

Crime, Self Protection and Business Growth in Cote d'Ivoire¹

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Abstract

Cote d'Ivoire was considered an island of stability and economic prosperity in a region of stagnation, and political turmoil. The situation was reversed in the early 2000, when a decade of instability is associated with poor economic performance. On the path of post-conflict reconstruction, the country faces surges in crime and violence, what will likely to challenge the dynamics of the private sector. The private sector is indeed the one that can lead this reconstruction by creating jobs and reducing the burden of poverty. Yet, very little is known about the effects of crime on private sector in Cote d'Ivoire even huge it may be important in the development of the business activities. Referring to a model on the relationship between, production function, level of crime and self-protection, this paper tested empirically the impact of crime on business activity in Cote d'Ivoire. Using a recent World Bank enterprise survey dataset and a quasi-experimental methodology we controlled for the direction of effects of crime on profitability and investment. As predicted by our theoretical framework, we found a mixed effects of crime through the channel of private provision of security: self-protection increases the profitability of contracted firms while hampering their level of investment.

KEY WORDS: CRIME, PRIVATE PROTECTION, BUSINESS,COTE D'IVOIRE

JEL: C31. D21. K40. K42. O12.

1 Introduction

In the immediate period after independence, Cote d'Ivoire was considered an island of stability and economic prosperity in a region of radical economic ideologies, stagnation, and political turmoil. The situation was reversed in the late 1990s, when a coup d'etat, repeated coup attempts, a series of violent clashes ultimately resulted in a civil war in 2002 (Akindes, 2002). This decade of instability was associated with poor economic performance, breakdown of law and order, increased violent crime, and a deterioration of business environment as recorded in most international governance reports. The *Mo Ibrahim Governance Report on Africa* ranked Cote d'Ivoire 46th out of 53 countries in 2011 and the country was ranked 170th out 183 worldwide in the World Bank's 2011 *Doing Business Report*.

Kimou (2010) shows that possession of illegal firearms increased noticeably in this period and the average counts of aggravated assaults increased by 100% compared to a decade earlier. The Ivorian Chamber of Commerce reported that in 2004, more than 10,000 jobs were lost and 100 enterprises closed following violent demonstrations, harassment, violence, and aggravated assaults.

That phenomenon was coupled with poor enforcement of the law and inefficient judicial system with estimated ratios of policeman per inhabitant and judge per inhabitant respectively of 1/1,500 and of 1/40,000 to create a climate of fear and uncertainty.

Increased crime rate in Cote d'Ivoire, may affect the dynamics of the private sector either by impeding the inflows of foreign direct investment (FDI) due to higher country risk, by harming the performance of existing firms, or preventing new and existing domestic firms from expansion because of increased cost of production. The increasing crime rate in a context of decreased police protection may drive firms to purchase protective services in order to decrease losses from crime. How do increased crime rates affect business performance under these circumstances? Does crime decrease the formation of new business, decrease the efficiency of existing businesses or prevent the expansion of existing businesses? If increased crime negatively affects business, what is the mechanisms through which these effects take place.

This paper investigates how business firms have been affected by crime specially in a post-conflict context. We use a recent World Bank enterprise survey data for Cote d'Ivoire, and a quasi-experimental method to investigate the issue of crime and self-protection in Cote d'Ivoire. The main hypothesis we test is that crime costs, generated self-protection significantly affect the

dynamics of business. We measure business growth/constraints in two different ways— accounting profit and volume of investment.

Cote d’Ivoire is going through a post-conflict reconstruction and one of the main ways to achieve a sustained peaceful reconstruction is to achieve a rapid and sustained long term economic growth. The private sector is essential in this reconstruction through job creation and poverty reduction. This private sector led reconstruction could be derailed by increased crime. Yet, very little is known about the effects of crime and violence on private sector activity in Cote d’Ivoire even though it may be important in the development of the private sector.

This paper is a contribution to the effects of crime on business activities in Cote d’Ivoire. Using Adams *et al* (2008) methodology, we perform the parametric two-steps Heckman model for selection bias correction and then compute difference-in-difference estimates to capture the effect of treatment (paying for security) on both treated and control groups.

The issues of crime, instability and institution nexus for economic development in Africa have been not thoroughly researched. While some papers investigate either the cause and consequences of crime on both individual and society (Demombynes and Ozler: 2005, Fafchamps and Minten: 2006, Kimou: 2010) or on the microeconomic and macroeconomic impacts of institutions and instability on business sector in Sub-Saharan Africa (Azam and Langmoen: 2001, Gaviria: 2002, Asiedu: 2005, Collier and Duponchel: 2010), very few have studied how firms operating in post-conflict countries are affected by high crime rates and security threat generally. Our main results can be summarized as follow: perceived crime is found to reduce the firm’s profitability while induced self-protection increases the profit for contracting businesses. Also, we found a significant and negative relationship between self-protection and firm level investment.

The remainder of the paper is structured as follows: The next section presents the literature review; section three presents a brief overview of crime and private sector trends in Cote d’Ivoire, the fourth section describes the methodology we use to estimate the effect of crime and disorder on business growth. Section 5 presents the results and provides some policy discussions. Section 6 concludes the paper.

2 Literature Review

The negative externally caused by crime has been moderately addressed in the literature. Many authors have pointed out the negative impact of crime either on economic growth (Rubio: 1996), poverty (Fafchamps and Minten: 2002), human capital investment (Fajnzylber *et al.*: 1996) or on social capital formation (Glaeser *et al.*: 1996, 1999). The World Bank (1997) points out the negative effect of crime on governance. However, inquiry on the economic consequence of crime and violence at the firm level is becoming of great interest, even though it is yet to be studied in many contexts.

Bates and Robb (2008) investigates the effects of crime rate on firm performance at different locations and concludes that the effect of crime on firm performance might be indeterminate. If low crime areas offer higher returns than high crime areas, investments should be driven to high crime area locations until returns are equalized across all locations. If high-crime locations are riskier than low-crime areas, investments flows should be driven towards the high-crime area, *only if* firms operating in that area earn above-average profits that exceed the cost of crime because of the disutility or decreased production up to a point where expected returns to capital are equalized across the two areas.

