

The Economic Burden of Crime: Evidence from Mexico

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February 2019

I estimate the impact of the recent and unprecedented surge in drug-related violence in Mexico on the labor market outcomes of Mexican workers. Using a nationally representative longitudinal dataset that allows me to account for unobserved time-invariant heterogeneity, I find that there is a negative relationship between local violence and labor market outcomes. Self-employed individuals are the most sensitive to a violent environment, with men experiencing significantly reduced earnings and productivity, while women decrease their hours of work or exit the labor force entirely. I also find suggestive evidence that fear of victimization plays an important role explaining these changes.

* I am grateful to Duncan Thomas, Erica Field, Amar Hamoudi, Seth Sanders, and Alessandro Tarozzi for their guidance during this project. This paper also benefitted from valuable discussions with Ryan Brown, Dan Reese, Peter Arcidiacono, Ernest Boffy-Ramirez, Gabriela Farfan, Elizabeth Frankenberg, Robert Garlick, Maria Genoni, Nick Ingwersen, Peter Katz, Sandra Ley, Luis Rubalcava, Graciela Teruel, Xiao Yu Wang, and participants at the Ninth Annual HiCN Workshop, NEUDC 2013, PAA 2013, The Economic and Social Consequences of Armed Conflict and Crime 2012, and the DUPRI, Duke Labor and Development seminar, and IPHD seminar series. I also want to thank the MxFLS team of surveyors for their hard work and commitment, and to two anonymous reviewers for their comments. All errors are my own.
JEL Codes: J16, J22, K42, N36

I. Introduction

Research suggests that high levels of violence alter the economic environment in ways that drastically impact individual and household behavior.¹ In particular, it can have an effect on both demand and supply sides of labor markets and the direction of the effect is ambiguous (Deininger, 2003; Kondylis, 2007; Calderón, Gáfaro and Ibáñez, 2011; Shemyakina, 2011; Bozzoli, Bruck and Wald, 2013; Fernández, Ibáñez and Peña, 2014).²

While gauging the economic impact of violence is vital to accurately measuring its true costs, researchers in this literature face several empirical challenges. First, in most cases the location and timing of violence are not random or unanticipated, which potentially makes the sample of individuals who are affected highly selected. Second, changes of violence over time may be correlated with trends in other local characteristics, creating an omitted variable bias problem. Third, crime outbreaks often happen concurrently with other events that also impact wages and employment confounding a simple analysis of the relationship between violence and labor market outcomes. The recent escalation of drug related crime in Mexico combined with a rich and nationally representative longitudinal data set provide a unique opportunity to investigate the effects of violence on labor market outcomes while improving the methods used in the literature to estimate these effects.

¹ A rich strand of the literature has shown evidence of the effects of high levels of violence on health outcomes (Bundervoet, Verwimp, and Akresh, 2009; Baez, 2011; Akresh, Lucchetti, and Thirumurthy, 2012; Mansour and Rees, 2012), human capital investment (Barrera and Ibáñez, 2004; Shemyakina, 2010; Leon, 2012; Rodriguez and Sánchez, 2012), and asset depletion and consumption (Ibáñez and Moya, 2010; Justino and Verwimp, 2013).

² On the supply side, labor participation can decrease because of fear of victimization or because of the emergence of illegal, but profitable, activities that decrease engagement in the legal labor. Labor supply could also increase if the earnings of the main breadwinner decrease because of violence, and other members of the household join the labor force (that is, and added-worker effect) to compensate for the loss in family income (Lundberg, 1985; Cunningham, 2001). Labor demand is also likely to be impacted by violence, and as with supply, the direction of the effect is ambiguous. Demand can decrease if firms affected by violence reduce costs by closing, downsizing, or not entering the market (Pshisva and Suárez, 2010; Camacho and Rodriguez, 2012; Collier and Duponchell, 2012), or if high levels of violence diminishes foot traffic in previously thriving consumer centers. Alternatively, an increased presence of individuals with disposable income from illegal businesses may bolster economic activity, leading to an increase in labor demand.

Between 2007 and 2011 the official annual homicide rate in Mexico, reported by the National Institute of Statistics and Geography (INEGI, its Spanish acronym), rose dramatically from an annual average of 8.5 to 24.4 per 100,000 inhabitants (Figure 1).³ In order to estimate the economic impact of violent crime on labor outcomes, I exploit the unanticipated change in the magnitude and location of violence in Mexico and use individual fixed-effects to control for time-invariant unobserved heterogeneity. Specifically, I match available information on homicide rates from INEGI at the month and municipality level from 2005-06 (a period of low violence) and 2009-12 (a period of higher violence) to the second and third waves of the Mexican Family Life Survey (MxFLS), a nationally representative longitudinal survey.⁴

Dell (2015) was the first to touch on the relationship between violent crime in Mexico and labor market outcomes. In this paper, I take a focused look at this relationship and extend Dell's analysis as well as the literature on the economic effects of violence in several directions.

First, my analysis combines quasi-experimental geographic and temporal variation in violence throughout Mexico and a nationally representative longitudinal dataset. In so doing, it provides empirically rigorous estimates without a loss of external validity.

Second, most studies of the impact of violence on labor market outcomes rely on cross-sectional data. The limitation of relying on cross-sectional data is that it is difficult to fully assess or control for the possible selection problem that arises from systematic avoidance of violent areas. If, for example, unobserved skills are related to both violence and labor outcomes, cross-sectional estimates would be biased. The panel nature of the MxFLS, however, makes it possible to compare the outcomes of the same individuals when exposed to low versus high levels of

³ Figure 1 shows monthly homicide rates.

⁴ Although surveys during the third wave of the MxFLS were conducted between 2009 and 2012, 94% of the respondents living in Mexico were interviewed between 2009 and 2010.

violence, allowing me to control for time-invariant unobserved heterogeneity. Below, I show this comparison is critical for accurate causal inference.

Third, I explore the impact of local violence on the respondent's time allocation outside the labor market. This novel feature of the analysis provides evidence on the potential mechanisms through which violence affects labor markets and is informative to assessing the potential long-term effects of exposure.

Fourth, I can explicitly test the most plausible threats to causal identification by using the Mexican Drug War as a natural experiment. Specifically, I show that there are no unobserved local trends correlated with both violence intensity and labor market outcomes. In addition, I show that the Great Recession does not drive the results.

Lastly, according to the theoretical framework proposed by Becker and Rubenstein (2011), an individual's ability to control their fear of victimization depends upon the economic costs and benefits of mitigating exposure. This suggests that individuals with the most influence over their own labor market engagement should experience the most profound changes to their economic status in response to the escalation of violence. The fine level of detail available in the MxFLS regarding an individual's employment type, status, activities and self-reported fear of victimization allows for a more nuanced understanding of the complex relationship between violence and labor market outcomes than currently exists in the literature.

Consistent with the Becker and Rubenstein (2011) hypothesis, I find that individuals with less attachment to the labor market are the most responsive to local violence. Exposure to an increase in the municipal homicide rate adversely affects the employment status and the number of hours worked by individuals with the weakest labor market attachment: self-employed women. The mechanism behind this relationship appears to be fear of victimization. In addition,

exploring time allocation behavior provides evidence that when these women reduce their working hours they, in turn, increase their time spent on home-production activities. Finally, while crime does not lead self-employed males to drop out of the labor market, it does reduce their hourly and total earnings.

This paper provides evidence that, during the recent intensification of organized crime in Mexico, self-employed workers were the most vulnerable to the economic effects of local violence. These results suggest that when gauging the impact of violence it is critical to bear in mind the share of the workforce that is self-employed. However, it is important to note that these are short-term effects and that self-employed workers may simply respond faster to violence than wage-workers. As such, the non-effect for wage-workers in the short-term is not sufficient to conclude that this group will not be impacted by violence in the medium- or long-term.

The next section of this paper provides background on the Mexican experience of organized crime over the last decade and introduces the information available on homicides. Section 3 reviews the literature on the impact of crime and violence on labor market outcomes. Section 4 describes the Mexican Family Life Survey and reports descriptive statistics of the analytical sample. Section 5 provides a description of the empirical specification. Section 6 presents and discusses the main results. Section 7 discusses potential threats to identification and provides robustness checks. Section 8 offers concluding remarks.

II. Background

The rapid increase in violent crime in Mexico has led to considerable debate about its causes.⁵ A strand of the literature characterizes it as a byproduct of the military strategy of increased

⁵ Guerrero-Gutiérrez (2011); Guerrero-Gutiérrez (2012); Molzahn, Rios, and Shirk (2012); Rios and Shirk (2012); Rios (2013); Dell (2015); Castillo, Mejia, and Restrepo (2018).

confrontation with Organized Crime Groups (OCGs) that took place when Felipe Calderón became president (Guerrero-Gutiérrez, 2011; Molzahn, Rios and Shirk, 2012).

Calderón's military strategy targeting the main “capos” of the cartels destabilized the old oligopolistic equilibrium in which OCGs operated and maintained relatively low levels of violence.⁶ Guerrero-Gutiérrez (2012) suggests that, by confronting the main leader of a drug trafficking group, two types of violence are created: first, an internal conflict arises for the leadership of the organization; and second, confrontations with enemy organizations that seek to wrest territorial control increase. Related to this debate, Dell (2015) compares municipalities where a mayor from Calderón’s party (Partido Acción Nacional - PAN) won the election by a margin of 5 percent or less to municipalities in which the PAN lost by the same margin. Comparing these municipalities 6 months before and 6 months after the election, Dell finds a significant increase in drug-related homicides in the municipalities where Calderón’s party won, suggesting that PAN related policies may have triggered the increase in homicides.

