative Destruction. *Econometrica*, 113(October), 323-351.
- Ashby, N. J., & Ramos, M. A. (2013). Foreign direct investment and industry response to organized crime: The Mexican case. *European Journal of Political Economy*, 80-91.
- African Development Bank. (2013). *Supporting the Transformation of the Private Sector in Africa: Private Sector Development Strategy, 2013-2017*.
- Bigsten, A., & Söderbom, M. (2006). What have we learned from a decade of manufacturing enterprise surveys in Africa?. *The World Bank Research Observer*, 21(2), 241-265.
- Blakeslee, D., & Fishman, R. (2014). *Weather Shocks, Crime and Agriculture: Evidence from India. Crime and Agriculture: Evidence from India*.
- Bruce, D. (2010). The ones in the pile were the ones going down. The reliability of violent crime statistics. *SA Crime Quarterly No 31*.
- Cichello, P. L., Almeleh, C., Mncube, L., & Oosthuizen, M. (2011). *Perceived Barriers to Entry into Self-employment in Khayelitsha, South Africa: Crime, Risk, and Start-up Capital Dominate Profit Concerns*. University of Cape Town. Centre for Social Science Research.
- Tutwa Consulting. (2014). *Business Climate Survey 2014: EU Trade and Investment in South Africa*. Imani Development South Africa.
- Dell, M., Jones, B. F., & Olken, B. A. (2013). *What do we learn from the weather? The new climate-economy literature*. National Bureau of Economic Research.
- Dell, M., Jones, B., & Olken, B. A. (2012). Temperature Shocks and Economic Growth: Evidence from the Last Half Century. *American Economic Journal: Macroeconomics*, 4(3), 66-95.
- Demombynes, G., & Ozler, B. (2002). *Crime and Local Inequality in South Africa*. POLICY RESEARCH WORKING PAPER 2925, The World Bank, Development Research Group.
- Detotto, C., & Otranto, E. (2010). Does Crime Affect Economic Growth? *KYKLOS*, 63, 330-345.
- Dinkelman, T. (2011). The Effects of Rural Electrification on Employment: New Evidence from South Africa. *American Economic Review*, 101(December 2011), 3078-3108.
- Dyck, A., & Ovaska, T. (2011). Business Environment and New Firm Creation: An International Comparison. *Journal of Small Business & Entrepreneurship*, 24(3), 301-317.
- Edwards, L., & Sundaram, A. (2013). *Private Sector Growth in Marginalised Localities in South Africa: Assessing private sector growth potential*. Washington D.C: World Bank.

- Eifert, B., Gelb, A., & Ramachandran, V. (2008). The cost of doing business in Africa: Evidence from enterprise survey data. *World Development*, 1531-1546.
- Elhiraika, A., & Nkurunziza, J. (2006). *Facilitating Firm Entry, Growth and Survival with Special Attention to SMEs*. African Trade Policy Centre.
- Gathani, S., Santini, M., & Stoelinga, D. (2013). Innovative techniques to evaluate the Impact of private sector development reform: An application to Rwanda and 11 other countries. *MPSA Annual Conference*.
- Gaviria, A. (2002). Assessing the effects of corruption and crime on firm performance: evidence from Latin America. *Emerging Markets Review*, 3, 245-268.
- Gibbons, S. (2004). The Costs of Urban Property Crime. *The Economic Journal*, 114(499), F441-F463.
- Grossman, G., & Helpman, E. (1991a). *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.
- Haltiwanger, J. (2012). Job Creation and Firm Dynamics in the United States. *Innovation Policy and the Economy*, 12, 17-38.
- Hidalgo, D. F., Naidu, S., Nichter, S., & Richardson, N. (2010). Economic Determinants of Land Invasions. *Review of Economics and Statistics*, 92(3), 505-523.
- Huffman, G., & Bolvin, D. (2014). *TRMM and Other Data Precipitation Data Set Documentation*.
- Ihlanfeldt, K., & Mayock, T. (2009). *Crime and Housing Prices*. Florida State University. Department of Economics and DeVoe Moore Center.
- Islam, A. (2014). *Economic Growth and Crime against Small and Medium Sized Enterprises in Developing Economies*. Policy Research Working Paper 6768.
- Kahn, M. (2010). New Evidence on the Trends in the Cost of Urban Agglomeration. In E. L. Glaeser (Ed.), *Agglomeration Economics* (pp. 339-354). NBER and University of Chicago Press.
- Kaplan, D., Morris, M., & Martin, L. (2014). *Identifying and developing sustainable interventions to promote non-automotive industries in the Eastern Cape*. Report prepared for the National Treasury.
- Kimou, A. J., & Gyimah-Brempong, K. (2012). *Crime, Self Protection and Business Growth in Cote d'Ivoire I*.
- Klapper, L., & Love, I. (2010). *The Impact of Business Environment Reforms on New Firm Registration*. The World Bank.
- Klapper, L., & Richmond, C. (2011). Patterns of business creation, survival and growth: Evidence from Africa. *Labour Economics*, 18, S32-S44.
- Klapper, L., Lewin, A., & Delgado, J. M. (2009). *The Impact of the Business Environment on the Business Creation Process*. Washington D C: The World Bank.