Using survey data on business owners in the United States, multivariate analysis, and taking into account neighborhood of market operation and separating small business from other businesses, Bates and Robb found that firms that are concerned about crime are no less viable than other identical firms reporting that crime has no impact on their business. That finding suggests that firms do not take into account high crime in decision to operate in an area.

Rosenthal and Ross (2010) analyzed the effects of crime on business location in five US cities. Combining crime data and business survey and assuming that land bids differ monotonically with violent crime, they found that while firms tend to disproportionately locate in high-crime areas, an increase in 100 violent crimes would reduce the retail share of employment by 22% and reduce the high-end share of local restaurants by 4.4 percentage points.

Krkoska and Robeck (2009) investigate different aspects of victimization at the firm level in Europe and Asia, pointing out the effect of size, sector, sales growth, and business conduct as significant determinants of the likelihood of being targeted from both street firms and organized firms. Another major finding is that firms that spend a higher share of their sales on security

services reinvest a lower share of their profit; suggesting that both direct (spending on security services) and indirect effects (perception of crime) negatively impact investment at the firm level. The study does not indicate the type of firms that are likely to suffer from crime, since paying for crime can be a management policy designed to improve the firm's performance. Further, the paper did not indicate what would have been the effect of crime on businesses if they did not pay for security (counterfactual analysis). This is likely because the authors did not notice any problem of selection bias in the data used while they mention several limitations with the crime and business data.

The possibilities of selection bias and endogeneity have been addressed by Greenbaum and Tita (2004) in their analysis of the impact of increased violent crime on private sector in the United States. Using a quasi-experimental methodology on geographically disaggregated crime data across five American cities, the authors found that increased violence has the largest impact on slowing the creation of new retail businesses.

The studies that indicate either a positive or a negative effect of crime on business do not take into account the cost of self protection and the direct cost of crime through decreased production. Asiedu (2005) points to the role of legal system, institutions and political instability as determinants of foreign direct investment (FDI) to Africa and finds that efficient legal system and a good investment framework promote FDI while corruption and political instability hamper it. Of course, high crime rate in a country or state is a manifestation of institutional failure. Her result, while providing evidence on the role of instability and legal system on private investment inflows to Africa, does not analyze the effect of crime on the performance of firms that are already operating in the country nor does it indicate the sectors that are likely to be affected. Further, the paper does not address the mechanism through which institutions (or institutional failure) affects business activities.

The limitations of earlier studies are summarized by Gaviria (2002) who indicate that corruption and crime substantially reduce competitiveness. The paper investigates the impact of *perceived crime* and corruption on sales and investment growth by comparing performance of firms in developing countries and those in OECD countries. This paper has a few limitations: first, it investigates the effects of *perceived crime* and corruption, not *actual experience* of crime since the impact of crime on business may be either direct (incidence of crime) or indirect (perceived crime); second, the methodology does not allow one to infer the performance of firm without incidence of crime. Third, comparing the performance of firms in the developing countries may not be the appropriate

way to investigate the effects of crime on corporate behavior. Lastly, the work by Gaviria focused on Latin American while very little is known about the impact of crime in economic activities in the Sub-Saharan Africa. Collier and Duponchel (2010) found that the intensity of the civil conflict in Sierra Leone negatively affects labor skill accumulation at the firm.

Based on a theoretical approach borrowed from the shirking model, Azam and Langmoen (2001) empirically investigated the determinants of thefts reporting at the manufacturing firm level in Cote d'Ivoire. They found that firms that use informal means for recruitment or do not pay or pay their workers less than market wages, are likely to report theft more frequently than others. This paper, while pinpointing criminal behavior and private enforcement of the law at the firm level, did not indicate the extent to which criminal activity affected business activity in general. Further, the conclusions of the paper reveal basically a human resources management issue—selecting honest workers—rather than showing how criminal activities impact the enterprise's growth.

Our work is not a commercial victimization analysis *per se*, as in Krkoska and Robeck (2009), Rosenthal and Ross (2009) or Azam and Langmoen (2001). Our research is different of these papers in three areas. First, it investigates the effects of crime on business as a consequence of institutional failure following a civil war and political instability. Second, it jointly assesses the effects of perceived crime and private protection on business activity. Lastly, since not all firms self-protect, our empirical approach accounts for self-selection into private protection.

This paper refers to commonly used performance indicators to assess the impact of crime. However, due to data limitations, we cannot use growth rate of economic outcomes as in Gaviria (2002), Greenbaum and Tita (2004) and Renders and Gaeremynck (2009) and Rosenthal and Ross (2010). Rather, we assess the effect of crime on profitability using annual profit and firm level investment as measurements for firm's growth. According to Hax (2003), using the profit (accounting profit) as performance indicator raises the issues of separation of periods—profit is calculated for only a single period—and the possibility of manipulation by the management, making it necessary to combine both profit (accounting) and market value as complementary measurement of performance. Still, profit serves to create incentives and appears to be a good indicator for our investigation. Indeed, the stock market is not as efficient in Cote d'Ivoire as it is worldwide and that our dataset is comprised of a large number of small businesses. Also, following Krkoska and Robeck (2009), inflows of investment should be likely to assess the possible deterrent effect of crime on economic development. The latter indicator should help to assess the microeconomic impact of governance on investment flows

in a subsaharan african country, which approach is quite different from the work by Asiedu(2005).

3 Crime and Private Sector Trends in Cote d'Ivoire

Cote d'Ivoire's economy is dominated by agriculture (mostly cocoa). A decade after independence in 1960, Cote d'Ivoire attempted structural transformation through massive shift from agricultural outputs to manufactured products. GDP growth rate averaged about 7% per annum during this period. This relatively fast growth rate as powered by increased production and exports of cocoa and coffee.

However, during the 1980s, the international price of cocoa and coffee collapsed, thus beginning a long period of economic crisis including balance of payments crisis. As a consequence of the economic crisis and with the assistance of the International Monetary Fund (IMF) and the World Bank, Cote d'Ivoire started a series of reforms designed to enhance productivity, reestablish external equilibrium, and revitalize macroeconomic performance. An essential part of these reforms was the privatization of state owned enterprises (SOEs). The induced privatization led to the emergence of the private sector as the engine of economic growth. As a result the private sector contributed nearly two-thirds of GDP in the 1990s and this led to the creation of several formal sector modern jobs.