This rapid and intense increase in violence can be observed in the official homicide rate reported by INEGI.⁷ According to this data source, the annual homicide rate has increased in Mexico by almost 200% between 2007 and 2011 (Figure 1). The dashed line in Figure 1 shows homicide rates reported from the National Public Security System (SNSP, its Spanish acronym), which was collected under the direction of President Felipe Calderón to assess the number of homicides exclusively related to organized crime. Comparing the numbers reported by INEGI

⁶ The term “drug cartel” is a colloquial term to refer to organized crime organizations but it does not imply any collusion to set prices. I use the term Organized Crime Groups (OCGs), and “cartels” indistinctively to refer to organized crime organizations involved in the drug-trafficking business.

⁷ In an effort to understand the new dynamics of crime in Mexico, in addition to the official numbers of intentional homicides reported by INEGI, other data sources were assembled to shed light on the puzzling increase of crime in Mexico. For an analysis and comparison of the different data available to measure homicides see Molzahn, Rios, and Shirk (2012) and Rios and Shirk (2012).

with those from SNSP, it is evident that most of the increasing trend in homicides reported by INEGI is explained by drug-related violence.⁸

The change in violence since 2007 is not just reflected in the overall intensity of homicides, but also in the geographical distribution of violence. The loss in leadership within the drug cartels due to the death or incarceration of the previous bosses created power vacuums that have led to the emergence of new leaders and increased the struggle for dominance over critical drug running corridors.

Figure 2 shows the INEGI homicide rates of 2002 and 2005, before Calderón took office, and 2007 and 2009, during Calderón's term. Before 2007, only a handful of municipalities were at the top of the distribution of homicides and they were highly concentrated in states with strong presence of OCGs. The first year of Calderón's term, 2007, was a relatively stable year in terms of violence, although his military strategy was already being implemented. However, from 2009 there is not only an increase in the national homicide rates but also a wide dispersion of violence into municipalities that previously had no contact with the drug war.

In addition to the increased number of confrontations between groups, the rising competition between OCGs led them to diversify their financial sources. While drug trafficking activities still account for most of the drug cartels' economic resources, in order to increase profits and fund their fight against the military and other OCGs, they relied more on criminal activities that directly affect the civil population, like kidnappings, extortions and car thefts. Moreover, the visibility of crimes changed the dynamics of the violence in Mexico. "Narco-messages" became a very popular method to signal territorial presence and to spread fear not just

⁸ The data that measures homicides related to organized crime was released by the Mexican government in December of 2010, and provides information of number of homicides "allegedly linked to organized crime" from December 2006 to September of 2011. The numbers from this data set show a rise in the annual homicide rate of more than 550% between 2007 and 2011; from 2.67 per 100,000 inhabitants in 2007 to 12.6 in 2010 and 18 in 2011 (dashed line in Figure 1 shows monthly homicide rates).

across other OCGs, but also authorities, journalists, and any citizen that did not support their actions. Moreover, the lack of trust in the State's institutions and the high levels of corruption and abuses from the police exacerbated the feeling of fear by the civilian population (Diaz-Cayeros et al., 2011; Guerrero-Gutiérrez, 2011).

In order to measure the effect of violent crime on individual and household outcomes, I use the homicide rates reported by INEGI. Homicide rates have been extensively used in the literature as a measure of crime and violence, although potential measurement error in INEGI homicide rate, related to shifts in the ability/motivation to more accurately report homicides, could bias the empirical estimation.⁹ This, however, does not seem to be an important issue in the Mexican context where the increasing violence has not only been evident in the official numbers (INEGI and the SNSP datasets) but also in alternative data sources collected by academics, the national press, and NGOs, all of which have verified the findings of the public records (Molzahn, Rios and Shirk, 2012).¹⁰

III. The Economic Effects of Crime and Violence

Although a number of studies analyze the causes of the increasing violence in Mexico, relatively few studies measure the impact of crime on individual outcomes. While it is not the focus of her paper, Dell (2015) made the first contribution to this literature by exploiting a network model of drug-trafficking routes and information from the National Survey of Occupation and Employment (ENOE) to measure the short-term economic effects of drug-related violence.

⁹ Because the final act of a homicide is the violent death of a person, and because of the difficulty related with hiding a body, homicides are less likely to be subject to underestimation or misinterpretation in comparison to crime on property or physical violence; moreover, the classification of a homicide is homogeneous across regional boundaries which diminishes potential measurement error (Shrader, 2001).

¹⁰ Another important feature of this dataset is that the definition of “intentional homicide” is based on the WHO cause of death guidelines and therefore is the same across all regions. This means that the geographic variation in crime is not explained by a simple difference in interpretation of what an intentional homicide is across regions.

Using a regression discontinuity strategy, Dell's results suggest that 6 months after a narrow PAN election win there are no effects on male labor participation or wages in the formal sector. By contrast, she finds negative effects on male wages in the informal sector and on female labor force participation. This study complements Dell's work by exploiting an alternative source of quasi-random variation, extending it to a nationally representative sample, exploring changes at the intensive margins of market and household labor supply, and investigating sources of heterogeneity that provide evidence on the mechanisms behind these relationships.¹¹

In addition, the rich individual data in the MxFLS allows this study to explore the heterogeneity of the relationship between exposure to violence and labor market outcomes by subjective measures of victimization, and to provide suggestive evidence of fear as a potential mechanism. Specifically, Becker and Rubinstein (2011) suggest that the ability to manage the fear of victimization depends on the economic costs and benefits associated with controlling these emotions. In this framework, Becker and Rubinstein (2011) categorize individuals as “occasional” or “regular” users depending on how frequently an individual performs an activity that could increase their likelihood of victimization. If the economic benefit to overcoming the fear of violence is higher among regular users than among occasional users, the model predicts that occasional users will be more sensitive to violence.

In the context of Mexico, the cost and benefits associated with overcoming the fear of victimization when participating in the labor force may differ by gender (for example, women in Mexico have lower labor force attachment than men and therefore are more likely to be “occasional users”) and by type of occupation (wage workers would be considered “regular users” due to the fact that having a contract reduces a wage workers’ flexibility in leaving or

¹¹ In addition, two working papers, Robles, Calderon, and Magaloni (2013) and Basu and Pearlman (2018) have also measured the effect of crime on labor outcomes.

altering their intensity of engagement with the labor market). By exploring these margins, this paper contributes to the current literature by examining the underlying mechanisms driving this relationship and providing insights applicable to more general settings of violence.

There also exists a broader literature measuring the impact of violence on labor market outcomes and household's economic conditions (Deininger, 2003; Kondylis, 2007; Calderón, Gáfar and Ibáñez, 2011; Shemyakina, 2011; Bozzoli, Bruck and Wald, 2013; Fernández, Ibáñez and Peña, 2014). These studies provide important insight into this relationship in the context of environments in which individuals have been forcibly displaced by violence and face considerable constraints with regard to destination cities. In this regard the Mexican setting is unique in this literature because represents a case in which violence rapidly increased but was not the result of a civil war or an armed conflict.

IV. Data: Mexican Family Life Survey

In order to study the impact of violence on economic outcomes at the individual and household level, I matched INEGI homicide data with the Mexican Family Life Survey (MxFLS). The MxFLS is a longitudinal, nationally representative survey of Mexican individuals and households. The baseline was conducted in 2002 and it includes information on approximately 8,440 households and 35,600 individuals spread across 136 municipalities and 16 states (Rubalcava and Teruel, 2006).¹² The MxFLS is designed to follow baseline respondents and their children born after 2002 independently of whether they moved within Mexico or to the U.S.

¹² Although the MxFLS is a nationally representative survey of the Mexican population, it is also important to provide evidence about its geographic representativeness of the increase in homicides over the period examined in this paper. The results of this test are provided in Online Appendix Table A1. The dependent variable in Column 1 is the change in the homicide rate between 2005 and 2010. The results show that the average change in the homicide rate between 2005 and 2010 was 11.3 per 100,000 for non-MxFLS municipalities, 12.2 per 100,000 for MxFLS municipalities. The difference between these estimates is not significantly different from zero. In addition, I conducted the same analysis using the change in the

The longitudinal nature of the MxFLS and its rich content make it an ideal source to study the behavior and economic outcomes of Mexican individuals and households. However, the contribution of using longitudinal data depends on the extent to which the original sample is successfully reinterviewed in each following wave. With regard to this study, it is especially important that both overall attrition and attrition within subgroups of the population are unrelated to the increasing wave of violence.

Overall, the MxFLS has achieved very low levels of attrition. In the second and third waves, over 89% of the baseline panel respondents were re-contacted. However, even though the re-contact rates provide evidence of a successful follow-up, if attrition is correlated with homicide rates the sample could lose its representativeness. Section VII contains the results of a test for selected attrition on measures of violence. The model is estimated separately for men and women and, in an alternative specification, allows for non-linearities in the measures of violence. I find no evidence of a relationship between violence exposure and attrition.

The MxFLS provides a number of advantageous features for studying the impact of the Mexican Drug War on the lives of Mexican citizens. First, as mentioned previously, the second wave (MxFLS2) was conducted in 2005-06 (during a period of “normal” levels of homicide rates) and the second follow-up (MxFLS3) was conducted between 2009 and 2012 (during a period of high levels of violence). As indicated in Figure 1, the timing of the MxFLS allows the comparison of outcomes of the same individual in periods of low and high levels of violence, which removes any time-invariant heterogeneity that could affect both the exposure to violence and the outcomes of interest (for example, fixed ability).

homicide rate between 2005 and 2009 (Column 2). There is no evidence in any of the specifications that the MxFLS2 municipalities capture changes in the violent crime environment that are not present at the national level.

