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Does Crime Affect Firm Innovation? Evidence from Trinidad and Tobago

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Abstract

Research has shown that a suitable business environment supports growth by encouraging investment and higher productivity which in turn impacts enterprise performance and accelerate economic growth. In Trinidad and Tobago, there has been an attempt to encourage investment in innovation through the provision of an enhanced business environment. According to a World Bank report (2007), there is a positive correlation between low rates of business expansion and investments and the increasing incidence of crime within the Caribbean region. This paper uses the 2010 Enterprise Survey dataset for Trinidad and Tobago produced by the World Bank to examine the link between crime and firm innovation. The results obtained in this study suggest that firms which are experiencing losses as a result of crime are less likely to adopt measures of innovation over their lifespan with past losses having both immediate and long-term impacts.

1. Introduction

Since Adam Smith in 1776 (Smith, 1776) there have been both theoretical and empirical (e.g. Solow, 1957; Lucas, 1988; Barro, 1990; Porter, 1990; Nadiri, 1993; Torun and Ciceki, 2007; Gordon, 2012) recognition of the nexus between innovation (in the form of new technologies, products, productive processes, and ways of managing) [1] and economic growth. This work argues that innovation leads to increased competitiveness and productivity, which in turn positively influences a country's economic activity and long-run economic growth. In line with this strand of literature, developing countries are becoming progressively more concerned about increasing competitiveness and productivity through innovation, as a response to the increasing pressure of globalization and economic uncertainty. Of note, Trinidad and Tobago dropped ten places in its Global Innovation Index (GII) (The Global Competitiveness Report 2013-2014) rankings from 81st to 91st in 2014 – this was behind Barbados (41st), Guyana (80th), and Jamaica (82nd) - largely due to a fall of 3.9 points in the innovation output sub-index and to a lesser extent on a 0.6 points drop in the innovation input sub-index. Nevertheless, it has been argued that entrepreneurship and the efficiency and effectiveness of innovation are dependent not only on firm and individual characteristics, but also on the policy, institutional, and behavioral environment (Pagés-Serra, 2010; Stern et al., 2001). This latest information from the GII rankings is signaling the need for Trinidad and Tobago to take the necessary steps to increase innovation, however, in order to do that, key aspects of the business environment must be addressed

To this end, the World's Bank Investment Climate Report (World Bank, 2005) listed crime as one of the four main constraints on business operation and growth. The report further stated that about 30% of businesses of all sizes indicated that crime was a major constraint of doing business. Specifically, in Trinidad and Tobago increases in serious crime are associated with negative growth of GDP. Therefore, despite all of the measures that can be put in place to boost productivity, if firms operate in an environment where crime is high there is not likely to be increases in productivity, competitiveness or innovation. The effect of crime on business and business activity has been under-studied in the Caribbean region, and particularly in Trinidad and Tobago. A report by the United Nations Office on Drugs and Crime and the Latin America and the Caribbean Region of the World Bank (2007) specified that crime has both a short-run and a long-run impact on firm development, since resources are diverted from expanding and enhancing a business towards prevention and protection from crime. The report also pointed out that firms in Jamaica have reacted to an increasing crime rate by intensifying security, which has resulted in a negative stance on business expansion plans and investments to improve productivity. Similarly, McDonald (2008) showed that crime has a shattering effect on the financial outlook and sustainability of many small and large businesses and Krkoska and Robeck (2009) found that increases in crime-related business activities lead to a reduction in resources from business expansion and improvements resulting in uncertainty in the sector. This study attempts to add to the limited empirical work in this

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[1] Innovation can be considered as both a bottom-up activity, namely the generation of ideas, practices and technologies, and a top-down activity; the adaptation of ideas, practices; all perceived to be new by the organization involved (Damanpour and Gopalakrishnan, 1998; Van de Ven, 1986).

area by assessing the impact of crime on firm innovation by employing the 2010 World Bank's Enterprise Survey Dataset for Trinidad and Tobago.

The paper is organized as follows: Section 2 reviews the existing literature. Section 3 describes the data and outlines the empirical framework. Section 4 discusses the empirical findings. The final section concludes the paper and provides policy implications and directions for future research.

2. Crime, innovation and firm growth

Entrepreneurial ventures and success in innovation are not only a function of the firm, but also of the business climate. Crime is an aspect of the business climate, in particular the non-regulatory business climate, and has a negative impact on investment (Pshisva and Suarez, 2006). However, most of the literature on the impact of crime on innovation has focused more on white-collar crime, in particular corporate crime, (Felson and Clarke, 1997) or the regulatory aspects of the business climate. The main contribution of this study to the literature is that it examines the direct impact that blue collar crimes, specifically property crimes, committed against business have on its past and future actions in relation to firm innovation.