In 2008, the formal private sector consist for 24 industrial sectors according to the Standard Industrial Classification (SICs), making Cote d'Ivoire one of the most "industrialized" countries in West Africa. Chemicals and food processing account for 33% and 28.5% respectively of national industrial output. Even though economic growth was still driven by agriculture, private industry was changing the structure of the economy. Referring to the World Bank's World Development Indicators, the annual growth rate of the value added by the industrial sector to the Ivorian economy grew substantially going from -7.06% in 1990, to 0.74% in 2000 and 4.5% in 2010. Further, the preeminence of agriculture dropped from 32.5% in 1990 to 24.22% in 2000 and 22.94% in 2010 while Service's contribution to GDP, went from 44.33% (1990) to 50.93% (2000) and 49.67% in (2010) while Manufacturing went from 20.9% in 1990, 21.68% in 2000 and 19.24% in 2010.

The period of instability beginning in 1999, combined with excessive supply of light weapons stemming from the civil wars in neighboring countries such as Liberia and Sierra Leone dramatically increased the incidence of crime. In the city of Abidjan for instance, aggravated assaults and

homicides, accounted for more than three-quarters of crimes, leading to the widespread feeling of insecurity among urbanites (Kimou, 2010). Over the last two decades, the Ivorian Criminal Police reported that in the District of Abidjan, the rate of aggravated assaults for every 100,000 populations was respectively 17.42 in 1990, 169.43 in 2000 and 180.05 in 2007 while homicides rates increased significantly going from 2.61 in 1990 to 4.15 in 2000 and 6.09 in 2007.

The increase in insecurity resulted in increased country risk that caused a drop in the FDI inflows. As evidenced by the World Bank's World Development Indicators, FDI inflows to Cote d'Ivoire dropped by 30% between 2008 and 2010. The African Development Bank (2012) also pointed out that the insecurity induced by the Ivorian post-election war heavily affected the economy with the real GDP estimated to have dropped by 6% in 2011, compared to an increase of 2.4% (2010) and 3.8% (2009).

The civil war led to a de-facto partition of the country into two where the government controlled the southern part and rebels controlled the northern part. The southern region, including the District of Abidjan, the cities of San-Pedro and Yamoussoukro, endowed with most of the natural resources (Cocoa, Gold, oil), is the location of most business activities. Given this division, the government could no longer efficiently provide public law enforcement and the resultant crime rates led companies to hire private security services to protect their businesses. Between 2005 and 2008 for instance, the number of private security enterprises increased by 300% with an estimated average annual turnover of 500 million dollars (Small Arms Survey, 2011) presumably in response to increased demand for protection.

4 Model, Data, and Estimation Method

Rizzo (1979) investigate the link between crime and business growth in a simple model linking changes in property values, crime and self-protection. Setting the model in a competitive market Rizzo (1979) investigate the relationship between, production, the level of crime in a given community and self-protection. According to this model, an increase in exogenous crime raises the marginal product of self-protection and the actual crime level will be higher the greater is the endowed or zero self-protection of crime.

At the equilibrium, an increase in the endowed crime level results in a lowering of the amount of capital. Holding the capital constant, an increase in the endowed crime level would lead to

an increase in the quantity of self-protection employed. However, the adjustment of the optimal capital resulting from a variation of self-protection is unclear. We present below the data and the econometric modeling used to test empirically these theoretical predictions.

4.1 Theoretical Framework

We use a simple but modified model of profit maximization to analyze the effects of crime on private business in Cote d'Ivoire. We assume that private sector businesses maximize profit subject to a technology constraint. We assume that these businesses take input and output prices as given. Output positively depends on the quantity and quality of traditional inputs of capital (K) and labor (L) as well as the level of safety (S) in the community. We define safety to mean the absence or low levels of crime, that is $S = s(Crime)$, $s_{crime} < 0$. An increase in crime decreases safety, hence reduces output, all things equal. The production technology is given as:

$$Qif(K, L, S) \quad f_k, \quad f_l, \quad f_s > 0 \quad (1)$$

There are several reasons why safety can be considered a productive input in a post-conflict country with high crime rates and ineffective judiciary. Businesses need a minimum level of safety within which to operate. Without this safety, both labor, capital and management are not safe and may not be available at prevailing wages. Even when businesses get these inputs, production can be disrupted by criminal gangs or output, input, and finances are likely to be stolen from production and sales facilities.

Safety has to be produced with labor and other inputs either by the public sector or by the private sector at a cost to businesses. Since safety is a public good, a minimum level of safety as indicated by a maximum level of crime acceptable to businesses and society (\hat{C}) has to be provided by the public. When the level of crime is higher (level of safety is lower) than what is acceptable to business, business will then have to invest in self protection in order to bring safety up (crime down) to the level that is acceptable. The level of safety depends on the level of safety provided through the public sector and the additional safety provided by the private sector. The total level of safety therefore depends on the level of safety provided by the public and the additional safety provided through self protection. Formally:

$$S = S(Sp, \hat{C}), \quad S_{Sp} > 0, \quad S_{\hat{C}} < 0 \quad (2)$$

We note that businesses will invest in self protection if public protection leads to crime rate that is over and above the maximum crime rate that business deem acceptable, S_p . Therefore S_p is positively related to the differential between the actual crime rate (C) and the maximum rate acceptable to businesses (\hat{C}). The relationship between crime rate and private self protection is given as: $S_p = g(C - \hat{C})$, $g' > 0$. Given \hat{C} , an increase in crime rate leads to an increase in self protection expenditure, all things equal.