- Lall, S. V., Schroeder, E., & Schmidt, E. (2014). Identifying Spatial Efficiency–Equity Trade-offs in Territorial Development Policies: Evidence from Uganda. *The Journal of Development Studies*.
- McDonald, K., Schlemmer, L., & Rankin, N. (2008). *The impact of crime on small businesses in South Africa*. South Africa: SBP Johannesburg.
- Miguel, E. (2005). Poverty and witch killing. *The Review of Economic Studies*, 72(4), 1153-1172.
- Miguel, E., & Satyanath, S. (2011). Re-examining Economic Shocks and Civil Conflict. *American Economic Journal: Applied Economics*, 3(October 2011), 228-232.
- Miguel, E., Satyanath, S., & Sergenti, E. (2004). Economic Shocks and Civil Conflict: An Instrumental Variable Approach. *Journal of Political Economy*, 112(4), 725-753.
- Motta, M., Oviedo, A. M., & Santini, M. (2010). *AN Open Door for Firms: The Impact of Business Entry Reforms*. The World Bank.
- NASA-TRMM. (2015). *TRMM Online Visualization and Analysis System (TOVAS) :TRMM Level-3 Monthly Products*. Retrieved from http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=TRMM_Monthly
- Quantec Research. (2014). *data from*. Retrieved June 2014, from <http://www.easydata.co.za/>
- Rogall, T., & Guariso, A. (2013). *The Escalation of Violence: Armed Groups and Civilian Perpetrators*. Working Paper.
- Rogerson, C., & Rogerson, J. (2010). Improving the local business environment of Johannesburg. *Development Southern Africa*, 27(4).
- Romer, P. (1990). Endogenous Technological Change. *Journal of Political Economy*, 94(October), 1002-1037.
- Shiferaw, A., & Bedi, A. S. (2009). *The Dynamics of Job Creation and Job Destruction: Is Sub-Saharan Africa Different?* IZA Discussion Papers 4623.
- South African Police Service. (2014). *Crime Situation in South Africa*. Retrieved June 2014, from http://www.saps.gov.za/resource_centre/publications/statistics/crimestats/2014/crime_stats.php
- Statistics South Africa. (2012). *Regional economic growth*. Statistics South Africa.
- Stel, A. v., Carree, M., & Thurick, R. (2005). The Effect of Entrepreneurship Activity on National Economic Growth. *Small Business Economics*, 24, 311-321.
- Stock, J. H., Wright, J. H., & Yogo, M. (2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business & Economic Statistics*, 20(4).
- Stone, C. (2006). *Crime, justice, and growth in South Africa: Toward a plausible contribution from criminal justice to economic growth*. John F. Kennedy School of Government Working Paper No. RWP06-038 .

- Thomas, A. (2006). Consistent estimation of binary-choice panel data models with heterogenous linear trends. *Econometrics Journal*, 9, 177-395.
- Tolonen, A. K. (2015). Extractive Industries, Production Shocks and Criminality: Evidence from a Middle-Income Country. *2015 Fall Conference: The Golden Age of Evidence-Based Policy, Appam*.
- Venables, A. J. (2010). Economic geography and African development. *Regional Science*.
- Wong, P. K., Yuen, H. P., & Autio, E. (2005). Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data. *Small Business Economics*, 24, 335-350.
- Wooldridge, J. M. (2012). *Introductory Econometrics: A Modern Approach* (Vol. Fifth Edition).
- World Bank. (2004). *World Development Report 2005: A Better Investment Climate For Everyone*. World Bank.
- World Bank. (2007). *Doing Business 2008*. Washington D C: World Bank.
- World Bank. (2010). *Second Investment Climate Assessment: Business Environment Issues in Shared Growth*. Washington DC.: World Bank.
- World Bank. (2014). *Local Development and Economic Integration in South Africa*.

8. Appendix

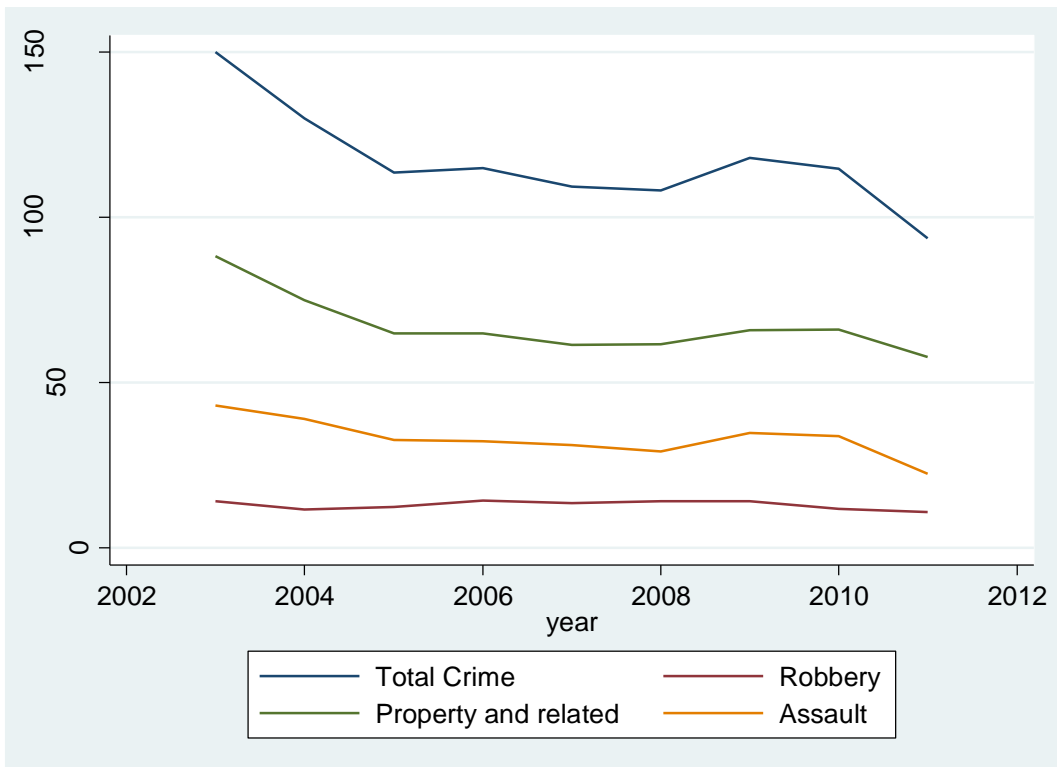


Figure A1: South Africa wide average crime rates (crime per 1000 population) over time