Street crime has an impact both on citizens and businesses. In fact businesses and companies are also victims of crimes whether committed directly against the private enterprises or indirectly, such as crimes against their employees (Broadhurst et al., 2011). Few studies on the impact of crime on entrepreneurial activities have been undertaken in Latin American countries. However, Gaviria (2002) sought to empirically investigate how investment decisions, the growth of the firm as measured by employment and sales, were impacted on by corruption and crime. Using both probit and tobit models, it was concluded that the overall competitiveness of the firm was negatively affected by corruption and crime. The reaction chain started with operational costs being increased which resulted in a decline in competitiveness and finally a reduction in sales. The decline in competitiveness was also attributed to the exodus of human capital and the loss of financial capital resulting from the apparent simultaneous effect of both corruption and crime. In addition, the study found that the firm's ventures into profitable business activities were hindered. Thus, there were limited opportunities for growth and all of this contributed to the already mentioned decline in sales, which led to a reduction in investments and competitiveness. Moreover, the results were robust even when the sample was divided into developing and developed countries.

Additionally, Ortega Alvarez (2002) in his study found that the likelihood of starting a new business was significantly lowered in the two Latin American countries of Venezuela and Colombia as a result of high levels of national crime. He examined how the level of national crime impacted the incentives for entrepreneurship. More specifically, he estimated how an individual's willingness to start a business is negatively affected by a marginal reduction in the rate of crime. He proposed that the short-term measured costs of crime are less than the long term costs if there is a significant negative impact of crime on entrepreneurial activities. The study found an inverse relationship between increasing levels of crime and entrepreneurial activities, especially in more affluent regions. Importantly, it was suggested that the cost of crime and its resulting

negative impact on entrepreneurial activities was greater than the usual costs of crime resulting from the implementation of preventative and deterrence measures.

Furthermore, Pshisva and Suarez (2006) using firm-level data found that kidnappings and other broader types of crime, such as kidnappings targeted against the personnel of firms, have a significantly negative impact on both the domestic and international investments by firms in Colombia. Also, similar findings have emerged from studies on the impact of crime on entrepreneurial activities that have been conducted on countries in the African continent. Kimou and Gyimah-Brempong (2012) conclude that self-protection as a measure of crime has a significant and negative relationship to business investments. In particular, businesses sacrifice the long-term, future profit-increasing investments for the immediate short-term measures of maintaining current business activities.

Bates and Robb (2008) examined approximately five thousand firms, which began operations between 1986 and 1992 in the inner cities of the United States, and they suggested that there might not be a negative relationship as proposed by Porter (1997). Porter (1997) had put forward the view that entrepreneurial activities were likely to be dampened in areas of high incidences of crime. More precisely, the findings of Bates and Robb's empirical study implied that high crime in an area is not a decision factor in the entrepreneurial activities of individuals, and even the investment decisions of the firms most negatively impacted by high crime rates were not affected. Moreover, Rosenthal and Ross (2010) proposed that high crime rates might not altogether discourage entrepreneurial activities but rather attract certain sectors of entrepreneurial activities, and that the investment decisions of entrepreneurs are centered on the localities of the incidences of violent crime.

In a study by Krkoska and Robeck (2009), one of the very few in the literature which has studied the impact of crime on microenterprises, found that the two effects – direct, which includes security expenditures, and indirect which is the perception of crime (street and organized crime at national level) - cause firms to reinvest a smaller percentage of their profits than they would prefer. Specifically, the enterprises that were most affected by crimes tend not to make any new investment decisions. Thus, there was an overall negative impact of crime on the investment decisions of firms in these thirty-four countries. The impact of crime (robberies, motor vehicle robberies and muggings) on investments by microenterprises was also investigated by Ben-Yishay and Pearlman (2011). They found that even when controlling for the various categories of crimes, such as homicides and the drug related ones, the investment decisions of microenterprises are put on hold for at least a year due to the increasing occurrences of robberies. In their study they brought to the forefront the fact that the social context in which microenterprises operate is a major factor in the investment decisions undertaken by such entrepreneurs.

3. Data and empirical model

Data for this study was obtained from the 2010 World Bank's Enterprise Survey for Trinidad and Tobago. This survey is a firm-level survey of a representative sample of Trinidad and Tobago's private sector and covers a broad range of topics related to the business environment, including crime, innovation and performance measures. The

survey targets business owners and top managers of firms as respondents to the questionnaire. Regarding innovation, this study employs two questions, and though there are different measures of innovation (e.g. product innovation), the data limits our options. The first question attempts to determine whether a firm (j) used any services or programs to support innovation during the last three years and the second question asks about whether the firms intends to employ services or programs to support innovation over the next three years. Based on these questions, we construct two binary variables ($i_{p,j}$: past innovation; $i_{f,j}$: future innovation) that is equal to one whenever the firm reports to have introduced innovation in period t and zero otherwise. With respect to information on crime used in this study, the questionnaire asked whether during the fiscal year 2009 the firm experienced losses as a result of theft, robbery, vandalism or arson. A binary variable taking the value of one if the firm has experience losses due to crime and zero if otherwise is also constructed (c_j). We also construct a number of variables (X_j) to capture firm and individual characteristics (see Table 1).