Given the prices of output and inputs and production technology, the firm chooses the level of labor, capital, and safety to maximize profit given as:

$$\Pi = p.Q(K, L, S) - rK - wl - P_s S \quad (3)$$

where p, r, w, and p_s are output price, rental rate on capital, wage rate, and the cost of safety. These input prices are assumed fixed for the firm even though they may change with increased aggregate demand or supply of these inputs. The first order conditions of profit maximization are given as:

$$\begin{aligned} \partial\Pi/\partial K &= pQ_k - r = 0 \\ \partial\Pi/\partial L &= pQ_l - w = 0 \\ \partial\Pi/\partial S &= pQ_s - P_s = 0 \end{aligned}$$

Safety has two opposing effects on profits. On the one hand, increased safety increases output but like any normal input, it also increases the cost of production. The first order conditions indicate that firms will continue to increase the input of safety up to the point where the marginal revenue product of safety equals the marginal cost of safety. Safety is generally not measurable but can be inferred from the crime rate. Here one can measure the dynamics of the effects of safety on output through the dynamics of the effects of crime on output.

An increase in crime affects the firms profit in two different ways—through a reduction in output and an increase in the cost of provision of self protection. This relationship is given as: $\partial\Pi/\partial C = p.\partial Q/\partial S * \partial S/\partial C - P_s(1 + \partial S/\partial S_p * \partial S_p/\partial C)$. An increase in crime rate decreases the profit by decreasing the marginal value product (first expression on the right hand side (RHS)) while increasing the marginal cost of safety provision (the second expression on the RHS). This

suggests that the profit maximizing output is lower with higher crime rate than with low crime rate, all things equal.

From the discussion above, we can derive several measures of firms performance as implicit functions of crime and other control variables. For example, we can derive the firm's profit as a function of input prices, crime rate, and level of output or we can derive the level of output as a function of input quantities and crime rate; similar arguments can be made for capacity utilization or labor demand by firms. In general we can write the firm's performance generally as:

$$Q_i = q(\textit{Crime}, \mathbf{X}) \quad (4)$$

where Q_i is outcome i of the form, \mathbf{X} is a vector of conditioning variables and crimes is as defined above. The elements contained in the \mathbf{X} vector include educational attainment of management, location, ownership structure of enterprise industry classification, size of enterprise, and input prices. Elements of \mathbf{X} that will be contained in a particular equation will depend on the outcome being investigated since not all variables may be relevant for all outcomes. In general, we expect crime to have a negative impact on outcome i , all things equal.

We have written equation (4) in a general form without specifying a functional form. Economic theory does not provide us with a specific functional form, hence we choose to specify a simple linear functional form of the equation we estimate. The equation we estimate is given as:

$$Y_i = \alpha_0 + \alpha_1(\textit{Crime}) + \alpha_2(\textit{Self - protection}) + (\mathbf{X}')\beta + \epsilon_i \quad (5)$$

where Y_i is firm outcomes, crime denotes perceived crime, self-protection is firm's provision for security α and β are coefficient to be estimated ϵ_i is a stochastic error term and all other variables are defined in the text above.

4.2 Data

The data used to investigate the effects of crime rate on business performance in this paper are from enterprise survey conducted by the World Bank in Cote d'Ivoire from 26 October 2008 to 20 February 2009. The survey was designed to provide information on the constraints to private sector growth and to capture the business environment in the country. The survey, targeted mainly non-agricultural sector, manufacturing, construction, services, and transport, storage and communication and was conducted in three cities.

The sample for registered establishments in Ivory Coast was selected using stratified random sampling. Three levels of stratification were used: sector, size, and geographic region. Industry stratification was designed taking into account three manufacturing industries (food, textiles, and other), one services industry (retail) and one residual sector. The sample targeting initially 240 manufactures and 120 services industries and residual categories, was then adjusted to reflect the accurate prevalence of manufacturing establishments in Ivory Coast.

Size stratification was defined following the SICs, namely: micro (1 to 4 employees), small (5 to 19 employees), medium (20 to 99 employees), and large (more than 99 employees). Regional stratification was defined in terms of the geographic regions with the largest commercial presence in the country: Abidjan, San Pedro, and Yamoussoukro were the three metropolitan areas selected, excluding Bouake (largest north-central city controlled by the rebellion).

The three cities chosen for the survey—Abidjan, Yamoussoukro and San-Pedro—are where business activities predominant in Cote d’Ivoire and are located in the southern region, a region under the government control. However, after cleaning the database, 526 observations were available for the analysis. These observations include food industries (31), textiles and garments (49), chemicals (18), plastics and rubber (12), non-metallic mineral products (5), basic metals (2), fabricated metal products (5), machinery and equipments (13), electronics (2), construction (14), wholesales (32), retails (124), hotels and restaurants (43), transports (24), information technology (13) other services (77) and other manufactures (58).

Besides standard business characteristics such as industry branch, firm size and ownership, questions were asked about multiple aspects of business regulations, crime, disorders and other matters that affect business operations. This is an important source of information useful to make the investigation of interest. Specifically, the data encompasses firm’s appraisal with respect to the followings: the perception of crime as a constraint to business, the propensity to pay for private security, the experience of losses due to crime and violence and the total annual value of losses caused by crime.

The problems with survey data are well known and are not uncommon to Cote d’Ivoire. For instance, many owners or managers of small scale companies have serious book keeping problems hence, they have not given accurate figures on finance and costs related questions. However, nothing indicate that large firms were also telling the truth and giving accurate source of information. Also, the serious political crisis and general sense of lawlessness since 1999, may have contributed

to inaccurate source of information; making it difficult to undertake such a survey. Despite these limitations, World Bank data are the only data collected on business activities at the enterprise level in Cote d'Ivoire in recent years. Table 1 presents the descriptive statistics of variables used in the sample, controlling for the difference between the group of enterprises that pays for security and those that do not at all.

72% of the sample is small firms and 22% large firms. A large proportion of businessmen interviewed are sole proprietors (71%) and only 16% are foreign-owned. A large proportion of owners are relatively well educated with 43% having a secondary school degree and 30% having university degree or higher. 39% are retail enterprise, 37% are manufacturing enterprises and 24% are service enterprises.

It appears that there is a significant relationship between firm size and private provision of security. Indeed, 82% of firms that do not pay for security are small business while 47% of large companies pay for security. There is also significant difference in ownership status with 25% of foreign owned firms paying for security while 22% of domestic private firms pay for self-protection. Meanwhile, difference in education level matters for firms paying for security and firms that do not pay for private security services. 42% of firms with higher educated top-managers pay for security while only 10% of firms whose management had only primary education provide self protection. Self protection is also positively correlated with location in an industrial zones.