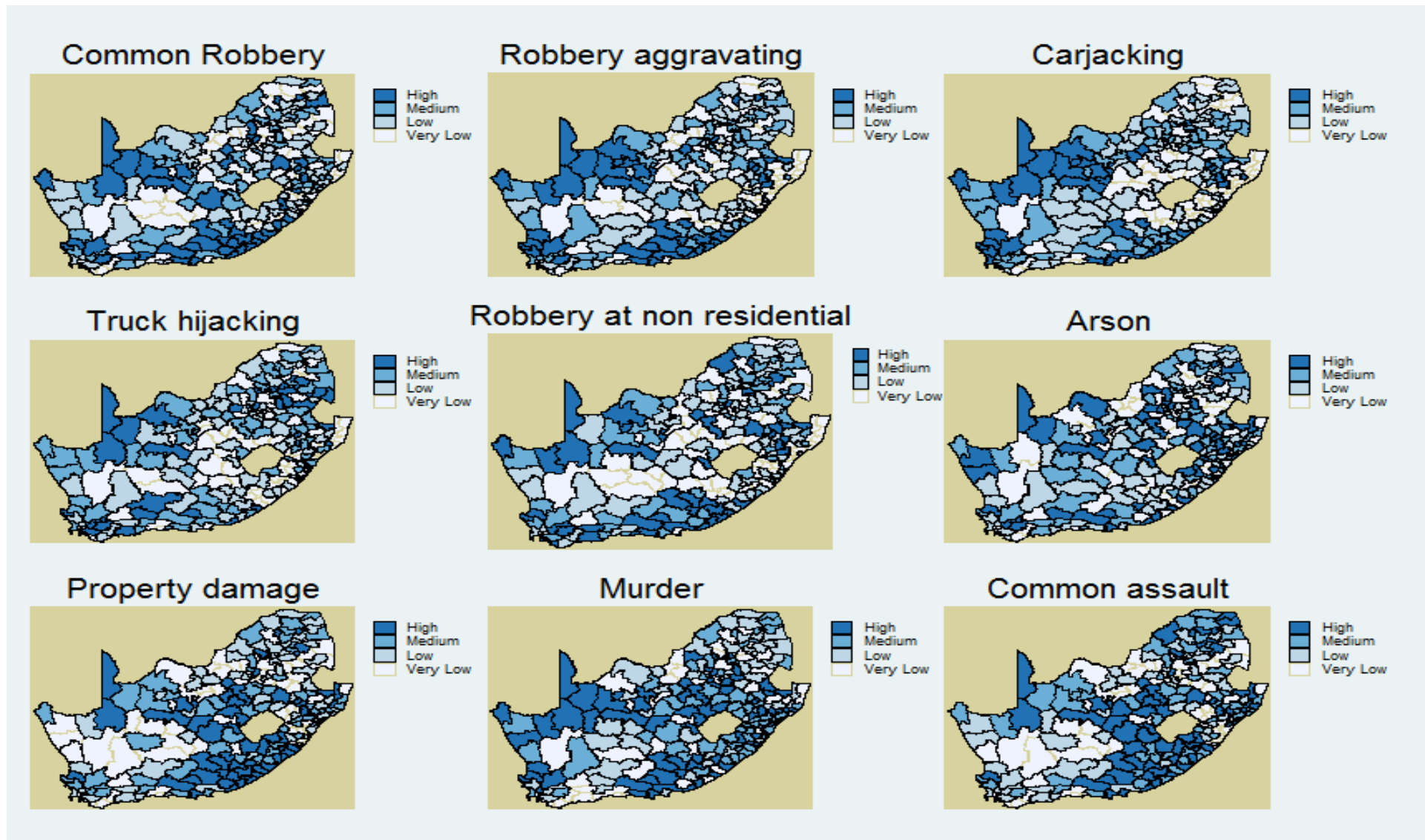


Figure A2: Spatial distribution of average 2003-2011 crime rates (crime per 1000 population)