Table 1: Summary statistics (n=150)

Variables:	Mean	Std. Dev.
Past innovation	0.2	0.4
Future innovation	0.5	0.5
Experienced losses as a result of crime	0.3	0.5
Size of locality (Less than 50,000 population)		
Capital city	0.5	0.5
>50,000 population	0.4	0.5
Firm Size (Large>=100)		
Small (5-19)	0.4	0.5
Medium (20-99)	0.3	0.5
Top manager female	0.1	0.3
Use of website	0.3	0.5
Export firm	0.1	0.3
ln(full-time workers completed secondary education)	4.1	0.6
ln(years of manager's experience)	2.7	0.7
ln(% of sales of main product/service)	4.3	0.3
ln(% of female employees)	-1.0	0.6
ln (numbers of establishments)	0.3	0.7
ln(years of operations)	2.7	0.8
ln(% of working capital borrowed by banks)	2.5	1.7
Industry (Other)		
Retail	0.6	0.5

Note: "ln" stands for natural logarithms.

We define a latent variable (i_j^*) that represents the propensity of a firm to report past or future use of services or programs to support innovation in their establishment. This drives the observed binary indicator of whether a firm j innovates through the following measurement equation:

$$i_j^* = \beta_1 c_j + b'X_j + u_j \tag{1}$$

$$i_j = \begin{cases} 1 \text{ if } i_j^* > 0 \\ 0 \text{ if } i_j^* \leq 0 \end{cases} \tag{2}$$

Where c_j is a binary variable capturing whether the firm has experienced losses due to crime, X is the vector of individual and firm characteristics (with b being the corresponding vector of parameters to be estimated) and u_j is a normally distributed error term. To estimate the relationship between innovation and crime, model (1), we use a probit approach (see Wooldridge, 2002).[2]

4. Results

The results from the probit models are provided in Table 2. The first column presents the results for past innovation initiatives while column 2 presents the results for future utilization of services and programs in support of innovation. The results of both models suggest that crime negatively impacts innovation activity by firms which experience losses as a result of crime. These findings support the conclusions drawn in the literature regarding the innovation and crime nexus. Importantly, our research shows that losses incurred due to criminal activity do not only have an immediate effect on investments in innovation in the short-run, but that it also has an impact in the long-term innovation decisions by firms, for example, by a firm diverting investment resources away from innovation to the increasing costs related to security and other protective measures. We observe that the marginal effects are equal to -0.146 and -0.175 for the past innovation and future innovation models, respectively (i.e. making the probabilities of past and future innovation lower by 14.6% and 17.5%).

The results of the other explanatory variables are also interesting. We find that firms operating in the city areas of Trinidad are more likely to innovate than firms operating in less densely populated cities (estimated to increase the probability by about 20%). According to Orlando and Verba (2005), studies which examine the geography of innovation, provide results to show that regions within countries with relatively larger populations tend to have higher levels of innovation. This can be explained by the fact that firms operating in city areas have greater access to the three main inputs necessary for innovative activity – knowledge, human and capital resources.

Another important factor driving firm innovation is the use of technology by the firm. Our results show that firms which make use of online technologies, such as having a website as part of their operations, are more likely to use a service or a program to support innovation through, for example, managing resources or in technical processes (this is found to increase probability by approximately 16.4% and 19.4% for the two

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[2]Before proceeding with the estimation of our model, we check for multicollinearity using the Variance Inflation Factor (VIF) method. The results suggest that multicollinearity is not an issue (results are available upon request).

models, respectively). These outcomes have support from various studies, which demonstrate that the prevailing technology of the firm or its technological capacity is a significant determinant of the innovative capacity of the firm (Cohen and Levinthal, 1990; Monery et al., 1996; Tsai, 2001; Vinding, 2006; Silva and Leitão, 2007). Specifically, these studies have all concluded that technological capacity increases the likelihood of product innovation. Conte (2009) shows that the acquisition of technology by small firms, in particular, is a most significant predictor of process innovation rather than product innovation.