Second, in the MxFLS there has been a concerted effort made to follow migrants within Mexico and to the U.S. This is particularly important for this study because migration may be a behavioral response to violent crime. For the sample of interest in this paper, 13.8 percent of the respondents migrated between the two waves, of which 5.6 percentage points were found in a different municipality between the two waves. The rest were found in the same municipality but report a long-term migration (more than one year) outside their municipality of residence. If migration is due to unobserved characteristics correlated with labor market outcomes and related to violence, it could bias the coefficients of interest. In the next section I examine migration as a behavioral response to violence and discuss whether it is a source of bias.

Third, the MxFLS has a rich set of characteristics about its participants, including information about the economic, social, and health status of each member of a surveyed household. Of particular interest for this study, the MxFLS contains a great deal of content about a respondent's labor market participation. For instance, employment is defined to include formal and informal jobs, as well as occupation and sector of employment. In addition, information on the earnings and weeks/hours worked is collected for the respondent's two main jobs. By examining information on the earnings and hours worked for an individual over the last 12 months, the analysis of the impact of violence not only explores net participation in labor markets, but also total earnings and a measure of productivity (hourly earnings). In addition to a detailed labor market activity component, the MxFLS collects information regarding a respondent's non-work time allocation and subjective measures of fear. These items can be used to explore how the overall daily activities of those who are exposed to violent crime are affected as well as help provide evidence on potential mechanisms.

A. Descriptive Statistics

Table 1 shows descriptive statistics measured in MxFLS2 for the sample of all individuals of working age (18 to 70 years old when interviewed in MxFLS2). The first and second Columns show the mean values for individuals who were living in municipalities where the change in the homicide rate was above and below the national average, respectively, and the third Column shows the p-value of their difference.¹³ Individuals living in places that suffered a higher increase in violence were, on average, more educated, their household size was smaller, they were less likely to be self-employed and were more likely to have relatives in the U.S. These observable differences highlight the importance of exploiting a longitudinal survey that can take into account the initial differences that existed among individuals living in each type of community.

The MxFLS also includes questions about self-perception and self-reported experience of violence. Table 1 shows that, for these measures, individuals from areas that would later become more violent did not have significantly higher perceptions of violence, nor did they report more experiences of violence before the escalation in organized crime. These results provide preliminary evidence that the heterogeneous increase in violence was unanticipated and not related to prior trends in perceptions of local safety.

These measures of perceived violence also provide insight with regard to the extent to which INEGI municipal homicide rates are correlated with reported feelings of fear. This correlation is important as it can help establish that the local homicide rates are relevant for the

¹³ Table A2 in the Online Appendix shows means for the same sample from Table 1 and the same variables measured in MxFLS2 and MxFLS3 without disaggregating the sample by levels of violence.

respondents.¹⁴ Table 2 shows the correlation between the change in the 12-month homicide rate between the MxFLS2 and MxFLS3 interview in the individual's municipality of residence in MxFLS2 and 6 different measures of self-perception of violence measured in MxFLS3 after the surge in crime began.^{15,16}

Panel A reports the results for the entire sample, Panel B for males and Panel C for females. For the three samples a strong correlation between the change in the homicide rate and the self-perceptions of violence can be observed. Specifically, an increase in the homicide rate is associated with reporting more fear of being assaulted, both during the day and at night, a perception of being less safe relative to 5 years ago, and the adoption of avoidance behaviors.

B. Sample Selection

From the baseline sample of the 35,677 individuals, 1,298 died between waves and 1,316 migrated to the United States either in MxFLS2 or MxFLS3. Given the empirical specification used in this paper, I need to observe an individual and their labor outcomes in Mexico both in MxFLS2 and MxFLS3. U.S. migrants, are therefore dropped from the sample. Following the same line of reasoning, if a respondent was not interviewed in either follow-up they are not included in the sample (5,193 respondents are dropped because of attrition). In MxFLS2 new eligible respondents (non-panel respondents living in a panel household) were interviewed. In

¹⁴ Using data from the National Survey on Victimization and Perception of Public Security (ENVIPE), Orozco-Aleman and Gonzalez-Lozano (2018) documented a negative relationship between violence and perceptions of public safety.

¹⁵ Specifically, three binary measures of self-reported perceived violence (the positive probability of being assaulted, fear of being assaulted during the day/night, and feeling less safe than 5 years ago) and two binary measures of self-reported behaviors that could change the likelihood of victimizations (go out at night very frequently or frequently, and go out less than 5 years ago) are used as the dependent variables. The model is described in detail in Online Appendix B.

¹⁶ The sample used in Table 2 is conditional on being an active member of the labor force in MxFLS2. This is the same sample used for the main analysis. This sample is smaller than the sample in Table 3 due to missing values in the measures of the respondent's self-perception of violence. In Online Appendix Table B1 I show that even if I assume the missing values correspond to no feelings of fear the results are unchanged.

total, 4,062 new members are interviewed in both follow-ups, which gives a total eligible sample of 31,932 respondents. The final sample is conditioned on age (respondents of age between 18 and 70 in MxFLS2) and on being in the labor force in MxFLS2 both in the formal and informal sectors (the sample is only conditioned on being an active member of the labor force in MxFLS2, without restrictions on occupation in MxFLS2 or MxFLS3). After these restrictions, I am left with a total sample of 9,587 respondents. The results of this paper are representative of individuals who were of working age and in the labor force before the escalation in violence.

V. Empirical Strategy

Drawing on a longitudinal survey that allows for the comparison of the same individual interviewed in 2005-06 (a period of relatively low violence) and in 2009-12 (a period of high violence), the identification strategy additionally leverages the rapid, unprecedented, and arguably unexpected increase in the level and location of violence in Mexico. The main specification also controls for a rich set of individual and household time-variant characteristics as well as economic measures at the state level.

One of the challenges to estimating this relationship is accounting for any systematic behavioral responses to violent crime. Specifically, non-random migration as a response to elevated violence would hinder identifying the true impact of violence on labor market outcomes. Previous authors studying the effect of the escalation of violence in Mexico on migration highlight the importance of this potential behavioral response.¹⁷ Online Appendix C describes a model of selective migration, and Tables C1 and C2 in the Online Appendix provide

¹⁷ Rios (2013) finds positive effects on migration, but cannot distinguish between internal and international migration; Basu and Pearlman (2017), find no effect on migration within Mexico, and no effect on international migration at the municipal level; Orozco-Aleman and Gonzalez-Lozano (2018) finds a significant increase on Mexican migration to the U.S.

evidence regarding the existence of this type of systematic behavioral response. The results provide some evidence of selective migration, suggesting that controlling for this endogenous migration could be important for causal identification.

To test for the potential bias from migration in a more direct way, I estimate the main specification with and without migrants. This is a novel analysis because migrants are not typically followed. Precise information about migration status allows me to directly test whether migration biases the results without making assumptions about its potential impact. Once the panel nature of the data is used with an individual fixed-effects model, the results are not significantly different when migrants are excluded.

However, given the results from previous literature and those in Tables C1 and C2, this paper follows a conservative approach to deal with potential selective migration. Specifically, the main empirical specification follows an intent-to-treat approach in which the municipality of residence in the second wave of the MxFLS is used to determine an individual's exposure to violence instead of municipality of residence in the third wave.¹⁸

Another challenge when estimating the effect of violence on labor market outcomes is omitted variable bias. The difficulty in estimating the relationship between violence and labor market outcomes could emerge from the fact that homicide rates have not increased in a random fashion over time and might not be orthogonal to unobserved factors that affect economic performance at municipality or individual level. To control for this unobserved heterogeneity, the empirical specification exploits the temporal and geographic variation in homicides rates between 2005 and 2009-12 in an individual fixed-effects framework. This model is particularly useful if we believe that there are time-invariant characteristics of individuals, such as ability that

¹⁸ The results of the main analysis are not qualitatively or significantly quantitatively changed if exposure to violence is based on current municipality of residence.

are correlated with both labor outcomes and violence.¹⁹ Moreover, if homicides are reported with error, the individual fixed-effects strategy will diminish its impact by differencing out the portion of the error that is constant over time.

The empirical strategy can be generalized in the following regression framework:

$$(1) \quad y_{ijmt} = \beta_0 + \beta_1 HomRate_{jt} + \theta_i + \Gamma' X_{ijmt} + GDP_{sa} + \gamma_a + \delta_q + u_{ijmt}$$

where y is the outcome of interest of individual i living in municipality j at the time of the MxFLS2 interview, and who is living in municipality m when interviewed in month and in year t . The measure of violence in these models, $HomRate_{jt}$, is the quartic root of the INEGI homicide rate over the 12 months prior to the MxFLS interview date, t , in the individual's municipality of residence in MxFLS2, j .²⁰ The quartic root transformation of the homicide rate is used because it approximates the logarithmic transformation, reducing the influence of outliers with the distinct advantage of not excluding municipalities with homicide rates of zero (Thomas et al. 2006; Tarozzi et al. 2014; and, Ashraf et al., 2015).²¹ As noted above, the panel nature of the data allows the use of individual fixed-effects, denoted by θ_i in Equation 1. In addition, X_{ijmt} , a vector of individual and household time-varying characteristics (marital status, whether the respondent lives with his/her parents, household size, number of children in the household, whether the place of residence is rural or urban, expectations of future migration, a measure of risk aversion and patience, a measure of emotional well-being and presence of relatives in the U.S.), is included; GDP at the state and year levels, GDP_{sa} , is included as a time-varying measure

¹⁹ Online Appendix Table D1 provides an analysis of the relationship between attrition and homicides and finds no significant relationships. However, if attrition is related to unobserved characteristics of the respondent it will bias a simple cross-sectional analysis. By making all comparisons within an individual, the internal validity threat of selective attrition is alleviated.

²⁰ The results are robust to using the homicide rate over the last 6 months for women, and over the last 1, 3, or 6 months for men.