List of municipalities in the sample

Municipality/Main place area	No of years	Municipality/Main place area	No of years	Municipality/Main place area	No of years	Municipality/Main place area	No of years
//Khara Hais Local Municipality	9	Emalahleni Local Municipality	9	Midvaal Local Municipality	9	Springs Stellenbosch Local Municipality	9
Adams Mission	9	Emfuleni Local Municipality	9	Milnerton and surrounds	9	Steve Tshwete Local Municipality	9
Albert Luthuli Local Municipality	9	Emthanjeni Local Municipality	9	Mitchell's Plain Mkhambathini Local Municipality	9	Strand and surrounds	9
Alberton	9	Excelsior	8	Modimolle Local Municipality	9	Swellendam Local Municipality	9
Alexandra	9	Ga-Rankuwa	9	Mogale City Local Municipality	9	Temba_Hammanskraal_Amade bele	9
Amahlathi Local Municipality	9	Gariep Local Municipality	9	Molemole Local Municipality	9	Thaba Chweu Local Municipality	9
Amanzimtoti and surrounds	9	George Local Municipality	9	Moqhaka Local Municipality	9	The Msunduzi Local Municipality	9
Atteridgeville	9	Germiston and surrounds	9	Mossel Bay Local Municipality	9	Theewaterskloof Local Municipality	9
Bapsfontein	9	Goodwood	9	Motherwell	9	Thembelihle Local Municipality	9
Beaufort West Local Municipality	9	Gordons Bay	9	Mpofana Local Municipality	9	Thembisile Local Municipality	9
Bedfordview	9	Hessequa Local Municipality	9	Msukaligwa Local Municipality	9	Thulamela Local Municipality	9
Bellville	9	Ibhayi_Kwadwesi	9	Musina Local Municipality	9	Tsakane	9
Benoni and surrounds	9	Impendle Local Municipality	9	Mutale Local Municipality	9	Tswaing Local Municipality	9
Bergrivier Local Municipality	9	Inanda_Mawotana and surrounds	9	Ndlambe Local Municipality	9	Ubuntu Local Municipality	9
Bethelsdorp	9	Inchanga Inxuba Yethemba Local Municipality	9	Ndwedwe Local Municipality	9	Uitenhage and surrounds	9
Bitou Local Municipality	9	Johannesburg	9	Newcastle Local Municipality	9	Umjindi Local Municipality	9
Blouberg Local Municipality	9	Kagiso_Slovoville_Tshepisonq	9	Newlands area	9	Umkomaas and surrounds	9
Blue Downs_Eersterivier	9	Kannaland Local Municipality	9	Ngwathe Local Municipality	9	Umlazi_Malagazi Umsobomvu Local Municipality	9
Boksburg and surrounds	9	Kareeberg Local Municipality	9	Nigel	9	Verulam and surrounds	9
Brackenfell	9	Katlehong	9	Nkomazi Local Municipality	9	Vosloorus	9
Brakpan	9	Kgetlengrivier Local Municipality	9	Nokeng tsa Taemane Local Municipality	9		
Breede River/Winelands Local Municip..	9						

Breede Valley Local Municipality	9	Khayelitsha	9	Noordhoek	9	Westonaria Local Municipality	9
Bushbuckridge Local Municipality	9	Khâi-Ma Local Municipality	9	North Coast Tongaat and surrounds	9	Westville	9
Cannonvale_Colchester	9	King Sabata Dalindyebo Local Municipality	9	Ntuzuma	9	Witzenberg Local Municipality	9
Cape Agulhas Local Municipality	9	Knysna Local Municipality	9	OrangeFarm_Poortjie	9	uMngeni Local Municipality	9
Cape Peninsula	9	Kou-Kamma Local Municipality	9	Oudtshoorn Local Municipality	9	uMshwathi Local Municipality	9
Cape Town area	9	Kraaifontein	9	Overstrand Local Municipality	9	Embo/Nksa Isimahla	9
Cato Ridge	9	Kuilsriver	9	Parow	9	Gqebera	9
Central Karoo	9	Kwa-Mashu	8	Phoenix	9	Mamre	9
Centurion and surrounds	9	KwaThema	9	Phumelela Local Municipality	9	Total	1,663
Chatsworth_Klaarwater	9	Kwadabeka	9	Pinetown and surrounds	9		
City of Tshwane Metro Part 1 [Part o..	9	Kwanobuhle	9	Polokwane Local Municipality	9		
Crossroads_Guguletu_Nyanga	9	Lamontville	9	Port Elizabeth area	9		
Dassenhoek_KwaNdengezi	9	Langa	9	Pretoria_Akasia	9		
Daveyton_Etwatwa_Lithuli	9	Lekwa Local Municipality	9	Prince Albert Local Municipality	9		
Delmas Local Municipality	9	Lesedi Local Municipality	9	Queensburgh	9		
Despatch	9	Local Municipality of Madibeng	9	Randburg and surrounds	9		
Diepkloof	9	Lukanji Local Municipality	9	Randfontein Local Municipality	9		
Diepsloot	9	Mabopane	9	Renosterberg Local Municipality	9		
Dikgatlong Local Municipality	9	Mafube Local Municipality	9	Richmond Local Municipality	9		
Dipaleseng Local Municipality	9	Makhado Local Municipality	9	Roodepoort	9		
Ditsobotla Local Municipality	9	Maletswai Local Municipality	9	Sakhisizwe Local Municipality	9		
Dr JS Moroka Local Municipality	9	Maluti a Phofung Local Municipality	9	Sandton	9		
Drakenstein Local Municipality	9	Mamellodi_Nellmapius	9	Seme Local Municipality	9		
Duduza	9	Mantsopa Local Municipality	9	Senqu Local Municipality	9		
Durban	9	Matzikama Local Municipality	9	Siyancuma Local Municipality	9		
Durbanville and surrounds	9	Mbhashe Local Municipality	9	Siyathemba Local Municipality	9		
Eden	9	Mbombela Local Municipality	9	Somerset West and surrounds	9		

Elsiesrivier	9	Meadowlands	9	Soshanguve	9
Emakhazeni Local Municipality	9	Metsimaholo Local Municipality	9	Soweto	9