Table 2: Probit estimates of past and future innovation

Innovation:	Past innovation		Future innovation	
Variables:	Coeff.	Std. err.	Coeff.	Std. err.
Experienced losses as a result of crime	-0.739**	0.334	-0.442*	0.262
Size of locality (Less than 50,000 population)				
Capital city	0.458	0.487	0.159	0.363
>50,000 population	0.808*	0.485	0.166	0.372
Firm Size (Large>=100)				
Small (5-19)	-0.581	0.370	-0.316	0.313
Medium (20-99)	0.167	0.381	0.255	0.346
Top manager female	-0.951*	0.547	-0.304	0.351
Use of website	0.636**	0.312	0.500*	0.288
Export firm	0.567	0.457	0.707	0.444
ln(full-time workers completed secondary education)	0.651*	0.343	0.207	0.197
ln(years of manager's experience)	-0.179	0.237	0.026	0.214
ln(% of sales of main product/service)	1.099*	0.588	0.672*	0.374
ln(% of female employees)	-0.040	0.236	0.038	0.197
ln (numbers of establishments)	-0.113	0.175	-0.179	0.167
ln(years of operations)	0.267	0.178	-0.118	0.155
ln(% of working capital borrowed by banks)	-0.148	0.091	0.139*	0.073
Industry (Other)				
Retail	-0.079	0.282	0.382	0.242
Constant	-8.548**	3.205	-4.011**	2.022
Log-likelihood	-63.24		-89.84	
LR chi2(16)	32.57**		26.32**	
Pseudo R2	0.205		0.128	
Observations	152		149	

Notes: **Significant at the 5% level; *Significant at the 10% level.

Similarly, our results show that firms with an increased sale focus on its main product/service have a higher likelihood of being more innovative than a firm with a diverged product/service focus (the marginal effects for the two models are 0.249 and 0.267, respectively). Barlet et al. (2000) find that process breakthroughs or the launching of products that are new have a positive impact on the New Product Ratio for total sales (NPR) or on a fraction of total revenue. Thus, it can be implied from this study that innovative activities are further stimulated by firms with a high percentage of first products or services in their annual sales (NPR).

We also find that having a female top manager reduces the likelihood of the firm undertaking innovation by approximately 14%, but this effect disappears in the long term. Other studies have similar findings - specifically, these studies (Kalleberg and Leicht, 1991; Hisrich and Brush, 1984) have found evidence to show that women are less likely to engage in innovative behavior than men. Millward and Freeman (2002) explain this as being a factor of the role that gender plays within the organizational context. One of the major findings of the Millward and Freeman (2002) study is that, while both men and women are innovative, there are different levels of risks associated with innovative activity carried out by men as opposed to women. In particular, failure associated with innovation is less damaging to men than women.

Our results specify that having an educated workforce increases the probability of innovation (with the marginal effect being 0.148). These outcomes are in line with previous work on the role of education in start-up rates, innovation and firm performance (Bhaumik, 2011; Knudsen et al., 2008; Galindo-Rueda and Haskel 2005). Lall (1992) examines the factors impacting product innovation and find a positive relationship between the level of employee education and product innovation. The study highlighted that educational achievements and experience go hand-in-hand as the necessary and sufficient conditions for increased innovative capabilities of the firm. Additionally, Schneider et al. (2010) find that highly educated, rather than experienced employees, are associated with firms involved in innovative activities that are radical or original.

Finally, we observe that firms with a higher proportion of their working capital borrowed from banks have a higher likelihood of engaging in future innovation (but the marginal effect is found to be marginally higher than 0.05). This supports previous work that stresses a positive link between bank lending and innovation, for example, by the bank's monitoring of its investment thus reducing moral hazard (Herrera and Minetti, 2007; De la Fuente and Marin, 1996). Also, Ayyagari et al. (2011) note that firms with access to external financing from banks to finance their capital are more innovative than those without such access.

5. Conclusions

This paper uses the 2010 World Bank's Enterprise Survey Dataset for Trinidad and Tobago to empirically examine the link between firm losses due to crime and consecutive innovative activity undertaken by the firm. Our results show that losses incurred as a result of crime have both immediate and long-term impacts on firms' innovation decisions and investments. Additionally, the findings provide some evidence of gender differences, firm location and the role of education and technological engagement in fostering innovation. It is also established that product/service sale strategy, as well as

investment financing by banks, increases innovative activity by firms. The empirical findings of this research reinforce the need for governmental policies to reduce crime in order to foster innovation, investment and entrepreneurial activity in Trinidad and Tobago, and generally in the Caribbean region. It is acknowledged that the factors influencing innovation are complementary and therefore securing the operating environment for firms is one of the steps that the government can take to augment the effectiveness of the other policies, some of which are already in place, that target firm innovation.

Given the inherent limitations of using crime data, which includes all the types of serious property crime, and undertaking an analysis of one country, future research on the impact of crime on innovative activity should undertake a panel analysis encompassing both developed and developing countries with separate categories of serious crimes represented in the dataset. Importantly, measures of firm innovation should be broadened to specify and capture innovation in the areas of produce, process, market and organizational innovation. In particular, measurement priorities of innovation should seek to encapsulate innovation capabilities and expenditure on innovation.

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