²¹ Approximately 32 percent of the municipalities report zero homicides in 2005, 33 in 2006, 28 in 2009, 29 in 2010.

of the state level economy; and, γ_a and δ_q represent controls for year and quarter of interview fixed-effects, respectively.²²

The outcomes of interest, y , denote labor force participation for respondents age 18 to 70 in MxFLS2, number of hours worked, hourly earnings, and total earnings over the last 12 months for individuals working in both waves. Specifically, the measure of hours worked is the quartic root of the total number of hours worked in the last 12 months, and the measures of earnings are the quartic root of hourly earnings and total earnings in the last 12 months.²³

Fear of being victimized is an important channel that can directly affect an individual's decision to participate in the labor market. This effect is likely to be different for men and women if the dynamics of crime are heterogeneous by gender, as is the case in Mexico.²⁴ Thus, the models will be estimated separately by gender. In addition, the difference in relative flexibility of engagement with the labor market at the intensive and extensive margin between wage-workers and the self-employed motivate stratifying the models by sector of employment as well. The stratification by employment sector is only based on occupation in MxFLS2 and not MxFLS3, as the occupational choice in MxFLS3 could be endogenously related to violence.²⁵

²² Specifications alternatively using time trends, and year and month fixed-effects were also estimated and do not change the reported findings.

²³ Hours worked and earnings in the last month may be noisy measures of labor outcomes, particularly for self-employed individuals whose labor income and hours can significantly vary within the year. For this reason I use earnings and hours worked in the last 12 months. Moreover, some individuals report zero hours worked or spent on certain activities and zero earnings, thus using a logarithmic transformation would drop a number of observations. The quartic root transformation is used instead as it behaves similarly to a logarithmic transformation for positive numbers without dropping zeros (Thomas et al. 2006; Tarozzi et al. 2014; and, Ashraf et al., 2015).

²⁴ Not only has the number of female homicides increased 120% from 2007 to 2012 (INEGI) but also, the violence used in female homicides has been more gruesome and personal. While more than 40% of the homicide cases of men are deaths caused by a firearm, female deaths are more violent - strangulation and the use of a sharp object are the most common incidences of homicide (United Nations Mujeres, 2011). Moreover, sexual violence against women in Mexico has also increased these years, and a study from the United Nations shows that Mexico is the country with the highest percentage of women who have suffered this kind of victimization.

²⁵ Since stratification at the occupation level is based only on MxFLS2 information, movement between occupations could potentially be driving the results. To test this possibility, I estimate models aimed at explaining transitions between self-employment and wage employment and between occupations within each category. Homicide rates are not a significant predictor of these transitions for men or for women.

As a complement to the labor market behavior analysis, time allocation information is used to investigate the activities that are acting as substitutes to any potential change in hours worked. To do this, the quartic transformation of the number of hours per week spent on domestic chores, caretaking of elderly or young household and non-household members, and helping household members on their schoolwork are separately explored.

VI. Results

Table 3 provides estimates of Equation 1 using participation in the labor market (Column 1), the quartic root of hours worked over the last 12 months (Column 2), the quartic root of hourly earnings (Column 3), and the quartic root of total earnings (Column 4) as dependent variables. In addition, the models are stratified by gender and by occupation (self-employment and wage-employment).

Panels A and B of Table 3 provide results for self-employed men and wage-earning men, respectively. The estimates in Column 1 and 2 indicate that the labor force participation of self-employed and wage-working men, both on the extensive and intensive margins, was not significantly changed by increased exposure to homicides. This result suggests that the level of engagement in the labor market of men in Mexico is not sensitive to the intensity of local violent crime.

Interestingly, while labor market participation does not seem to be related to violence for working men in Mexico, the coefficients in Columns 3 and 4 suggest that the earnings from work, both hourly and total, are adversely affected by increased local homicides. Moreover, it is the earnings of self-employed men that seem to be particularly vulnerable to elevated rates of violence. Specifically, evaluating the coefficient of Column 3 for self-employed men at the mean

of self-employed males' earnings and at the mean of the homicide rate in MxFLS2, the marginal effect of an additional homicide per 100,000 people is associated with a reduction in hourly earnings of 0.37 pesos.²⁶ Given that the average homicide rate increase between 2005 and 2011 was approximately 15 homicides per 100,000, this result suggests that the average self-employed male experienced a decrease in hourly earnings of 5.6 pesos, which amounts to 15% loss of their hourly earnings. This loss in hourly earnings for self-employed men paired with no adjustment in hours worked translates into a significant decrease in their total annual earnings (Column 4): an additional homicide per 100,000 people is associated with a reduction in total earnings of 328 pesos, which amounts to an 11.4% loss.²⁷

The negative impact on the total earnings of self-employed men lends support to anecdotal evidence that self-employed individuals have been the most affected by violence. According to the MxFLS, over 50% of self-employed men work in retail, commerce and manufacturing activities (men in the manufacturing sector are mainly auto mechanics, taxi drivers, artisans, electricians and masons). It is reasonable to think these vocations would be particularly sensitive to violence because consumers living in insecure municipalities will be less likely to engage in commerce in the evening or hire the services of workers who would have access to the employer's home. Because there is no evidence of an effect on labor supply, it appears that self-employed men are not closing their businesses early or shutting them down but rather the lower demand for their services or goods is negatively affecting their income. An alternative hypothesis is that the decrease in earnings was generated by a shift to lower-paid

²⁶ This is calculated as: $\frac{dHourlyEarnings}{dHom} = 4 * HourlyEarnings^{\frac{3}{4}} * \frac{1}{4} * (-0.12)hom^{-\frac{3}{4}} = 4 * 36.37^{\frac{3}{4}} * \frac{1}{4} * (-0.12)8.07^{-\frac{3}{4}} = -0.37$

²⁷ This is calculated as: $\frac{dEarnings}{dHom} = 4 * Earnings^{\frac{3}{4}} * \frac{1}{4} * (-0.52)hom^{-\frac{3}{4}} = 4 * 40,860.36^{\frac{3}{4}} * \frac{1}{4} * (-0.52)8.07^{-\frac{3}{4}} = -312.1$

occupations. In order to explore this hypothesis, I included controls for time-varying characteristics of the job into the main analysis. Table E1 in the Online Appendix provides the results. Column 1 replicates the results shown in Table 3, Column 2 includes indicator variables for the two-digit Mexican classification of occupation type, Column 3 includes indicator variables for aggregated categories of employment, Columns 4-13 add 8 different binary measures of benefits received in the worker's job, and Column 14 uses all of the controls.²⁸ The results show that the estimated effects of violence on self-employed earnings are robust to the inclusion of these characteristics. Moreover, a model that interacts homicide rates with self-employment in MxFLS3 suggests that individuals who were self-employed in both waves were among the most affected by violence. These results provide evidence that movements between job types or changes in the work environment do not explain the negative effect of violence exposure on earnings.

A standard concern when examining the impact of an event on earnings is that, because individuals who leave the labor market no longer report earnings, this selection mechanism could potentially bias the results. In order to explore this concern, I conduct a sensitivity test in which earnings of 0 are assigned to all individuals who were working in MxFLS2 but were not working in MxFLS3. If individuals who became unemployed in high violence areas had lower initial earnings as compared to individuals who became unemployed in low violence areas, this robustness test should attenuate the original estimates. After making this adjustment, the

²⁸ The aggregated categories are: 1. Self-employed peasant; 2. Unpaid worker; 3. Wage worker non in agriculture; 4. Wage worker in agriculture; 5. Boss, employer; 6. Self-employed.

magnitude and precision of the main estimates do not appreciably change (Online Appendix Table E2).²⁹

A similar concern is that individuals with higher earnings might be more reticent to report their labor income during high levels of violence. If this were true, the sample of respondents would be possibly selected, potentially biasing the results. To address this concern, Online Appendix Table E3 shows the results of a non-response model for men who were working in MxFLS2. The purpose of the model is to test whether the earnings of working men in MxFLS2 were significantly different between those who did and did not report their earnings in MxFLS3. Columns 1 and 2 show the results for earnings and Columns 3 and 4 show the estimates for hourly earnings. Considering all workers (Columns 1 and 3) and only self-employed workers (Columns 2 and 4), the results show that the pre-violence earnings of respondents and non-respondents are statistically indistinguishable.

Panels C and D of Table 3 show the results for self-employed and wage-working females, respectively. The results in Column 1 suggest that exposure to violence has little to no impact on wage-working women, but it has a negative and significant effect on the labor force participation of self-employed women. Specifically, a self-employed woman who was living in a municipality with zero violence exposure in 2005 (20% of the municipalities in the MxFLS2 sample) and then experienced the average increase in violence (that is, 15 in 100,000 homicides) would decrease her likelihood of labor force participation by approximately 14%.³⁰ In addition, Column 2 shows that the hours worked in the labor force went down among self-employed women that experienced an increase in local violence. Specifically, an additional homicide per 100,000

²⁹The results in Online Appendix Table E2 are shown for self-employed men, the group for which there is a significant impact of violence exposure on earnings in the main results. The estimates for the other groups are also unchanged qualitatively or quantitatively when applying this sensitivity analysis.

³⁰ $0.07 * (15^{1/4}) = 0.14$.

people reduces annual hours worked by 32.66, which evaluated at the mean increase of violence, corresponds to a 489.9 hour decrease, or a 33% reduction in the annual hours worked for a self-employed woman.³¹

Among those self-employed women that remain in the labor force (Column 3 and 4 of Panel C) there is an imprecisely estimated increase in hourly earnings in more violent communities.³² This positive relationship may be as a result of the decreased labor supply effect found in Columns 1 and 2.