Table A1: Summary statistics of variables used in the estimation

Variable		Mean	Std. Dev.	Min	Max	Observations
Log entry of firms	overall	3.712665	1.864494	0	8.689465	N = 1663
	between		1.797556	0	8.40409	n = 185
	within		0.5145	1.514476	5.228247	T = 8.98919
Log(robbery)	overall	1.374198	1.193838	-2.483656	7.154466	N = 1663
	between		1.163714	-1.294071	6.924731	n = 185
	within		0.285554	-0.2198823	3.69689	T = 8.98919
Log (property)	overall	3.393468	1.028901	0	7.955269	N = 1663
	between		1.020069	0.511055	7.612184	n = 185
	within		0.1893938	2.791862	6.09679	T = 8.98919
Log (assault)	overall	2.731419	0.8389865	0	7.693818	N = 1663
	between		0.8254393	0.4815181	7.419244	n = 185
	within		0.2031603	2.03477	5.333567	T = 8.98919
Log (per capita household income)	overall	-2.707977	0.5009875	-4.178932	-1.161864	N = 1663
	between		0.4859784	-4.040745	-1.507156	n = 185
	within		0.1280753	-3.501989	-2.033919	T = 8.98919
Log (share of households with electricity)	overall	-1.603987	0.3809164	-3.761164	-0.0272623	N = 1663
	between		0.3633907	-3.225403	-0.0907635	n = 185
	within		0.1168426	-2.270681	-1.158427	T = 8.98919
Log (share of households without school)	overall	-2.233185	0.4589844	-3.525444	0	N = 1663
	between		0.4481872	-3.455055	0	n = 185
	within		0.1081065	-2.782377	-1.785001	T = 8.98919
Log (share of households with primary education)	overall	-0.3535284	0.0701842	-0.7467173	-0.2059469	N = 1663
	between		0.066936	-0.6397312	-0.2122418	n = 185
	within		0.021526	-0.4895112	-0.2208856	T = 8.98919
Log (share of households with tertiary education)	overall	-1.727358	0.184057	-2.123011	-0.7698903	N = 1663
	between		0.1756613	-2.050186	-0.8076523	n = 185

Principal component utilities	within		0.0566096	-2.064112	-1.492401	T = 8.98919
	overall	-1.14E-09	1.526666	-5.151599	9.243518	N = 1663
	between		1.500274	-4.198271	9.21606	n = 185
Log (share of households with access to telecomms)	within		0.3010582	-1.331927	3.517619	T = 8.98919
	overall	-1.31728	0.1564648	-1.722726	0	N = 1663
	between		0.155183	-1.684677	-0.0063905	n = 185
Rain deviation (monthly)	within		0.0224107	-1.440484	-1.194889	T = 8.98919
	overall	0.1232331	4.186638	-8.41962	13.57552	N = 1663
	between		0.3115297	-0.5618158	0.6819858	n = 185
Average rain (mm/day)	within		4.175079	-8.260827	13.59842	T = 8.98919
	overall	1.891304	0.609552	0.188151	4.082	N = 1663
	between		0.455172	0.3985657	2.966444	n = 185
Annual rainfall(mm/year)	within		0.4068019	0.8261932	3.348193	T = 8.98919
	overall	689.9687	222.4229	68.72899	1488.648	N = 1663
	between		166.3494	144.8441	1077.797	n = 185
	within		148.1487	297.6834	1219.043	T = 8.98919



Figure A3: Crime and Firm entry over the 2003-2011 period

Table A2 : Pooled OLS and Fixed Effects Regression: Crime and Firm Entry

	Robbery		Property		Assault	
	OLS (1)	FE (2)	OLS (3)	FE (4)	OLS (5)	FE (6)
Log (robbery)	0.383*** (0.0582)	-0.145** (0.0716)				
Log (property)			0.275*** (0.0684)	-0.422* (0.235)		
Log(assault)					-0.531*** (0.0548)	-0.266 (0.192)
Log(per capita household income)	0.124 (0.105)	0.704*** (0.204)	0.0223 (0.110)	0.644*** (0.219)	0.227** (0.105)	0.657*** (0.214)
Log (share households with electricity)	-0.0826 (0.236)	0.300 (0.270)	-0.00645 (0.251)	0.293 (0.272)	0.140 (0.265)	0.283 (0.266)
Log (share households without education)	-0.683*** (0.203)	1.033 (0.630)	-0.754*** (0.205)	0.945 (0.630)	-1.036*** (0.175)	0.989 (0.630)
Log(share households with primary education)	-7.192*** (1.384)	12.19*** (2.775)	-8.733*** (1.385)	11.41*** (2.738)	-9.084*** (1.303)	11.65*** (2.754)
Log (share households with tertiary education)	-1.984*** (0.549)	6.253*** (1.086)	-2.548*** (0.553)	5.940*** (1.061)	-2.938*** (0.515)	6.047*** (1.061)
Principal component utilities	0.166* (0.100)	0.0606 (0.176)	0.222** (0.105)	0.0616 (0.184)	0.125 (0.111)	0.0708 (0.176)
Log (share households with access to telecomms)	-1.763** (0.785)	0.449 (1.614)	-1.870** (0.836)	0.593 (1.733)	0.197 (0.852)	0.539 (1.643)
R-squared	0.078	0.116	0.043	0.130	0.073	0.118
Number of municipalities		185		185		185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the natural log of entry. Province specific trends and municipal fixed effects included. Total number of observations is 1663.

Table A3 : First Stage Regression: Rainfall and Crime

	Robbery		Property		Assault	
	1	2	3	4	5	6
Average rain (mm/day)	-0.0257 (0.0180)		-0.0513*** (0.00954)		-0.0264** (0.0115)	
Rain deviation		-0.00227 (0.00176)		-0.00400*** (0.00106)		-0.00261** (0.00117)
Log (per capita household income)	0.00383 (0.122)	0.00224 (0.122)	-0.129 (0.0874)	-0.134 (0.0874)	-0.171** (0.0786)	-0.172** (0.0787)
Log (share households with electricity)	0.185 (0.192)	0.184 (0.193)	0.0448 (0.0960)	0.0431 (0.0967)	0.0368 (0.116)	0.0357 (0.116)
Log (share households without education)	-0.905** (0.437)	-0.912** (0.438)	-0.473** (0.213)	-0.493** (0.214)	-0.645** (0.284)	-0.650** (0.285)
Log (share households with primary education)	-4.294*** (1.542)	-4.315*** (1.544)	-3.130*** (0.993)	-3.195*** (0.991)	-4.291*** (1.050)	-4.300*** (1.048)
Log (share households with tertiary education)	-1.508** (0.605)	-1.518** (0.605)	-1.176*** (0.395)	-1.206*** (0.394)	-1.571*** (0.410)	-1.576*** (0.408)
Principal component utilities	0.0724 (0.0703)	0.0722 (0.0701)	0.0274 (0.0617)	0.0270 (0.0616)	0.0778 (0.0634)	0.0775 (0.0633)
Log (share of households with access to telecomms)	-1.329 (0.830)	-1.320 (0.829)	-0.121 (0.688)	-0.104 (0.685)	-0.390 (0.698)	-0.380 (0.695)
R-squared	0.070	0.069	0.194	0.190	0.300	0.300
Number of municipalities	185	185	185	185	185	185
F-stat	3.442	3.500	14.97	13.90	25.20	25.44