32% of firms located in industrial zone pay for self protection while only 10% providing self security are located outside industrial zones. There is no significant difference in capacity utilization between self-protected firms and firms that do not pay for security, with the average capacity utilization of 68.9%.

Lastly, while 23% of firms not paying for security consider crime to be a serious impediment to their activities, approximately 16% of those that pay for self-protection believe crime to be a severe constraint. The difference is statistically significant. Besides, a large proportion of businesses that experience losses (16.09%) do not pay for self protection. This difference is statistically significant. The data description above delineates some significant differences between firms that offer self protection and those that do not and this may help to determine the choice of self-protection.

4.3 Estimation Method

Crime affects business through two possible channels: directly by decreasing production and indirectly through the cost of self protection. Self protection may be endogenous since firms that care about their productivity and performance may choose to self protect. These firms may also be the firms that can afford to finance self protection. To assess the impact of crime and insecurity on business sector, our econometric design is borrowed from program evaluation methodology to account for selection into self-protection. According to Greenbaum and Tita (2004), business survey data very often exhibit selection bias and endogeneity. A methodology that can best address both issues is a quasi-experimental method.

Self-protection may be viewed as a treatment. The appropriate approach to deal with this endogeneity issues would be an instrumental variable (IV) estimation. However, we do not have appropriate instruments. We therefore borrow the methodology of program evaluation in estimating the effects of crime business performance in Cote d'Ivoire. One of the conditions of the quasi-experimental approach is the conditional independence assumption (CIA) which states that, given a set of observable covariates \mathbf{X} which are not affected by treatment, potential outcomes should be independent of treatment assignment. In that case, the experiment is based on observable characteristics, indicating that we can perform the propensity score matching to evaluate the effect of the treatment on pre-identified outcomes. If the CIA does not hold, it means that some unobservable characteristics can affect the treatment, thus exhibiting selection bias. We use the Heckman two-step procedure to correct for that selection bias before performing the difference-in-difference matching to capture the treatment effects.

The effect of crime in this study is captured through the demand of self-protection by firms, taking self-protection as treatment for private crime policing. The treatment variable is a binary one (paying for security or not). Following Wooldridge (2002), the treatment variable is defined as follows:

$$d_i = \begin{cases} 1 & \text{if firm pays for security} \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

The output variable y is a continuous one and is observed for firms paying for security and for those that do not. Denote \mathbf{X} the matrix of observable characteristics of firms. According to Renders and Gaeremynck (2009) and Bates and Robb (2008), those business characteristics include: size,

location, industry and top manager's characteristics and his experience with crime. Our outcomes variables are the profit and the volume of investment.

The treatment effect for a firm i can be written as:

$$\tau_i = y_1 - y_2 \quad (7)$$

Another parameter of interest is the average treatment effect (ATE), defined by:

$$\tau_{ATE} = E[y_1 - y_2] \quad (8)$$

Also, as indicated by Rosenthal and Ross (2010), the endogeneous nature of self-protection as a measurement of crime is associated to the fact that economic activity may cause attractiveness to crime because of higher rate of returns or the impact of crime on firm's cost function differ from firm to firm. To consistently estimate the average effect of self-protection, we postulate a structural model:

$$\begin{aligned} y &= \beta_0 + \beta_1 d + \beta_2 X + \epsilon \\ d &= \omega_i \delta + \mu \end{aligned} \quad (9)$$

where $E(\epsilon|z) = 0$ and $E(d|z) \neq 0$; $E(\mu|z) = 0$ and $E(\mu|X) = 0$.

Following Adams (2008), we use a two-step instrumental variable method with the additional assumptions that $prob(d = 1|X, z) \neq prob(d = 1|X)$ and $prob(d = 1|X, z) = F(X, z, \gamma)$.

In the first step, we estimate the reduced form capturing selection into self-protect (probit model) using Maximum Likelihood method; we then calculate the inverse Mills' ratio using the predicted value from the regression. In the second stage, the outcome equation is estimated using OLS for each sub-sample (treated and not treated). One of the issues associated with the Heckman sample selection model is that the asymptotic sampling distribution may be very difficult to derive (Wooldridge, 2002). To produce better approximation of standard errors and increase bias correction, we use the method of bootstrap method with 500 replications.

Following Adams (2008), we determine the average treatment effect, by first estimating the observed mean of our outcome and then finding the predicted average mean for each firm j ($j = 1, 0$ with $j = 1$ if the firm pays for security and $j = 0$, otherwise).

$$E(y_j | d = j) = \hat{\beta}_{0,j} + \hat{\gamma}_{1,j} \hat{\lambda} + \hat{\beta}_{2,j} X \quad (10)$$

A third step is to evaluate the outcome of counterfactuals from firm s as follow:

$$E(y_s | d = j) = \hat{\beta}_{0,s} + \hat{\gamma}_{1,s}\hat{\lambda} + \hat{\beta}_{2,s}X \quad (11)$$

The average effect of self-protection on performance of business j is then given by:

$$ATE_j = E(y_j | d = j) - E(y_s | d = j) \quad (12)$$

5 Empirical Results

This section presents the results for self-protection and business performance. The first sub-section discusses the estimates for the probability of self protection while the second sub-section discusses the effects of self protection on business performance.

5.1 The selection for self-protection

Table 3 presents the results from the first step regression (probit model) tackling the likelihood to pay for security. Our model specification assumes that the firm's likelihood for self-protection is associated with the size, location, the top manager's education, the date of operation, the level of sales, perceived crime and experience with crime.

We found no significant relationship between the likelihood for self-protection and firm size, suggesting that size is not a significant determinant to hire private security. However, education seems positively and significantly associated with the likelihood to self-protect. A discrete change from a non-educated top manager to a top manager graduating from college, raises the probability to self-protect by 10.3 percentage points. This finding seems consistent with many empirical works highlighting the role of education, as in Gaviria and Pages (2002), Barslund *et al* (2007) and Kimou (2010). This result is consistent with the human capital effect of crime.

