

# **Will Violent Crime Incentivize the Hiding of Small Firms?**

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## **Abstract**

I examine the relationship between exposure to violent crime and firm informality. I employ a rotating panel survey matched to municipal homicide rates and temperature as an instrument and find that exposure to violent crime causes firms to become informal. Losses derived from crime may take away income that could otherwise be used to afford formality. Also, firms may prefer to stay underground to avoid disclosing their existence to criminals.

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## **1. Introduction**

Does exposure to violent crime increase firm informality? While arguably an important question, to my knowledge it has not been yet addressed. This is remarkable given that in many developing countries the size of the underground economy is rather large and as such constitutes a pressing problem. As an example, underground economy represents around forty-five percent of the gross domestic product and more than seventy percent of the labor force in Latin America (Loayza et al., 2009). It is clear that a better understanding of key informality drivers is needed in order to better design policies to deal with this issue.

In this research I focus on the case of Mexico and take advantage of its notorious increase in violent crime in the context of the country's "war on drugs," a conflict between the government and the drug trafficking organizations that began in 2006 and created large variations in violence intensity. In addition, to address potential endogeneity concerns due to self-selection I rely on the literature that links weather and violent crime (Carleton and Hsiang, 2016). I employ temperature as an instrument that adequately complies with the exclusion restriction by focusing on non-agricultural firms and accounting for seasonal variations.

Interestingly, any observed causal link from violent crime exposure to increases in informality might signify that firms willing to become formal are in fact discouraged to do so by reasons that are beyond the typical determinants of informality currently in the literature, such as tax and regulation burden, financial market development, and the quality of the legal system (Inchauste et al., 2005). Becoming or staying informal to these firms can be costly in both additional effort and loss of resources in order to go underground as well as to avoid being uncovered and singled out by criminals. In fact, firm profits in Mexico have decreased during the war on drugs period, which is directly attributed to violent crime. For instance, this is the case of

local businesses such as gas stations, drugstores, and professional offices, including medical doctors and lawyers, as they tend to shorten operating hours in order to reduce exposure to violence<sup>1</sup>. Similarly, the tourism industry, which is particularly large in the country, has shown a drastic decline in activity in locations known to be violent as well as in locations linked to roads where criminal activity is known to occur<sup>2</sup>. Furthermore, the fact that criminal organizations tend to charge firms with quotas or implicit taxes only tends to compound this problem<sup>3</sup>.

The paper is organized as follows. The next section describes the data. Section 3 presents the empirical methodology. Section 4 presents the main findings. Section 5 concludes.

## 2. Data

The data come from three main publicly available sources. First, I draw quarterly individual information on businesses, including informality, from the National Survey on Employment and Occupation (ENOE), which is the primary source of labor force statistics in the country. It is a rotating panel survey where individuals are interviewed for five consecutive quarters and then replaced. Second, I collect data on homicide rates by quarter and municipality from official reports provided by the National Statistical Agency (INEGI). Finally, I use temperature averages by quarter and state from the National Water Commission (CONAGUA). Matching all available data allows us to study the period from 2005 to 2016.

The definition of informality employed is the same used by INEGI. Informal businesses are those firms owned by household's members that are not constituted as separate legal entities, lack complete accounts that permit a financial separation of their production activities, and/or are not registered under specific forms of national legislation, including tax or social security laws.

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<sup>1</sup> <http://www.excelsior.com.mx/2012/08/13/nacional/853135>

<sup>2</sup> <http://archivo.eluniversal.com.mx/estados/85953.html>.

<sup>3</sup> <https://www.proceso.com.mx/290237/para-pagar-cuota-al-narco-suben-kilo-de-tortilla-en-michoacan>

The details on how the informality variable is constructed as well as the rest of variables in this paper is provided in Table 1.

### 3. Empirical Strategy

I focus on employers and self-employed individuals from the private sector who are sampled for the full five quarters of the corresponding rotating panel using information related to their main job<sup>4</sup>. My sample excludes those employed in the agriculture sector and those who are domestic employees. I focus on actively working individuals, as I am interested in tax registration shifts of ongoing businesses<sup>5</sup>. My set of controls includes demographic controls such as age, sex, years of education, as well as income level. In addition, I include municipal, quarter, and year fixed effects. The dependent variable is a dummy that reflects the informal status of the firm. As such, I employ a linear probability approach with the following reduced form:

$$y_{mitq} = \beta_0 + \beta_1 x_{mtq} + \gamma_m + \eta_t + \eta_q + \epsilon_{mitq}, \quad (1)$$

where  $y_{mitq}$  is the informality status associated with firm  $i$  in municipality  $m$  at year  $t$  in quarter  $q$ ,  $x_{mtq}$  is the homicide rate (per 10,000) in municipality  $m$  at year  $t$  and quarter  $q$ ,  $\eta_t$  stands for year fixed effects and  $\eta_q$  stands for quarter fixed effects and  $\epsilon_{mitq}$  is the error term. The informality status takes a value of one if the firm is regarded as informal and zero otherwise. I use homicide rates per 10,000 as the explanatory variable. In addition, I correct for the lack of independent variation in homicide rates within municipalities clustering errors at this level. I alternatively include state-year fixed effects to allow for different trends at the subnational level and individual fixed effects to control for individual heterogeneity.