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the natural log of robbery, assault and property crime rates. Province specific trends and municipal fixed effects included. Total number of observations is 1663.

Table A4: Reduced form estimates: Rainfall and Entry

	Entry	
	1	2
Average rain	0.174*** (0.0259)	
Rain deviation		0.0117*** (0.00277)
R-squared	0.127	0.118
Number of municipalities	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the natural log of entry. We also included various control variables. Province specific trends and municipality fixed effects included. Total number of observations is 1663.

Table A5 : Impact of Crime on Firm Entry (IV-2SLS)

	Property		Assault	
	Average Rain (1)	Rain deviation (2)	Average Rain (3)	Rain deviation (4)
Log(property)	-3.383*** (0.767)	-2.916*** (1.014)		
Log (assault)			-6.568** (2.919)	-4.468** (2.187)
Number of municipalities	185	185	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of entry. We also included various control variables. Province specific trends and municipality fixed effects included. Total number of observations is 1663.

Table A6: First Stage Regression: Rainfall and Crime (common time trend)

	Robbery		Property		Assault	
	(1)	(2)	(3)	(4)	(5)	(6)
Average rain	-0.0598*** (0.0184)		-0.0422*** (0.00877)		-0.0174* (0.00981)	
Rain deviation		-0.00572*** (0.00176)		-0.00272*** (0.000858)		-0.00132 (0.000889)
Log (per capita household income)	0.0579 (0.128)	0.0563 (0.128)	-0.109 (0.0723)	-0.111 (0.0723)	-0.0990 (0.0784)	-0.0996 (0.0785)
Log (share of households with electricity)	0.347* (0.183)	0.348* (0.183)	0.107 (0.0926)	0.111 (0.0929)	0.144 (0.106)	0.145 (0.106)
Log (share households without education)	-0.741* (0.421)	-0.747* (0.421)	-0.519** (0.225)	-0.531** (0.224)	-0.593** (0.297)	-0.597** (0.297)
Log(share households with primary education)	-4.315*** (1.528)	-4.296*** (1.531)	-3.015*** (0.927)	-3.093*** (0.927)	-3.488*** (0.964)	-3.507*** (0.958)
Log (share households with tertiary education)	-1.454** (0.577)	-1.458** (0.576)	-1.318*** (0.399)	-1.352*** (0.396)	-1.250*** (0.403)	-1.259*** (0.399)
Principal component utilities	0.0192 (0.0690)	0.0184 (0.0688)	0.0176 (0.0636)	0.0164 (0.0633)	0.0970 (0.0655)	0.0966 (0.0654)
Log (share of households with access to telecomms)	-1.349 (0.830)	-1.330 (0.827)	-0.295 (0.656)	-0.290 (0.653)	-0.562 (0.664)	-0.559 (0.662)
R-squared	0.027	0.027	0.158	0.153	0.264	0.263
Number of municipalities	185	185	185	185	185	185
F-stats	2.732	2.850	18.85	16.97	34.85	34.81

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of assault, property and robbery crime rates. Common time trends and municipality fixed effects included. Total number of observations is 1663.

Table A7: Reduced Form regressions: Rainfall and Entry (common time trends)

	Entry	
	(1)	(2)
Average rain	0.134*** (0.0259)	
Rain deviation		0.00768*** (0.00270)
Log (per capita household income)	0.648*** (0.205)	0.652*** (0.205)
Log (share of households with electricity)	0.166 (0.250)	0.152 (0.248)
Log (share households without education)	0.772 (0.641)	0.814 (0.637)
Log (share households with primary education)	7.504*** (2.643)	7.814*** (2.649)
Log (share households with tertiary education)	3.922*** (0.971)	4.052*** (0.974)
Principal component utilities	0.0422 (0.148)	0.0461 (0.150)
Log (share of households with access to telecomms)	-0.271 (1.389)	-0.277 (1.406)
R-squared	0.083	0.076
Number of municipalities	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of entry. Column (1) is regression of average rainfall (mm/day) on entry. Column (2) is regression of rainfall deviations on entry. Common time trends and municipality fixed effects included. Total number of observations is 1663.

Table A8: Impact of Crime on Firm Entry (IV-2SLS)(common time trends)

	Robbery		Property		Assault	
	Average rain (1)	Rain deviation (2)	Average rain (3)	Rain deviation (4)	Average rain (6)	Rain deviation (7)
Log (robbery)	-2.232*** (0.769)	-1.342** (0.588)				
Log (robbery)			-3.166*** (0.832)	-2.821** (1.244)		
Log (assault)					-7.674 (5.222)	-5.835 (5.346)
Number of municipalities	185	185	185	185	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of entry. Controls included. Second stage regression of various crime types, instrumented by either average rain and rainfall deviations, on firm entry. Common time trends and municipality fixed effects included. Total number of observations is 1663.