Online Appendix Table E4 provides the results of a fully interacted model for the sample of men and women who were self-employed in MxFLS2, which can be used to directly compare the effects of violence on labor market outcomes for men versus women. As expected, there is strong evidence that violence has different effects based on gender. Increases in violence appear to decrease the labor force participation of women. By contrast, violence is associated with a decrease in wages and earnings of men.

A. Longitudinal Data

As an illustration of the importance of accounting for unobserved heterogeneity, in Online Appendix Table E5 I provide estimates that are more closely comparable to what would be found in this context if only cross-sectional data were available.³³ Specifically, Columns 1-6 show the

³¹ $\frac{dHours}{dHom} = 4 * 1,496.42^{\frac{3}{4}} * \frac{1}{4} * (-0.65)8.07^{-\frac{3}{4}} = -32.7$

³² In fact, the magnitude on the positive estimate for hourly earnings for self-employed women is actually larger than the negative and statistically significant effect found for self-employed men.

³³ Brown et al. (2018) and Vieider and DiFalco (2018) provide evidence of the importance of using panel data when estimating the effects of shocks on risk preferences.

results from alternative models that do not use the longitudinal characteristics of the MxFLS³⁴ and Columns 7-9 replicate the main specification from Table 3.³⁵

Using only the MxFLS3 relies exclusively on geographic variation in violence to identify the relationship of interest, and therefore the lowest level of regional fixed-effect that can be reasonably employed are state fixed-effects.³⁶ The results from this model counter-intuitively suggest that there is a positive effect of violence on the earnings of men and women. The obvious concern with this approach is that, while it exploits the geographic variation of violence, it does not exploit its temporal variation. Moreover, the results could be biased if unobserved individual heterogeneity is related to both violence and labor market outcomes.

The second model (Columns 4-6) uses both MxFLS2 and MxFLS3 as pooled cross-sectional data (individuals ages 18-70 in MxFLS2 and those ages 18-70 in MxFLS3) without utilizing the individual fixed-effects available from the panel nature of the data. An advantage of this model is that by increasing the amount of temporal variation, finer levels of regional fixed-effects (specifically at the municipality level) can be included. The results provide no evidence of a relationship between violence and earnings. The potential flaw of this strategy is that, while it exploits temporal variation, it can not control for unobserved individual heterogeneity related both with the intensity of local violence exposure and labor outcomes.

The preferred identification strategy (Columns 7-9), which replicates the results from Table 3, exploits the panel nature of the survey and compares the labor outcomes of the same individual exposed to different levels of violence. This strategy removes individual- and

³⁴ In both models I control for a rich set of individual and household characteristics, year of interview, quarter of interview fixed-effects and regional fixed-effects (state fixed-effects in the first case, since the homicide rate variable is measured at the municipality level; and municipality fixed-effects in the second model).

³⁵ Online Appendix Table E5 does not show results for the probability of participation in the labor force since the variation for this variable comes from exploiting the panel data.

³⁶ Alternatively using no regional fixed-effects or municipality-level fixed-effects do not qualitatively change the results when treating MxFLS3 as a cross-section. Within-municipality variation comes from differences in date of interview.

community-specific heterogeneity caused by, for instance, selective attrition and allows selective migration to be controlled by assigning exposure based on pre-escalation level of violence in their place of residence. If this unobserved heterogeneity is not leading to bias, estimates that also exploit the temporal and geographic variation of violence should not be substantially different from estimates produced using the preferred specification.

A comparison of the different models highlights the importance of controlling for these potential sources of bias. For instance, when the longitudinal nature of the data is exploited, a clear negative relationship between violence and earnings emerge. As shown in Online Appendix Table E5, this relationship would have been hidden by unobserved heterogeneity had only cross-sectional data been available.

B. Mechanisms

A potential mechanism to explain the negative effect of violence on labor force participation of self-employed women is fear of victimization. If women are afraid of being victimized, the opportunity cost of leaving the labor market decreases. Moreover, self-employed individuals might have more flexibility when deciding to leave the labor market temporarily or cutting back on their working hours.

In order to explore whether fear is a possible mechanism for the negative relationship between labor market outcomes of self-employed and violence intensity, I estimate Equation 1 stratifying the groups presented in Table 3 according to the subjective measures of fear measured in MxFLS3.³⁷ The results provide suggestive evidence that fear is a potential mechanism driving the effect of violence on the reduction of labor market participation of self-employed women

³⁷ When analyzing the sample of wage-workers, both for men and women, the results are statistically the same for individuals who report more or less fear. Similarly, self-employed males who report more fear are not more affected by violence.

both at the intensive and extensive margin. Panel A of Table 4 provides the estimates for all women (the same results of Panel C in Table 3), Panel B for women who report to have changed transportation to avoid being victimized, Panel C for women who report “a lot of fear” of being assaulted during the day, and Panel D for women who report “a lot” or “some” fear of being assaulted during the day. The negative and significant effect not only persists in these subsamples but the magnitude of the effect of violence is considerably larger for these women.^{38, 39}

Considering these results in combination with those in Table 2, it appears that both men and women feel higher levels of fear because of the increase of violence, but only self-employed women respond to it by changing their labor force participation. This could be because the activities of self-employed men and women are different and/or because the opportunity cost of leaving the labor force is lower for women who in most cases are not the main breadwinner in the household.⁴⁰ In order to explore this explanation, I compare working and non-working people in MxFLS3 in Online Appendix Table E6 for the sample of women who were self-employed in MxFLS2. The results show that women who are not working in MxFLS3 are older, more likely to be married, less educated and had lower earnings and PCE, and thus more likely to have a lower opportunity cost of leaving the labor force.

Given that there exists a significant alteration of labor market activity for self-employed women exposed to violence, I next use Equation 1 to investigate which activities are being substituted into as a consequence of this change in behavior. The results of this analysis can be

³⁸ The effect of violence on labor participation is still negative and significant but the magnitude is smaller for women who do not report fear of being assaulted during the day or women who did not change transportation.

³⁹ Similarly, Brown et al. (2018) find that individuals exposed to violence in Mexico become more risk averse and the main channel through which violence operates is an individual’s increased perception of potential victimization rather than financial, or mental health channels.

⁴⁰ 11% of self-employed men and 20% of self-employed women work on retail; and, 3.5% of self-employed men offer personal services while 14% of self-employed women do. Moreover, when disaggregating the sample of self-employed women by a more disaggregated level of occupations the results show that women in retail/commerce and manufacturing are the most likely to leave the labor force or reduce their working hours.

found in Table 5. When exploring the non-labor time allocation of self-employed women exposed to violence, the results suggest that they are trading working hours for time spent on domestic chores and/or helping a household member with their schoolwork (Panel A, Table 5). Evaluated at the average increase of violence for a self-employed woman, an increase in violence is associated with an increase in time allocated to domestic chores by 17% and an increase in time helping other household members with their schoolwork by 20%. Panel B in Table 5 provides estimates of the same analysis for women working as employees. For this sample the results for time spent on home production are not significant and the magnitude of the coefficients is close to zero. These results suggests that the significant time allocation change for self-employed women exposed to violence is not driven by an unobserved trend common to all working women. For women of both employment types, time spent on caregiving, entertainment, and agricultural activities were not significantly related to violence exposure.⁴¹

In addition, there is no evidence that alternative income sources are substituting for the lost monetary earnings from work for these women. I directly test this by investigating whether violence has had an effect on the probability of receiving transfers (monetary or in-kind), on the amount of the transfers, and on non-labor income. These estimates, found in Online Appendix Table E7, show that violence did not lead to an increase in transfers or non-labor income for these women.⁴²

An alternative potential mechanism to compensate for the loss in income is to rely on labor participation of young men in the family. Brown and Velasquez (2017) found evidence

⁴¹ Results available upon request.

⁴² Online Appendix Table E7 shows the results of a model with individual fixed-effects for self-employed women in MxFLS2. Column 1 displays the results for the probability of getting a transfer from any relative or friend; Column 2 shows estimations for the total amount of transfers received; and, Column 3 provides the results for non-labor income. Non-labor income includes subsidies or governmental aid; scholarships or donations; indemnities against labored risks, employment liquidation, and workers compensation; and, retirement funds, retirement or pension.

supporting this mechanism. Specifically, their results suggest that young men of self-employed parents who are exposed to local violence in Mexico are at significantly higher risk to drop out of school and join the labor force.

C. Discussion

Overall, the results of these analyses highlight the significant heterogeneity of the effects of violence in Mexico on labor market outcomes. Specifically, the findings suggest that self-employed individuals are the most adversely affected by increasing local violence. If the effect of violence on earnings is working through the demand side, we might expect to see comparable effects for male wage earners in similar occupations. One hypothesis for why the self-employed might be more vulnerable to this kind of shock is that their labor income is immediately affected by a lower demand in the market, while the wages of employees shift more slowly due to predetermined contracts. Another possible explanation for this relationship is that these men are suffering from decreased economic activity caused by fear of being victimized in these dangerous localities. This interpretation is consistent with the findings of Levitt and Venkatesh (2000), who show that violence from gang wars in Chicago kept customers away from the conflict area and this negative demand shock negatively affected both the price and quantity of drugs sold.

Moreover, the analysis indicates that there is a significant difference in the labor market reactions of self-employed males that face increased violence relative to self-employed females. While self-employed males' labor force participation has not been affected by the increase in violent crime, the results suggest that a nontrivial number of self-employed females are leaving the labor market or reducing their hours worked, and substituting these working hours with

increased home production. This result is particularly important in an already unequal society, as any shock that disproportionately affects women also needs to be recognized as contributor to a widening gender gap.