There is a positive and significant relationship between the logarithm of annual sales and the likelihood to self-protect. A 1% change in annual sales raises the probability of paying for private security by 6.5 percentage points. This is consistent with Rizzo (1978). The expected returns to crime should be higher the more performing firms perform.

The probability of self-protection is also significantly and positively related to location in an export or industrial area. The change of location from non industrial zone to an industrial or export zone increases the probability to self-protect by 17.16 percentage points. This finding is also

in accordance with the works by Greenbaum and Engberg (2004), Felson and Clark (1997) and Matheson and Baade (2004).

Perceived crime, another measurement of crime, is significantly and negatively associated with the likelihood for self-protection. Also, there is a negative and significant relationship between operating after the violence of 2004 and the probability to pay for private security. A change from not perceiving crime as an obstacle to doing business to perceiving crime as a serious obstacle to doing business in Cote d'Ivoire reduces the likelihood to self-protect by 11.5 percentage points. Also operating after 2004 reduces the probability to pay for self-protection by 13.27. This coefficient estimate is unexpected.

Three reasons may explain these unexpected results. First, data collection bias: this unusual violent crime goes back the occurrence of conflicts in neighboring countries of Liberia and Sierra Leone (in the 1990s) and the military coup d'etat and civil war (early 2000s) in Cote d'Ivoire, while the survey was being conducted in 2009. Existing firms may have already included instability in their decision. Also, 72% of the observations in our sample are small businesses that cannot afford private protection and may have already factored insecurity into their behavior. Lastly, after the violent riots against the private sector in 2004, the government initiated many programs for the private sector including tax cuts, and special security measures to encourage firms to stay while attracting prospective investors as well. It is also possible that these firms had not yet been victims of crime, hence did not have the need to self-protect.

This last explanation seems to be confirmed by the variable capturing experience with crime. There is a positive and significant relationship between the likelihood to self-protect and loss associated with crime, violence and disorder. A discrete change from not losing to losing stuffs due to crime, violence and disorder increases the likelihood to hire a private security company by 13.7 percentage points.

5.2 Correction for selection bias

We first run an OLS regression as a benchmark model designed under the assumptions that self-protection is exogenous to firm's performance. Neither the dummy describing the payment of private security nor the perceived crime are significant. These estimates may suggest that our model exhibits a selection bias. Paying for security may be affected by unobserved characteristics. The observed population may be divided into two subgroups not randomly selected: firms self-

protecting and businesses that don't.

In the framework of the program evaluation methodology, the selection bias problem is corrected using the Heckman's two-steps procedures. According to Sartori (2003), if we can find at least one explanatory variable that affect the selection, but not in the outcome equation, our estimation technique will be good. In our empirical design the variable "experience loss due to crime" appear to significantly impact selection into self-protection while not affecting firms' profitability and investment capacity as evidenced by the benchmark model. We run the Heckman two-steps both for treated group and non-treated using "experience loss due to crime" as exclusion restriction in the profitability model, then predict counterfactual for the treated group so that to capture the effects of self-protection. In the investment mode in addition to "experience loss due to crime", the second stage regression has been conducted with selected variables likley to explain inflow of investment.

The results for the profitability equation are presented in tables 5,7 and 9. The inverse Mill's ratio is significant and positively signed suggesting that the error terms in the selection and primary equations are positively correlated. There are some unobserved characteristics that increase the probability of paying for security (or not paying for security) with a positive impact on profitability. While perceived crime negatively and significantly affect firms' profit, self-protection tends to provide a positive effect on firm performance. Paying for security seems to be a rational decision in the threat of crime and violence, since it allows to keep the firm in a flow. From this findings another question emerges: if self-protection helps build a profitable business in a context of instability, does it allow the firm to take advantage of future business opportunities? In short, does this positive effect of self-protection drive to an increase in inflow of investment at the firm level?

The results from the investment regression (see tables 6, 8 and 10) give a clue to that question. Like in the profit regression, the inverse Mill's ratio is significant in the overall equation and in the firms self-protecting sub-regression as well reinforcing the assumption of self-slection. However, here the unobserved characterisitcs that affect the likelihood to self-protect have a negative impact on investment. This findings suggest that self-protection is basically inttended to maintain existing production capacity (short term decision), while long-term ones (investment decision) will likely to be ponsoned for a more reliable business environment.

The main objective of this paper is to capture the effect of crime on performance. We wonder whether self-protection pays in a context of poor crime policing. To answer that question, a

robustness check, led us to compute the average treatment effects which is the difference between the predicted mean value and the counterfactual (equation 12) for the treated businesses. We found that self-protection increases the average profit by $2.015e+09$, approximately a magnitude of 11 percentage points. Regarding the level of investment, self-protection increased the logarithm of investment by 0.8431, approximately by 0.56 percentage points. The slight positive sign of the treatment effect regarding investment though, should be taken with caution due to the issues associated with business survey data described in early sections. It appears that in a decade of instability and high incidence of crime, violence and disorders in Cote d'Ivoire, private provision for security seems to increase profitability while hampering the level of investment.

6 Conclusion

Cote d'Ivoire, one of the most stable countries in Africa after independences, went through political unrest in the late 1990s which worsened its economic performance. The period of instability is associated with high crime rate, recurrent violence and ramping disorder. While the effects of that instability on the economy are reportedly pointed out, very few studies have empirically attempted to test the economic impacts of this turmoil.

This paper is a contribution to the understanding of the microeconomic impacts of increased crime in Cote d'Ivoire. Specifically, the paper investigated the effects of crime and violence on the development of the private sector. We tested the impacts of crime and the generated self-protection on firm's profitability and capital accumulation. Theoretically, the economic consequence of crime on business is to be determined: either positively due to likely weak competition and readily available cheaper labor force or negatively consecutive to additional costs imposed by high crime incidence.

We tested these theoretical predictions using a quasi-experimental methodology, handling self-protection as a treatment. The two-steps methodology pointed out that self-protection exhibit a sample selection problem. To deal with issues identification and potentially biased standard errors pertaining to the Heckman selection model, past experience with loss caused by crime has been used as exclusion restriction and while bootstrapping the second stage regression with 500 replications. For robustness check, we then implemented a difference-in-difference analysis for treated firms (those paying for security).