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<sup>4</sup> By doing this, I exclude heads of firms that were unemployed, turned into employees or for some reason, were not interviewed.

<sup>5</sup> ENOE follows heads of firms not firms themselves.

I further explore endogeneity concerns by instrumenting homicide rates using temperature, where the exclusion restriction assumes that variations in temperature do not directly affect the incentives to switch registration status after controlling for time fixed effects that account for seasonal and annual variations in weather. As outlined above, individuals pertaining to the agriculture sector are excluded from the analysis, further ensuring the instrument validity. This identification strategy also relies on the assumption that quarterly variations in weather changes on average do not differ significantly across municipalities within a state in a quarter.

#### **4. Findings**

The main results correspond to the sample consisting of business heads, i.e. employers and self-employed individuals observed for the full five quarters of the rotating panel. The first three columns in Table 2 show the linear probability model (LPM) results, which point that on average an additional homicide per 10,000 people each quarter increases the probability to be informal by in between 0.6 percent and 1.1 percent<sup>6</sup>. The last three columns in Table 2 show the results from the second stage least squares from the instrumental variables (IV) approach using temperature as an instrument, which indicate that such change corresponds to an increase between 13.7 percent and 17.3 percent in the probability to be informal. Common to IV findings, these estimations yield larger coefficients, which is likely the result of the fact that they measure LATE impacts. All results presented include sampling weights.<sup>7</sup>

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<sup>6</sup> Probits yield virtually identical results.

<sup>7</sup> Specifications without sampling weights display similar results although the coefficients are slightly smaller. Since ENOE does not sample all municipalities each quarter, using sampling weights accounts for underrepresentation that may miss to capture variations in homicides.

Table 3 shows that my estimates are robust to changes in the way I treat formality and informality. In particular, I explore whether results are sensitive to dropping firms that show consecutive changes in registration status during any of the five quarters that the firm is followed in the rotating panel. Since switches from and to formal registration status of a firm are not costless, one might argue that these quarterly changes could be due to potential misclassifications<sup>8</sup>. Panel A in Table 3 excludes firms showing at most one formal-informal registration switch in any of the five quarters of the rotating panel. Similarly, Panel B in the same table excludes firms showing one or more of such formal-informal registration switches. I observe that the findings in Table 3 are analogous to the one presented in Table 2<sup>9</sup>.

## 5. Conclusions

I find that exposure to violent crime promotes informality. On average an additional homicide per 10,000 people each quarter increases the probability to be informal between 0.6 percentage points and 1.1 percentage points. These results are further corroborated when using an instrumental variables approach that is consistent with the exclusion restriction, which indicates that these estimates range between 13.7 percentage points and 17.3 percentage points.

It appears that exposure to violent crime increases the opportunity costs of informality as losses and spending on security measures may otherwise be used to afford formality. An

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<sup>8</sup> Becoming informal restricts business networks due to unavailability of invoices and access to the financial system. Becoming formal, besides the paper work and tax payments implied, may be a risky move as it discloses the firm's existence.

<sup>9</sup> Results are robust to including those that are interviewed less than five times in the rotating panel. In addition, I also pursue additional robustness tests by employing alternative definitions of informality different from the official ones employed by INEGI. When using a definition based social security registration status, I find slightly less statistically significant results, which is reasonable, as firm owners do not necessarily act as workers in their own business. These findings are available upon request. Including individual fixed effects shows similar results for the LPM but the IV approach is not significant.

additional mechanism at work may be fear. Owners may prefer to stay underground or reduce working hours in order to reduce exposure to violence. Finally, these findings help inform policymakers on the potential benefits that reducing violent crime can have in terms of incorporating firms into the regulated sector and thus increasing the tax base.

## **References**

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**Table 1**  
**Description of Variables**