When evaluating the long-term consequences of the increase of violence in Mexico, one must also consider whether individuals can adapt or habituate to this new environment of violence (De Choudhury, Monroy-Hernández, and Mark, 2014). The empirical literature on the economics of crime provides little guidance regarding the scope for adaption to violence. In this study, the limited heterogeneity in the timing of the interviews that take place after the escalation in violence does not allow for a thorough, direct evaluation of this potential behavioral response. As a way of providing suggestive evidence with respect to adaption, I examine whether the effects of violence on labor market outcomes are larger for individuals living in areas that had lower levels of violence prior to the spike in homicide rates. If individuals adapt their behavior in response to a violent environment, then respondents with exposure to higher levels of homicides prior to the intensification of violent would be expected to have a less severe reaction to its intensification. However, the results of these estimations show that the overall effect of the change in violence on economic outcomes does not differ depending on the previous level of violence exposure (Online Appendix Table E8).

VII. Threats to Identification and Robustness Checks

This analysis exploits an unprecedented, temporally sharp, geographically diverse, and plausibly exogenous change in the Mexican conflict environment paired with within-respondent comparisons to evaluate the relationship between exposure to violent crime and labor market outcomes. The main threats to causal identification that remain are unobserved municipal trends

or a parallel event that is correlated with both the escalation in violence in Mexico and labor market outcomes. The potential confounder that could generate the results of this paper would need to present similar temporal and geographic heterogeneity as found in Figures 1 and 2. Furthermore, it would have to only impact self-employed individuals and impact men and women in dissimilar ways.

In order to provide evidence regarding the exogeneity of the surge in crime observed in Mexico since 2007 to underlying municipality trends, I conduct a placebo test of the relationship between current municipal violent crime rates and prior labor market outcomes. Specifically, given that the increase of violence in Mexico is evident from 2007 but from 2002 to 2005 the homicide rate was stable, I estimate the same model discussed in the main specification but use observations from MxFLS1 (2002) and MxFLS2 (2005-2006) and assign them the municipal homicide rate from the subsequent wave (i.e. from MxFLS2 and MxFLS3, respectively). If it were the case that the crime surge was due to, for instance, underlying economic trends, then we would expect significant effects of violence in this specification. The results from this analysis are presented in Table 6.

Panel A and B provide the results for self-employed and wage-employed men. For both occupation groups, the estimates for earnings and hourly earnings are insignificant and the signs are positive, suggesting that if an underlying unobserved trend exists it would likely only serve to cause an underestimate of the effects found in Table 3. Panel C reports the effects for self-employed women. The relationship between violence and labor force participation is negative but insignificant and 42% smaller than the estimate in the main specification. Moreover, the placebo test estimate on hours worked for self-employed women (Panel C, Column 2) is insignificant and positive, contrary to what was found in Table 3. In general, each of the

estimates in the placebo test is insignificant at the 10% level. Overall, these results provide support for the assumption that the main results in Table 3 are not a function of underlying downward linear trends in labor market outcomes within municipalities that would become violent.

An additional method of examining whether confounding local characteristics are driving the results is to test if pre-treatment trends in local demography, infrastructure, economic activity, police presence and fear of victimization predict the 2009 homicide rate or changes in the homicide rate between 2005 and 2009 in the 136 municipalities that contributed data to the MxFLS baseline. The pre-treatment municipality characteristics used for this test are a set of 31 characteristics from the Census and the MxFLS. In order to capture whether municipality or locality trends predict the spike of violence observed in Mexico the independent variables are measured as a change between 2000 and 2005 for the Census variables and between MxFLS2 (2002) and MxFLS2 (2005-2006) for the MxFLS variables. The results in Online Appendix Table E9 suggest that prior municipality characteristic trends are not correlated with the location of greater levels of changes in violent conflict.⁴³ This provides further evidence that the change in a municipality's level of violence is not simply a reflection of underlying linear trends in other characteristics of that municipality.

The type of confounder that can not be ruled out by the previous tests is a change in the labor market outcomes of the self-employed that has similar geographic heterogeneity to the change in violent crime and also happens non-linearly immediately before or simultaneously to the escalation of violence. One potential source of this type of bias would be present if the 2008 financial crisis impacted Mexico with the same temporal and geographic heterogeneity as the

⁴³ Only 3 coefficients are significant at the 10% level out of 31 independent variables, which is the amount of significant covariates that would be expected by chance.

change in violence and self-employed men's earnings and self-employed women's labor market participation were the most sensitive to that economic shock. Two additional tests are conducted to test the sensitivity of the main analysis to the potential biasing effects of the economic downturn.⁴⁴

Table 7 provides the results for self-employed men (Panel A) and self-employed women (Panel B) when the municipality level unemployment rate, and characteristics of the manufacturing industry and retail sector are added to Equation 1.⁴⁵ Columns 1 and 4 show the results of the main specification, Columns 2 and 5 add the unemployment rate, and Columns 3 and 6 additionally include the total number of workers employed in the manufacturing industry and retail sector and the gross aggregate value of both industries.⁴⁶ Adding these additional controls do not affect the significance or the magnitude of the estimate effects of violence on labor outcomes.⁴⁷

Alternatively, given the evidence of a large impact of the economic crisis on the manufacturing sector in Mexico and particularly the maquiladoras/export sector along the northern border with the United States (Villarreal, 2010), I estimate Equation 1 excluding all states along the U.S.-Mexico border. The results of this analysis in Table 8 show that the estimates of the main specification hold.

⁴⁴ GDP at the state level is already included in the main specification.

⁴⁵ Table 7 only provides the results for the outcomes and sub-samples that had significant results in the main specification. Estimates for all other outcomes and samples are also qualitatively and quantitatively equivalent to Table 3.

⁴⁶ The source for the unemployment rate is the Census. This variable is available at the municipality level for 2000 and 2010. The characteristics of the manufacturing industry and retail sector are available at the municipality and yearly level through the Sistema Estatal y Municipal de Bases de Datos (SIMBAD). All the data can be downloaded from INEGI at www.inegi.com.

⁴⁷ I have also estimated additional regressions adding characteristics for other economic sectors: basic services, financial services, private (non-financial) services, and transportation. The results are consistent across all specifications.

Lastly, in order to test for potential selective attrition as a consequence of increased violence, a model is estimated that predicts whether the probability of attrition from MxFLS3 is related to the municipal homicide rate. While the use of an individual fixed-effects strategy shields the estimates from most internal validity bias from violence-related selective attrition, a relationship between survey retention and the local violence environment would diminish the external validity of the results. The details of the model are in Online Appendix D and the results are reported in Online Appendix Table D1. The results provide strong evidence that living in a municipality that would have a larger increase in violence did not lead to higher probability of survey attrition.

VIII. Conclusion

Being able to identify the impact of national and local events has great policy relevance to governments and policy-makers as they try to assist the individuals who have been adversely affected. However, identifying the effect of negative environmental changes presents important challenges. First, in the case of a destructive event, like violent crime, it is generally not possible to use a randomized experiment to measure its impact. Second, for a simple natural or quasi-experiment to be valid, the change has to be unexpected and unrelated to other characteristics of the time and place. Third, if the event is of substantial importance in an individual's life, tracking and accounting for systematic behavioral response is imperative.

In an effort to explore the effect of violence on labor market outcomes, this paper exploits information from a nationally representative longitudinal survey whose timing perfectly aligned to capture the impact of an unanticipated change in Mexico's conflict environment. The timing of the last two waves of the MxFLS, paired with the panel nature of the survey, provides the

opportunity to compare the same individual in periods of low and high violence, removing potentially endogenous time-invariant unobserved heterogeneity between respondents.

The results provide evidence that the recent escalation of violence in Mexico had a particularly strong and multidimensional impact on the labor market outcomes of self-employed individuals. Specifically, I find that exposure to violent conflict leads self-employed women to leave the labor market and reduces the number of hours they work. This effect is stronger for women who report having higher levels of fear. Moreover, self-employed women are substituting hours of work with time spent on household chores. Violent crime in Mexico has also affected the labor outcomes of self-employed males. For this group of the population, the adverse relationship between conflict and economic outcomes is not driven by employment behavior, but rather through a decline in the profits that they collect. I conclude that the increasing violence in Mexico not only affects the direct participants in the Mexican Drug War but also its civilians, suggesting that it may be in the best interest of the government to mediate the negative wealth shocks the rise in violence is imposing in order to reduce the long-term impact of this conflict.