We found that selection for self-protection is significantly and positively related to sales, location in an industrial area and loss due to crime previously encountered; while negatively affected by perceived crime. These findings suggest that firms with large assets which have been affected by crime are likely to pay for security. Private security provision is costly and is only made affordable for firms that have large assets. Small firms although perceiving crime and violence as serious obstacles to doing business cannot afford private protection.

As far as the effects of treatment on business growth are concerned, we found that self-protection induced by high incidence of crime increases the profitability of contracting firms suggesting that there is a positive return from private policing at the firm level. We showed that firms paying for security increase their profit by 11 percent points compare to firm that don't. However, we also found that crime through self-protection is negatively and significantly related to private investment. The surges in violence seriously harm businesses through perceived crime and incidence of crime as well. Indeed, self-protected firms lower that negative impact by restructuring their management scheme through the hiring of private security services so that to keep there business profitable while posponing long-term business growth decision (investment).

From these results, we recommend the implementation of a security policy involving all stakeholders including the private sector. Such as a policy should aim at reducing the security threat and reduce the perceived country risk by corporate and prospective entrepreneurs. Security reforms could be implemented along with some specific incentives (tax or employment incentives for instance) towards the industries that have been deeply affected by crime and violence; particularly small business.

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newpage

Table 1: Classification of industries in the sample

Description	Number
<i>food</i>	31
<i>textiles and garnament</i>	49
<i>Chemicals</i>	18
<i>Plastics and rubber</i>	12
<i>non metallic mineral products</i>	5
<i>Basic metals</i>	2
<i>fabricate metal products</i>	9
<i>machinery and equipment</i>	13
<i>Electronics</i>	2
<i>Construction</i>	14
<i>Otherservices</i>	77
<i>wholesale</i>	32
<i>Retail</i>	124
<i>Hotel and restaurants</i>	43
<i>transport</i>	24
<i>Information technology</i>	13
<i>Other manufactures</i>	58
Total	526

Table 2: Summary Statistics of Sample Data

Variable	Mean group ¹	Self- protection	No self-protection	Mean diff. ²
<i>Retailers (%)</i>	0.2357	0.2478	0.2260	-0.0218
<i>Service (%)</i>	0.3859	0.4059	0.3698	-0.0361
<i>Foodandplastics (%)</i>	0.0817	0.1068	0.0616	-0.0451*
<i>Textile (%)</i>	0.0931	0.0341	0.1404	0.1062***
<i>Other manufactures (%)</i>	0.2015	0.2051	0.1986	-0.0064
<i>Small (%)</i>	0.7205	0.5940	0.8219	0.2279
<i>Medium (%)</i>	0.4068	0.4957	0.3356	-0.1601**
<i>Large (%)</i>	0.2281	0.4743	0.0308	-0.4435***
<i>Sole proprietorship (%)</i>	0.7186	0.5641	0.8424	0.2783***
<i>Domestic (%)</i>	0.7129	0.6196	0.7876	0.1680***
<i>Foreign (%)</i>	0.1596	0.2564	0.0821	-0.1742***
<i>Public (%)</i>	0.1197	0.1154	0.1232	0.0079
<i>Higher education (%)</i>	0.2984	0.4230	0.1986	-0.2244***
<i>Secondary education (%)</i>	0.4334	0.3589	0.4931	0.1341**
<i>Primary education (%)</i>	0.1311	0.1068	0.1506	0.0438
<i>located in export area (%)</i>	0.1939	0.3247	0.0890	-0.2357***
<i>Sales</i>	2.16e+09	4.66e+09	1.48e+08	-4.52e+09***
<i>Perceived Crime (%)</i>	0.1996	0.1581	0.2328	0.0747**
<i>Experience loss (%)</i>	0.2509	0.3632	0.1609	-0.2023***
N	526	234	292	

¹ These are unweighted averages

² (*),(**),(***), significant difference respectively at 10%,5% and 1%.

Table 3: Probit model on self-protection

dependent Variable ⁺	Coefficient ⁺⁺	Std. err.	z	Marginal effects
<i>Higher education</i>	0.2603*	0.1421	1.83	0.1033
<i>Log sales</i>	0.1660***	0.0300	5.52	0.0657
<i>Small firm</i>	0.0581	0.1599	0.36	0.0229
<i>Large firm</i>	0.1439	0.1203	1.20	0.0569
<i>located in export area</i>	0.4337*	0.1634	2.65	.1716
<i>Operated after 2004</i>	-0.3375*	0.1245	-2.71	-0.1327
<i>Perceived Crime</i>	-0.2959*	0.1596	-1.85	-0.1150
<i>Experience loss\$</i>	0.3453**	0.1437	2.40	0.1370
<i>Log – Likelihood</i>			-285.8369	
<i>Wald chi2(8)</i>			101.71	
<i>Pseudo R2</i>			0.2091	
N			526	

⁺ Dependent variable=1, if firm pays for security; Base: medium firm, primary education, shared business, publicly owned, other manufactures

⁺⁺ (*),(**),(***) are significance respectively at 10%,5% and 1%.

Table 4: **Benchmark model: OLS estimation**

	Profit⁺	Coefficient⁺⁺	Std. error.
<i>Higer education</i>		5.29e+08	1.05e+09
<i>Log Sales</i>		1.43e+09***	2.16e+08
<i>Smallfirm</i>		9.57e+08	1.21e+09
<i>Largefirm</i>		4.41e+09***	6.74e+08
<i>located in export area</i>		-2.71e+09**	1.24e+09
<i>Operated after 2004</i>		1.23e+09	9.29e+08
<i>Perceived crime</i>		-9.79e+08	1.11e+09
<i>Experience loss</i>		1.01e+09	1.07e+09
<i>Constant</i>		-2.47e+10	4.07e+09
<i>F(8, 517)</i>		23.36	
<i>R – squared</i>		0.2541	
<i>N</i>		526	

⁺ Dependent variable: annual profit;

⁺⁺ (*),(**),(***) are significance respectively at 10%,5% and 1%.