Table A9: First Stage Regression: Rainfall and Crime (year dummies)

	Robbery		Property		Assault	
	(1)	(2)	(3)	(4)	(5)	(2)
Average rain	-0.0474** (0.0215)		0.00474 (0.0101)		0.00900 (0.0120)	
Rain deviation		-0.00621*** (0.00208)		0.00121 (0.00101)		0.000959 (0.00109)
Log (per capita household income)	0.103 (0.134)	0.100 (0.134)	-0.0354 (0.0706)	-0.0346 (0.0706)	-0.0358 (0.0775)	-0.0354 (0.0774)
Log (share of households with electricity)	0.330* (0.181)	0.327* (0.181)	0.104 (0.0835)	0.106 (0.0832)	0.144 (0.0959)	0.144 (0.0956)
Log (share households without education)	-0.313 (0.440)	-0.308 (0.437)	-0.158 (0.204)	-0.158 (0.204)	-0.427 (0.294)	-0.428 (0.294)
Log(share households with primary education)	-3.348** (1.501)	-3.235** (1.494)	-1.880** (0.874)	-1.918** (0.873)	-2.734*** (0.947)	-2.746*** (0.946)
Log (share households with tertiary education)	-1.239** (0.563)	-1.214** (0.560)	-0.887** (0.378)	-0.898** (0.375)	-0.898** (0.391)	-0.900** (0.388)
Principal component utilities	0.0283 (0.0697)	0.0280 (0.0692)	0.0210 (0.0635)	0.0209 (0.0635)	0.0981 (0.0669)	0.0982 (0.0670)
Log (share households with tertiary education)	-1.438* (0.826)	-1.409* (0.821)	-0.335 (0.661)	-0.342 (0.659)	-0.575 (0.674)	-0.579 (0.673)
R-squared	0.075	0.077	0.262	0.262	0.303	0.303
Number of municipalities	185	185	185	185	185	185
F-stats	8.388	8.485	35.78	35.80	23.98	23.94

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of crime rates. Municipal fixed effects and year dummies included. Total number of observations is 1663.

Table A10: Reduced Form regressions: Rainfall and Entry (year dummies)

	Entry	
	(1)	(2)
Average rain	-0.0735** (0.0307)	
Rain deviation		-0.00931*** (0.00309)
Number of municipalities	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of entry. Controls included. Column (1) is regression of average rainfall (mm/day) on entry. Column (2) is regression of rainfall deviations on entry. Municipal fixed effects and year dummies included. Total number of observations is 1663.

Table A11: Impact of Crime on Firm Entry (IV-2SLS)

	Robbery		Property		Assault	
	Average rain (1)	Rain deviation (2)	Average rain (3)	Rain deviation (4)	Average rain (5)	Rain deviation (7)
Log(robbery)	1.549 (0.996)	1.498** (0.748)				
Log(property)			-15.50 (34.07)	-7.662 (6.859)		
Log(assault)					-8.165 (11.44)	-9.706 (13.89)
Number of municipalities	185	185	185	185	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of entry. Controls included. Second stage regression of various crime types, instrumented by either average rain and rainfall deviations, on firm entry. Municipal fixed effects and year dummies included. Total number of observations is 1663.

Table A12: Pooled OLS and Fixed Effects Regression: Contact crime and firm Entry

	OLS	FE	FE
	Contact	Year dummies	Province trend
	(1)	(2)	(3)
Log (contact crime rates)	-0.240*** (0.0635)	0.0870 (0.127)	-0.169 (0.177)
Log (per capita household income)	0.150 (0.107)	0.318 (0.207)	0.681*** (0.210)
Log (share of households with electricity)	0.0994 (0.265)	0.1000 (0.222)	0.288 (0.264)
Log (share households without education)	-0.992*** (0.188)	0.419 (0.543)	1.027 (0.641)
Log (share households with primary education)	-9.341*** (1.353)	2.397 (2.287)	11.99*** (2.783)
Log (share households with tertiary education)	-2.931*** (0.535)	0.734 (0.883)	6.183*** (1.068)
Principal component utilities	0.163 (0.110)	0.0819 (0.0853)	0.0661 (0.174)
Log (share households with access to telecomms)	-0.470 (0.855)	-0.770 (0.959)	0.507 (1.602)
Municipal fixed effects		Yes	Yes
Year dummies		Yes	No
Province specific time trends		No	Yes
R-squared	0.034	0.544	0.114
Number of municipalities		185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of entry. Contact crime rates include crime classified under robbery and assault. Total number of observations is 1663.

Table A13: First stage regression of rainfall and contact crime rates

	Contact Crime			
	Year dummies		Province trends	
	Average rain (1)	Rain deviation (2)	Average rain (3)	Rain deviation (4)
Average rain	0.000197 (0.0128)		-0.0215* (0.0121)	
Rain deviation		-9.07e-05 (0.00116)		-0.00210 (0.00128)
Log (per capita household income)	-0.0100 (0.0886)	-0.0101 (0.0886)	-0.132 (0.0948)	-0.133 (0.0949)
Log (share of households with electricity)	0.199* (0.102)	0.199* (0.102)	0.0848 (0.128)	0.0839 (0.128)
Log (share households without education)	-0.559* (0.287)	-0.559* (0.287)	-0.810*** (0.291)	-0.815*** (0.291)
Log (share households with primary education)	-3.385*** (1.006)	-3.380*** (1.005)	-4.846*** (1.145)	-4.855*** (1.142)
Log (share households with tertiary education)	-1.113*** (0.424)	-1.111*** (0.421)	-1.709*** (0.445)	-1.714*** (0.443)
Principal component utilities	0.101 (0.0751)	0.101 (0.0752)	0.0946 (0.0745)	0.0944 (0.0744)
Log (share households with access to telecomms)	-0.960 (0.772)	-0.959 (0.770)	-0.800 (0.808)	-0.792 (0.805)
Municipal fixed effects	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	No	No
Province specific trends	No	No	Yes	Yes
R-squared	0.214	0.214	0.205	0.205
Number of municipalities	185	185	185	185
F-stat	16.54	16.54	14.68	14.90

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the natural log of contact crime rates. Contact crime rates include crime classified under robbery and assault. Total number of observations is 1663.