IX. Tables and Figures

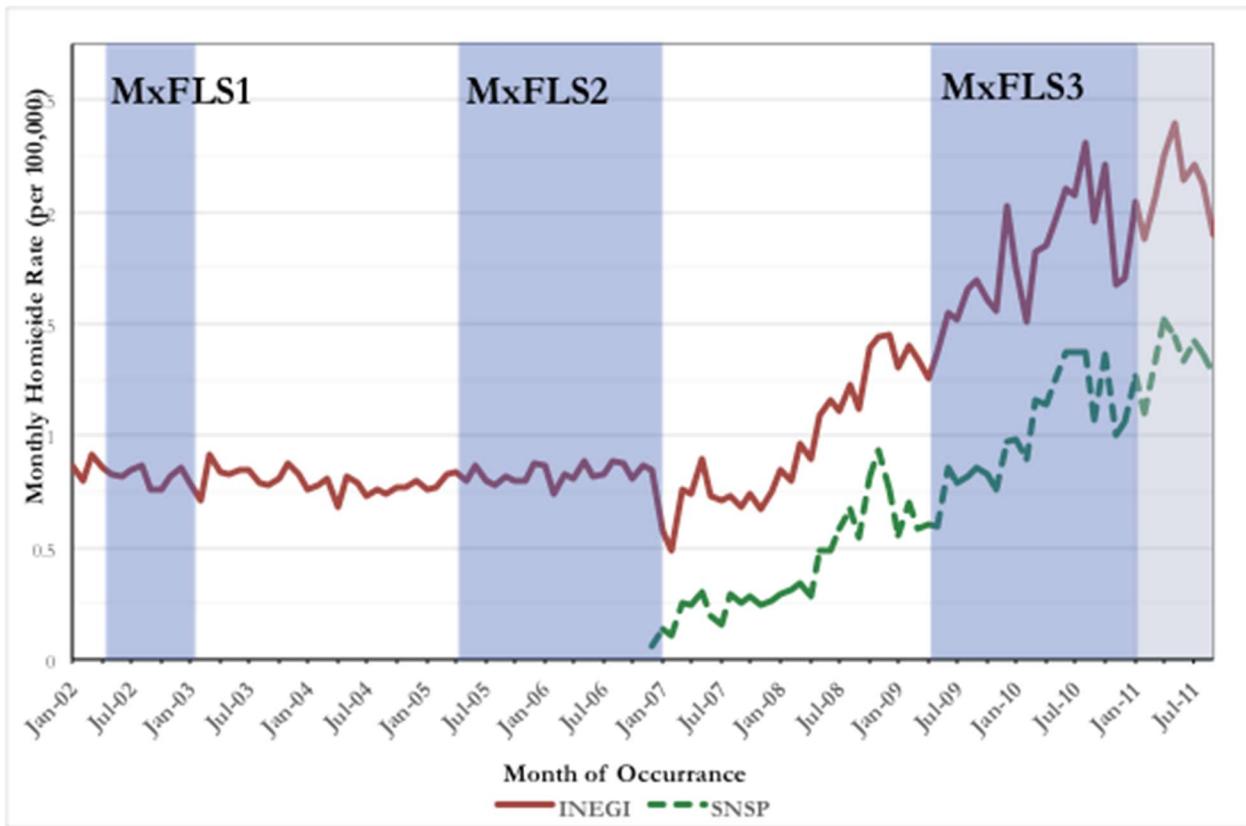


Figure 1.

INEGI and National Public Security System Monthly Homicide Rate (per 100,000 Inhabitants)

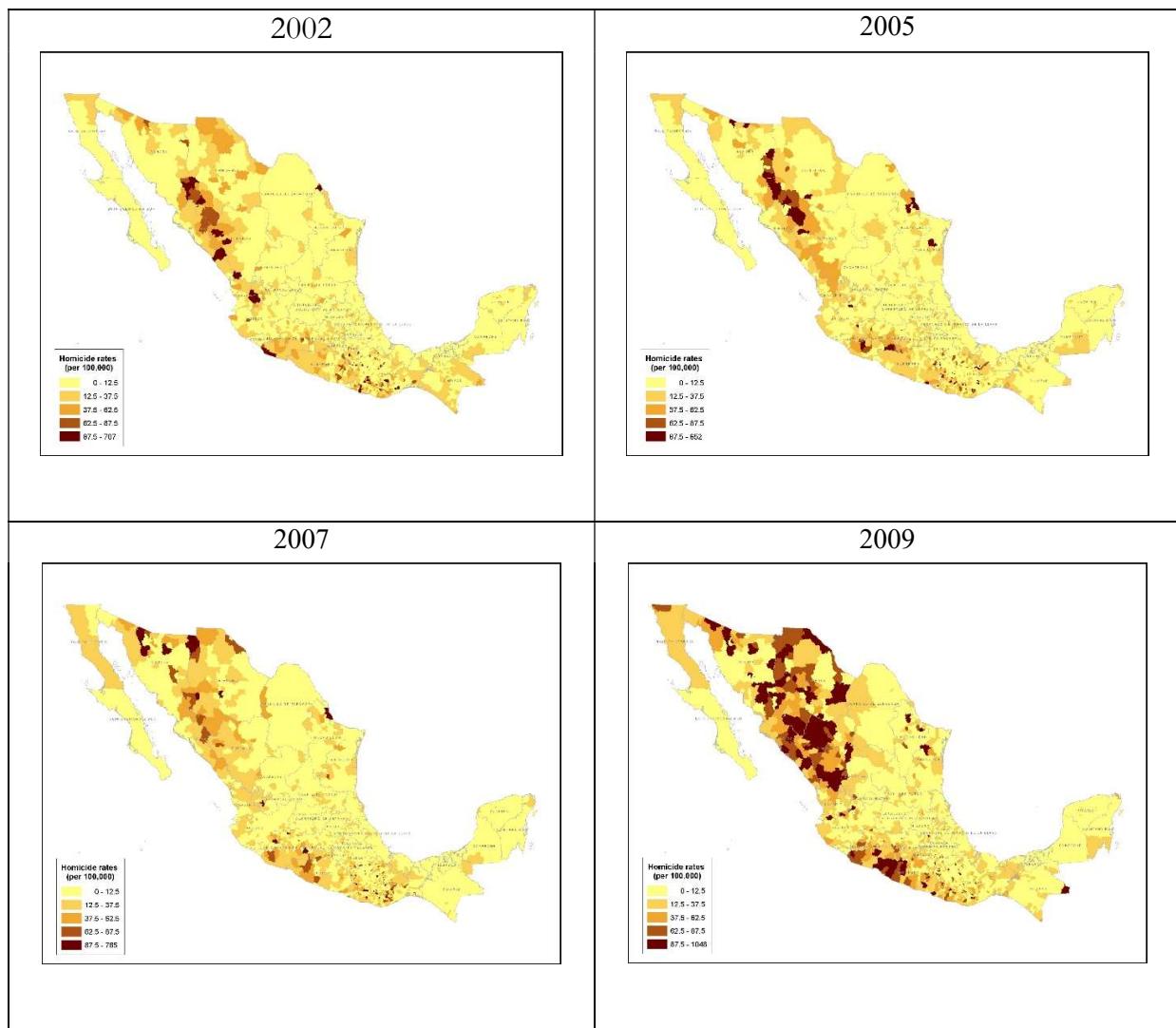


Figure 2.
Annual Homicide Rates (INEGI) at the municipality level (per 100,000 Inhabitants)

Table 1.
Descriptive Statistics for Respondents Aged 18-70 in MxFLS2

Variables measured in MxFLS2	Difference in the Homicide Rate between MxFLS2 and MxFLS3		
	Above National Mean	Below National Mean	P-value
<i>Basic demographics</i>			
Female (percent)	53.94	54.55	0.44
Age	38.37	38.08	0.19
Married (percent)	77.06	76.18	0.20
Years of education	7.96	7.71	0.00
Primary incomplete (percent)	28.60	31.51	0.00
Primary complete (percent)	27.30	25.98	0.06
High school incomplete (percent)	39.42	38.43	0.20
High school complete (percent)	11.36	10.36	0.04
College or more (percent)	15.67	15.28	0.51
<i>Household composition</i>			
Household size	5.33	5.54	0.00
Number of co-resident children	1.66	1.71	0.10
<i>Individual characteristics</i>			
Total earnings last 12 months	2,212	2,226	0.51
Hourly earnings	26,736	28,394	0.43
Worked last week (percent)	32.16	34.19	0.49
Self-employed (percent)	65.19	66.51	0.08
Wage worker (percent)	19.89	23.09	0.00
Has relatives in U.S. (percent)	49.00	47.07	0.02
Number of relatives in U.S.	49.24	42.20	0.00
Most impatient (percent)	1.73	1.77	0.09
<i>Locality characteristics</i>	52.26	51.46	0.36
Rural (percent)			
Fear of being assaulted during the day (percent)	44.88	44.43	0.57
Fear of being assaulted during the night (percent)	7.59	8.20	0.16
Positive probability of being assaulted (percent)	11.87	12.87	0.06
Victim of assault outside own home (percent)	33.91	32.83	0.16
GDP per capita (state level)	13.31	13.80	0.39
Sample size	6,294	10,438	

Table 2.

Relationship between Measures of Violence in MxFLS3 and the Change in the Homicide Rate between MxFLS2 and MxFLS3

	(1)	(2)	(3)	(4)	(5)	(6)
	Positive probability of being assaulted = 100	Fear of being assaulted during the day = 100	Fear of being assaulted during the night = 100	Feels less safe than 5 years ago = 100	Go out at night very frequently or frequently = 100	Go out less than 5 years ago = 100
Panel A. Men and Women						
Change in the Homicide Rate between MxFLS2 and MxFLS3	0.127*** [0.045]	0.165*** [0.048]	0.148*** [0.047]	0.283*** [0.050]	-0.065** [0.028]	0.255*** [0.047]
Constant	24.401*** [2.930]	18.058*** [2.402]	22.040*** [2.464]	28.126*** [2.902]	19.164*** [2.176]	36.592*** [2.632]
Sample size	7,457	7,457	7,457	7,457	7,457	7,457
R-squared	0.018	0.020	0.016	0.033	0.015	0.019
Panel B. Men						
Change in the Homicide Rate between MxFLS2 and MxFLS3	0.120*** [0.043]	0.148*** [0.036]	0.134*** [0.044]	0.261*** [0.049]	-0.066** [0.029]	0.249*** [0.042]
Constant	20.535*** [3.140]	14.518*** [2.282]	19.464*** [2.404]	26.035*** [3.128]	19.757*** [2.556]	34.590*** [2.828]
Sample size	4,954	4,954	4,954	4,954	4,954	4,954
R-squared	0.022	0.020	0.015	0.031	0.014	0.019
Panel C. Women						
Change in the Homicide Rate between MxFLS2 and MxFLS3	0.149** [0.070]	0.207** [0.082]	0.182*** [0.067]	0.334*** [0.060]	-0.066* [0.039]	0.266*** [0.083]
Constant	33.616*** [4.486]	26.552*** [4.792]	27.892*** [4.788]	34.048*** [4.717]	17.966*** [3.586]	41.912*** [4.946]
Sample size	2,503	2,503	2,503	2,503	2,503	2,503
R-squared	0.022	0.039	0.034	0.050	0.016	0.024

Standard errors clustered at MxFLS2 municipality level in brackets

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

Note: Controls for differences in age, education, marital status, household composition, labor force participation, occupation, earnings, per capita expenditure, rural place of residence, presence of relatives in U.S., unemployment rate at the municipality level and state GDP per capita

Table 3.