Variable	Definition
Firm Informality	Informality status based on ENOE's questions 4C-4D, 4E, and 4G as defined by INEGI. 4C and 4D classify a firm by means of its official name. 4E is "business or activity, a) has an establishment and office, b) has only an office, c) has only an establishment, d) does not have an office or establishment." 4G is "In this business or activity, a) do you use the services of an accountant to keep records? b) do you only use a notebook or write personal notes to keep accounting records? c) do you use an income booklet or do you have a cash register from the Ministry of Finance for small taxpayers? d) you do not keep any accounting records." If 4C and 4D identify the business as complex, informality equals 0. If not complex and 4E is a), b) or c), the value depends on 4G: informality is 1 if 4G is b) or d) and is 0 if it is a) or c). If not complex but 4E is d) then informality is 1. Source: ENOE (2005-2016).
Worker Informality	Informality based on social security status using question Q6D from ENOE: "Due to this job, do you have access to health services through: a) IMSS, b) ISSSTE, c) state ISSSTE, d) other institution, e) none." Variable equals one if response is (a) and 0 otherwise. IMSS refers to social security of private sector; ISSSTE refers to that of public sector. Source: ENOE (2005-2016).
Age	Age in years. Source: ENOE (2005-2016)
Sex	Binary variable taking the value of 1 if female and 0 if male. Source: ENOE from 2005 to 2016.
Education	Years of education based on the last academic degree reported by the individual. Source: ENOE from 2005 to 2016.
Income	Reported monthly income. Source: ENOE from 2005 to 2016.
Homicide rate	Number of homicides per quarter and municipality divided by population size multiplied by 10,000. Source: INEGI (2005, 2016) and CONAPO (2005, 2010).
Temperature	State and quarterly average temperature in Celsius. Source: NWC (2005, 2016)

**Table 2.**  
**Violent Crime and Informality**

	LPM			IV 2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Homicide rate	0.011*** (0.003)	0.009*** (0.002)	0.006*** (0.002)	0.156*** (0.051)	0.137*** (0.044)	0.173* (0.102)
Year FE	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X
Municipality FE	X	X	X	X	X	X
Demographics		X	X		X	X
State by year FE			X			X
Weak instruments KP Statistic	n.a.	n.a.	n.a.	41.08	41.02	16.95
10% maximal size critical value	n.a.	n.a.	n.a.	16.38	16.38	16.38
Observations	482761	482640	482640	482761	482640	482640

CEOs surveyed at least one time. Sample period corresponds to 2005-2016 and frequency of all variables is quarterly. Informality data corresponds to the individual level, homicides to the municipal level and weather data to the state level. Homicide rates are in per capita terms (per 10,000). Each column represents a different regression. Dependent variable mean is 0.64. Standard errors in parenthesis. All specifications include sampling weights. Demographic controls include age, sex, years of education and income level. Errors are clustered at the municipal level. \*Coefficient is significant at 10% level.  
\*\*Coefficient is significant at 5% level. \*\*\*Coefficient is significant at 1% level.

**Table 3.**  
**Robustness Tests**

	LPM			IV 2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Panel A</b>						
Homicide rate	0.010*** (0.002)	0.009*** (0.002)	0.006** (0.002)	0.155*** (0.054)	0.139*** (0.047)	0.188* (0.110)
Weak instruments KP Statistic	n.a.	n.a.	n.a.	36.15	36.09	16.43
10% maximal size critical value	n.a.	n.a.	n.a.	16.38	16.38	16.38
Observations	391901	391806	391806	391901	391806	391806
<b>Panel B</b>						
Homicide rate	0.011*** (0.003)	0.010*** (0.002)	0.005** (0.002)	0.156*** (0.055)	0.141*** (0.048)	0.178 (0.113)
Dep. Variable mean	0.68	0.68	0.68	0.68	0.68	0.68
Weak instruments KP Statistic	n.a.	n.a.	n.a.	37.32	37.27	15.36
10% maximal size critical value	n.a.	n.a.	n.a.	16.38	16.38	16.38
Observations	374462	374372	374372	374462	374372	374372
Year FE	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X
Municipality FE	X	X	X	X	X	X
Demographics		X	X		X	X
State by year FE			X			X

Sample period is 2005-2016 and frequency of all variables is quarterly. Informality data correspond to the individual level, homicides to the municipal level and weather data to the state level. Homicide rates are in per capita terms (per 10,000). Standard errors are in parenthesis. All specifications include sampling weights. Demographic controls: age, sex, years of education and income level. Errors are clustered at the municipal level. Panel A excludes individuals where changes do not last more than a quarter but there is at most one such pattern along the five quarters. Panel B excludes individuals where changes do not last more than a quarter and there is one or more such patterns along the five quarters. Dependent variable mean is 0.67. \*Coefficient is significant at 10% level. \*\*Coefficient is significant at 5% level. \*\*\*Coefficient is significant at 1% level.

**Appendix**  
**First Stages**

	(1)	(2)	(3)
Temperature	0.0169*** (0.0053)	0.0169*** (0.0053)	0.0073* (0.0041)
Year FE	X	X	X
Quarter FE	X	X	X
Municipality FE	X	X	X
Demographics		X	X
State by year FE			X
Observations	482761	482640	482640

Sample period is 2005-2016 and frequency of all variables is quarterly. Informality data corresponds to the individual level, homicides to the municipal level and weather data to the state level. Homicide rates are in per capita terms (per 10,000). Dependent variable mean is 0.64. Standard errors in parenthesis. All specifications include sampling weights. Demographic controls include age, sex, years of education and income level. Errors are clustered at the municipal level. \*Coefficient is significant at 10% level. \*\*Coefficient is significant at 5% level. \*\*\*Coefficient is significant at 1% level.