Table 5: **Two-step estimation: Crime and profitability**

	Profit⁺	coefficient	Boot. Std. err.
<i>Higher education</i>		5.04e+09**	1.79e+09
<i>Log Sales</i>		4.55e+09***	1.18e+09
<i>Smallfirm</i>		2.36e+09**	9.70e+08
<i>Largefirm</i>		5.04e+09**	1.62e+09
<i>Operated after 2004</i>		-6.24e+09**	2.13e+09
<i>located in export area</i>		6.11e+09**	2.90e+09
<i>Perceived crime</i>		-7.82e+09**	2.50e+09
<i>Inverse Mill's Ratio</i>		2.98e+10 **	8.85e+09
<i>Constant</i>		-1.06e+11**	2.85e+10
<i>Adjusted R – squared</i>		0.3310	
	N	526	

⁺ Dependent variable: Annual profit

Exclusion: Past experience with Loss due to crime and disorder

Bootstrap: results after 500 replications

⁺⁺ (*),(**),(***), are significance respectively at 10%,5% and 1%.

Table 6: **Two-step estimation: Crime and Investment**

Log investment⁺	coefficient	Boot. Std. err.
<i>Higher education</i>	0.0229	0.3232
<i>Log Sales</i>	0.3392***	0.1045
<i>Small</i>	-1.0234**	0.3318
<i>Large</i>	-0.0290	0.1435
<i>Perceived crime</i>	0.2151	0.3179
<i>Inverse Mill's Ratio</i>	-1.9738***	0.6199
<i>Constant</i>	11.3124**	2.3688
<i>Adjusted R – squared</i>	0.5868	
N	199	

⁺ Dependent variable: Logarithm investment

Exlcusion: past experience with Loss due to crime and disorder, location and operation after 2004

Bootstrap: results after 500 replications

⁺⁺ (*),(**),(***) are significance respectively at 10%,5% and 1%.

newpage

Table 7: Two-step estimation on self-protected firms: Crime and profitability

	Profit ⁺	coefficient	Boot. Std. err.
<i>Higher education</i>		7.04e+09*	2.70e+09
<i>Log Sales</i>		7.15e+09***	1.74e+09
<i>Small</i>		4.98e+09**	1.98e+09
<i>Large firm</i>		5.46e+09***	1.63e+09
<i>Operated after 2004</i>		-8.70e+09**	3.54e+09
<i>located in export area</i>		9.40e+09**	4.42e+09
<i>Perceived crime</i>		-1.22e+10**	3.84e+09
<i>Inverse Mill's Ratio</i>		4.67e+10 ***	1.35e+10
<i>Constant</i>		-1.68e+11**	4.25e+10
<i>Adjusted R – squared</i>		0.3928	
	N	234	

⁺ Dependent variable: Profit

excluded variable: experience Loss due to crime and disorder

Bootstrap: results after 500 replications

⁺⁺ (*),(**),(***), are significance respectively at 10%,5% and 1%.

Table 8: **Two-step estimation on self-protected firms: Crime and investment**

Log investment⁺	coefficient	Boot. Std. err.
<i>Higher education</i>	-0.0905	0.3955
<i>Log Sales</i>	0.2338**	0.1040
<i>Small firm</i>	-1.0461**	0.3661
<i>Large firm</i>	-0.0214	0.1519
<i>Perceived crime</i>	0.1105	0.3699
<i>Inverse Mill's Ratio</i>	-2.3943 ***	0.7128
<i>Constant</i>	13.7971**	2.4130
<i>Adjusted R – squared</i>	0.5076	
N	133	

⁺ Dependent variable: Logarithm Investment
excluded variable: experience Loss due to crime and disorder, location and operation after 2004

Bootstrap: results after 500 replications

++ (*),(**),(***) are significance respectively at 10%,5% and 1%.

Table 9: Two-step estimation non self-protected firms: Crime and profitability

	Profit ⁺	coefficient	Boot. Std. err.
<i>Higher education</i>		2.95e+08*	1.78e+08
<i>Log Sales</i>		2.48e+08*	1.06e+08
<i>Small firm</i>		9.77e+07	1.18e+08
<i>Large firm</i>		1.06e+09	8.02e+08
<i>Operated after 2004</i>		-3.17e+08	2.09e+08
<i>located in export area</i>		6.48e+08*	3.64e+08
<i>Perceived crime</i>		-4.45e+08**	2.13e+08
<i>Inverse Mill's Ratio</i>		1.43e+09 **	7.28e+08
<i>Constant</i>		-1.68e+11**	4.25e+10
<i>Adjusted R – squared</i>		0.4177	
	N	292	

⁺ Dependent variable: annual profit
 excluded variable: experience Loss due to crime and disorder
 Bootstrap: results after 480 replications
⁺⁺ (*),(**),(***) are significance respectively at 10%,5% and 1%.

Table 10: **Two-step estimation non self-protected firms: Crime and investment**

Log Investment⁺	coefficient	Boot. Std. err.
<i>Higher education</i>	0.36188	0.5802
<i>Log Sales</i>	0.6310**	0.2223
<i>Small firm</i>	-1.0022	0.8810
<i>Large firm</i>	0.0661	0.3543
<i>Perceived crime</i>	0.1426	0.5803
<i>Inverse Mill's Ratio</i>	-0.1014	1.0570
<i>Constant</i>	4.0860**	4.8321
<i>Adjusted R – squared</i>	0.5155	
N	66	

⁺ Dependent variable: logarithm investment
excluded variable: experience Loss due to crime and disorder, location and operation after 2004
Bootstrap: results after 480 replications
++ (*),(**),(***) are significance respectively at 10%,5% and 1%.

Table 11: **Treatment effect on profitability: difference-in-difference analysis**

Economic Outcome:	Annual profit			
	obs. (1)	pred. (2)	c'factual (3)	ATE (2)-(3)
<i>self – protected firms</i>	4.30e+09	1.79e+09	-2.25e+08	+ 2.015e+09
N	234	526	292	

Table 12: **Treatment effect on investment: difference-in-difference analysis**

Economic Outcome:	logarithm investment			
	obs. (1)	pred. (2)	c'factual (3)	ATE (2)-(3)
<i>self – protected firms</i>	15.4989	14.8026	13.9595	+0.8431
N	199	526	292	