Impact of Homicide Rates on Labor Outcomes for Respondents Aged 18-70 in MxFLS2
Individual Fixed Effects comparing same individual in MxFLS2 and MxFLS3

	(1)	(2)	(3)	(4)
	Worked last week (1)	$\sqrt[4]{\text{Hours worked last 12 months}}$	$\sqrt[4]{\text{Hourly Earnings}}$	$\sqrt[4]{\text{Total Earnings last 12 months}}$
Panel A. Self-employed Men				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	-0.01 [0.012]	0.03 [0.104]	-0.12** [0.052]	-0.52* [0.262]
Sample size	1,743	1,727	1,103	1,108
R-squared	0.136	0.113	0.028	0.020
Panel B. Wage-employed Men				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	0.00 [0.007]	0.1 [0.062]	-0.04* [0.021]	-0.09 [0.137]
Sample size	4,852	4,793	3,482	3,500
R-squared	0.131	0.108	0.008	0.009
Panel C. Self-employed Women				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	-0.07** [0.028]	-0.65*** [0.187]	0.27 [0.542]	0.11 [0.128]
Sample size	803	803	328	328
R-squared	0.455	0.344	0.052	0.063
Panel D. Wage-employed Women				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	-0.01 [0.024]	-0.09 [0.148]	0.01 [0.047]	0.27 [0.217]
Sample size	2,182	2,172	1,211	1,212
R-squared	0.354	0.327	0.031	0.023

Standard errors clustered at the MxFLS2 municipality level in brackets

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

Note: All models include marital status, household composition, rural/urban, migration expectations, preferences, emotional status, presence of relatives in U.S., year of interview fixed effects, quarter of interview fixed effects and state GDP.

Table 4.

Impact of Homicide Rates on Labor Outcomes by Measures of Fear for Self-employed Women Aged 18-70 in MxFLS2
 Individual Fixed Effects comparing same individual in MxFLS2 and MxFLS3

	(1)	(2)
	Worked last week (1)	$^4\sqrt{\text{Hours worked}}$ last 12 months
Panel A. All self-employed women		
$^4\sqrt{\text{Homicide Rate last 12 months}}$	-0.07** [0.030]	-0.68*** [0.189]
Sample size	803	803
R-squared	0.45	0.343
Panel B. Self-employed women who changed transportation to avoid victimization		
$^4\sqrt{\text{Homicide Rate last 12 months}}$	-0.26*** [0.086]	-2.40*** [0.644]
Sample size	63	63
R-squared	0.492	0.399
Panel C. Self-employed women who report a lot of fear during the day		
$^4\sqrt{\text{Homicide Rate last 12 months}}$	-0.24* [0.132]	-1.22* [0.702]
Sample size	43	43
R-squared	0.605	0.525
Panel D. self-employed women who report a lot/some fear during the day		
$^4\sqrt{\text{Homicide Rate last 12 months}}$	-0.12* [0.069]	-1.04** [0.445]
Sample size	174	174
R-squared	0.403	0.305

Standard errors clustered at the MxFLS2 municipality level in brackets

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

Note: All models include marital status, household composition, rural/urban, migration expectations, preferences, emotional status, presence of relatives in U.S., year and quarter of interview and state GDP

Table 5.

Impact of Homicide Rates on Time Allocation for Women Aged 18-70 in MxFLS2
 Individual Fixed Effects comparing same individual in MxFLS2 and MxFLS3

	(1)	(2)
	${}^4\sqrt{\text{Hours helped hh member with his/her homework/week}}$	${}^4\sqrt{\text{Hours domestic chores/week}}$
Panel A. Self-employed Women		
${}^4\sqrt{\text{Homicide Rate last 12 months}}$	0.12** [0.045]	0.07** [0.035]
Sample size	795	795
R-squared	0.0293	0.018
Panel B. Wage-employed Women		
${}^4\sqrt{\text{Homicide Rate last 12 months}}$	0.00 [0.034]	0.04 [0.037]
Sample size	2,087	2,088
R-squared	0.0757	0.0123

Standard errors clustered at the MxFLS2 municipality level in brackets

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

Note: All models include marital status, household composition, rural/urban, migration expectations, preferences, emotional status, presence of relatives in U.S., year and quarter of interview and state GDP

Table 6.

Impact of Future Homicide Rates on Labor Outcomes for Respondents Aged 18-70 in MxFLS1
Individual Fixed Effects comparing same individual in MxFLS1 and MxFLS2

	(1)	(2)	(3)	(4)
	Worked last week (1)	$\sqrt[4]{\text{Hours worked last 12 months}}$	$\sqrt[4]{\text{Hourly Earnings}}$	$\sqrt[4]{\text{Total Earnings last 12 months}}$
Panel A. Self-employed Men				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	0.00 [0.015]	-0.02 [0.044]	0.02 [0.042]	0.28 [0.233]
Sample size	1,750	1,713	1,300	1,315
R-squared	0.038	0.034	0.012	0.015
Panel B. Wage-employed Men				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	0.00 [0.008]	-0.03 [0.039]	0.04 [0.032]	0.21 [0.248]
Sample size	3,848	3,805	3,319	3,343
R-squared	0.029	0.007	0.057	0.023
Panel C. Self-employed Women				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	-0.04 [0.031]	0.05 [0.147]	0.02 [0.114]	-0.36 [0.549]
Sample size	854	823	371	380
R-squared	0.111	0.009	0.052	0.015
Panel D. Wage-employed Women				
$\sqrt[4]{\text{Homicide Rate last 12 months}}$	0.01 [0.020]	-0.01 [0.069]	0.05 [0.079]	0.39 [0.463]
Sample size	1,759	1,731	1,176	1,182
R-squared	0.170	0.018	0.098	0.011

Standard errors clustered at the MxFLS1 municipality level in brackets

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

Note: All models include marital status, household composition, rural/urban, migration expectations, preferences, emotional status, presence of relatives in U.S., year and quarter of interview and state GDP

Table 7.

Impact of Homicide Rates on Labor Outcomes for Respondents Aged 18-70 in MxFLS2
 Including Municipalities' Economic Variables
 Individual Fixed Effects comparing same individual in MxFLS2 and MxFLS3

Panel A. Self-employed men	(1)	(2)	(3)	(4)	(5)	(6)
	⁴ $\sqrt{\text{Hourly Earnings}}$			⁴ $\sqrt{\text{Total Earnings last 12 months}}$		
⁴ $\sqrt{\text{Homicide Rate last 12 months}}$	-0.12** [0.052]	-0.11** [0.053]	-0.13** [0.056]	-0.55** [0.263]	-0.50+ [0.272]	-0.56** [0.274]
Unemployment Rate	NO	YES	YES	NO	YES	YES
Manufacturing Industry Characteristics	NO	NO	YES	NO	NO	YES
# employed workers and gross aggregate value						
Retail Sector Characteristics	NO	NO	YES	NO	NO	YES
# employed workers and gross aggregate value						
Sample size	1,103	1,103	1,103	1,108	1,108	1,108
R-squared	0.03	0.03	0.04	0.02	0.02	0.02

Panel B. Self-employed women	(1)	(2)	(3)	(4)	(5)	(6)
	Worked last week (1)			⁴ $\sqrt{\text{Hours worked last 12 months}}$		
⁴ $\sqrt{\text{Homicide Rate last 12 months}}$	-0.07** [0.030]	-0.07** [0.029]	-0.08** [0.034]	-0.68*** [0.189]	-0.69*** [0.183]	-0.73*** [0.214]
Unemployment Rate	NO	YES	YES	NO	YES	YES
Manufacturing Industry Characteristics	NO	NO	YES	NO	NO	YES
# employed workers and gross aggregate value						
Retail Sector Characteristics	NO	NO	YES	NO	NO	YES
# employed workers and gross aggregate value						
Sample size	803	803	803	803	803	801
R-squared	0.45	0.45	0.45	0.34	0.34	0.35

Standard errors clustered at the MxFLS2 municipality level in brackets

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

Note 1: All models include marital status, household composition, rural/urban, migration expectations, preferences, emotional status, presence of relatives in U.S., year and quarter of interview and state GDP

Table 8.

Impact of Homicide Rates on Labor Outcomes for Respondents Aged 18-70 in MxFLS2
Without States in along the U.S.-Mexico Border
Individual Fixed Effects comparing same individual in MxFLS2 and MxFLS3

Panel A. Self-employed men

	(1)	(2)
	$^4\sqrt{\text{Hourly Earnings}}$	$^4\sqrt{\text{Total Earnings last 12 months}}$
$^4\sqrt{\text{Homicide Rate last 12 months}}$	-0.13** [0.051]	-0.57** [0.257]
Sample size	966	971
R-squared	0.03	0.02

Panel B. Self-employed women

	(1)	(2)
	Worked last week	$^4\sqrt{\text{Hours worked last 12 months}}$
	(1)	
$^4\sqrt{\text{Homicide Rate last 12 months}}$	-0.08** [0.030]	-0.73*** [0.186]
Sample size	711	711
R-squared	0.45	0.34

Standard errors clustered at the MxFLS2 municipality level in brackets

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

Note: All models include marital status, household composition, rural/urban, migration expectations, preferences, emotional status, presence of relatives in U.S., year and quarter of interview and state GDP

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