Table A14: Impact of Contact Crime on Firm Entry (IV-2SLS)

	Entry	
	Average rain	Rain deviation
	(1)	(2)
Log (contact crime rates)	-8.060* (4.556)	-5.536 (3.519)
Log (per capita household income)	-0.416 (0.823)	-0.0650 (0.627)
Log (share of households with electricity)	0.957 (1.071)	0.743 (0.757)
Log (share households without education)	-5.553 (4.347)	-3.448 (3.273)
Log (share households with primary education)	-27.03 (21.90)	-14.55 (16.65)
Log (share households with tertiary education)	-7.645 (7.638)	-3.221 (5.637)
Principal component utilities	0.813 (0.699)	0.574 (0.472)
Log (share households with access to telecomms)	-5.793 (6.910)	-3.777 (4.620)
Number of municipalities	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of firm entry. Municipal fixed effects and year dummies included. Total number of observations is 1663.

Table A15: Impact of crime on Firm Entry (2SLS-IV): Different time periods (main specification)

	Total crime		Property	
	2003-2007	2008-2011	2003-2007	2008-2011
Total crime	-3.033** (1.373)	-89.40 (430.7)		
Property crime			-4.016* (2.307)	-88.34 (329.3)
Observations	924	739	924	739
Number of municipalities	185	185	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of entry. Controls included. We also included municipality fixed effects and municipality specific time trends.

Table A16: Pooled OLS and Fixed effects estimate: Principal component crime and Firm entry : whole sample

	(1) OLS	(2) FE	(3) FE
Principal component crime	-0.101*** (0.00949)	0.00785 (0.0196)	0.0237 (0.0241)
Log(per capita household income)	0.0672 (0.103)	0.704*** (0.209)	0.315 (0.205)
Log (share of households with electricity)	-0.0413 (0.260)	0.271 (0.265)	0.110 (0.224)
Log(share households without education)	-1.038*** (0.179)	1.184* (0.637)	0.407 (0.538)
Log(share households with primary education)	-8.919*** (1.320)	12.87*** (2.808)	2.209 (2.326)
Log(share households with tertiary education)	-2.643*** (0.525)	6.498*** (1.112)	0.684 (0.911)
Principal component utilities	0.196* (0.108)	0.0495 (0.172)	0.0895 (0.0949)
Log (share households with access to telecomms)	-0.831 (0.827)	0.651 (1.595)	-0.830 (1.036)
Municipality fixed effects		Yes	Yes
Year dummies		No	Yes
Province specific trend		Yes	No
R-squared	0.060	0.110	0.543
Number of municipalities		185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of firm entry. Total number of observations is 1663.

Table A17: First Stage regression of rainfall and principal component of crime: whole sample

	Province time trends		Year dummies	
	(1)	(2)	(3)	(4)
Average rain	-0.0249 (0.0249)		-0.0134 (0.0189)	
Rain deviation		-0.00216 (0.00261)		-0.00221 (0.00184)
Log(per capita household income)	0.0970 (0.218)	0.0954 (0.217)	0.103 (0.153)	0.102 (0.153)
Log (share of households with electricity)	0.368* (0.221)	0.367* (0.221)	0.316* (0.163)	0.314* (0.164)
Log(share households without education)	-1.921** (0.779)	-1.929** (0.778)	-1.522** (0.644)	-1.521** (0.646)
Log(share households with primary education)	-5.508** (2.476)	-5.529** (2.457)	-4.438** (1.736)	-4.386** (1.708)
Log(share households with tertiary education)	-2.224** (1.111)	-2.234** (1.103)	-1.953** (0.781)	-1.940** (0.772)
Principal component utilities	0.0652 (0.0475)	0.0651 (0.0476)	0.0541 (0.0349)	0.0541 (0.0353)
Log (share households with access to telecomms)	-1.150* (0.636)	-1.141* (0.634)	-1.006* (0.554)	-0.994* (0.553)
Municipality fixed effects	Yes	Yes	Yes	Yes
Province specific trends	Yes	Yes	No	No
Year dummies	No	No	Yes	Yes
R-squared	0.025	0.025	0.035	0.035
Number of municipalities	185	185	185	185
F-stat	3.918	3.747	5.181	5.150

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is principal component of crime in levels. Total number of observations is 1663.

Table A18: Impact of Crime (principal component crime) on Firm Entry (IV-2SLS): whole sample

	Entry	
	Average rain (1)	Rain deviation (2)
Principal component crime	-6.990 (6.965)	-5.387 (6.527)
Log(per capita household income)	1.330 (1.595)	1.187 (1.333)
Log (share of households with electricity)	2.845 (2.626)	2.255 (2.446)
Log(share households without education)	-12.45 (12.85)	-9.328 (11.43)
Log(share households with primary education)	-26.47 (37.69)	-17.46 (32.61)
Log(share households with tertiary education)	-9.412 (15.08)	-5.768 (12.83)
Principal component utilities	0.506 (0.678)	0.402 (0.592)
Log (share households with access to telecomms)	-7.379 (7.925)	-5.539 (7.669)
Observations	1,663	1,663
Number of municipalities	185	185

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is natural log of firm entry. Municipal fixed effects and province specific trends included. Total number of observations is 1663.