Violence and Labor Market Responses: Evidence from Mexico's Drug War *

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Abstract

We examine the impact of violence on labor market activity using the case of Mexico, which experienced a sharp increase in homicides after 2006. We use data from a large panel on occupation and employment, which allows us to examine greater heterogeneity across groups and several margins of activity. The data also allow us to use a fixed effects instrumental variables model to account for the endogeneity of violence. We find homicides lead to reductions in employment, but only for individuals who are less likely to be breadwinners. For those who remain employed, violence increases hours worked but does not change monthly income. We find shifts out of higher paid formal salaried work and self employment and into lower paid, informal salaried work explain this. The switching of job types highlights another important dimension along which violence can affect the population and economy.

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1 Introduction

While there is a large literature on the impact of labor market opportunities on crime, less is known about the impact of crime, and particularly violent crime, on labor market outcomes. In this paper we analyze the case of Mexico, which experienced a sharp and sudden increase in violent death after the government launched a federal crack down on drug trafficking organizations in late 2006. The direct effects of the violence were high and geographically concentrated (Rios and Shirk, 2011). There also were large indirect effects, as the gruesome and public nature of many of the killings as well as the perception that cartel members operate with impunity generated a high level of fear among the population. Nationally representative victimization surveys show that the percentage of adults who felt unsafe rose significantly and uniformly across states during the conflict.[1] As several papers examining the economic impacts of terrorism have shown, a rising level of fear can influence economic activity, even though most individuals do not expect to be caught up directly in the conflict (Becker and Rubinstein 2011, Metcalf et. al. 2011, Ahern 2018).[2]

Although a labor market response in areas affected by violence might be expected, ex-ante the direction and scale of the response is unclear. On one hand, labor market activity might decline if firms reduce investment, change production, or close down entirely (Singh 2012, Camacho and Rodriguez 2012, Rozo 2018). It also could decline if individuals

[1]Source: The 2004, 2008 and 2009 ENSI, or National Survey of Insecurity. This nationally representative victimization survey was conducted by Mexico's statistical agency, INEGI, and the data and documentation are available on their website (www.inegi.org.mx). Feelings of insecurity are asked about the state and municipality of residence, as well as home and work, and rise for all four measures. The percentage of adults who say the state they live in is unsafe rose from 54% in 2004 to 65% in 2009, while the percentage of individuals who feel their work is unsafe rose from 14% to 19%.

[2]Velásquez (2019) finds that the response to violence in Mexico among self-employed women is larger for those who report a lot of fear. One channel for this indirect impact may be changes in risk aversion. Nasir et. al. (2017), for example, find that violence from the Drug War in Mexico led to increases in risk aversion.

become more reluctant to engage with the labor force (Dell 2015, Velásquez 2019) or with their external environment (Becker and Rubinstein 2011, Braakmann 2012). On the other hand, labor market activity might increase if individuals use labor income to manage actual or expected shocks from violence (Menon and Rodgers 2015, Fernandez, Ibáñez and Peña 2014). For example, some household members might increase or change labor market activity to compensate for the lost income from other members leaving the labor market (Lundberg 1985, Cunningham 2001, Brown and Velásquez 2017).

This is not the first paper to look at the effects of the Drug war and ensuing violence in Mexico on labor responses and economic activity. Velásquez (2019) uses the longitudinal Mexican Family Life Survey and finds the conflict led to significant declines in earnings for men and reductions in work hours for self-employed women. Coronado and Saucedo (2019), use state level employment aggregates and find that both low and high skill employment fell with increasing drug-related violence, with high skill employment exhibiting a larger response. Utar (2018), however, finds different results using plant-level data. She finds that while violence due to the Drug War limited plant's growth and increased the likelihood of closure, the negative employment effects are larger for blue collar workers, particularly those in female-intensive plants. Thus while the literature to date generally finds a reduction in labor market activity, there no clear agreement about who is most affected.

Our contribution to the growing literature on the impact of the Drug War is manifold. First, we use quarterly data from a large, rotating panel survey on occupation and employment (the Mexican National Survey of Occupation and Employment, or the ENOE). The ENOE is the only dataset with detailed information on labor market activity, high

frequency time variation (quarterly) and representativeness at a sub-national level (the state). This allows us to examine short term responses to violence and, as outlined below, implement an estimation strategy that controls for time-varying, geographic shocks. Furthermore, while the same is dataset employed by Coronado and Saucedo (2019), we use the individual data rather than state level aggregates. This is important, as the size of the dataset and focus on labor market outcomes allow us to examine greater heterogeneity across groups and several margins of activity. We can provide a more nuanced picture of the response to violence as a result.

Second, we use a different identification strategy to control for the potential endogeneity of violence due to local, time invariant and time varying factors. We argue the latter is important given that the intensification of the Drug War coincides with the Great Recession, which differentially affected areas in Mexico. Indeed, Dell et. al. 2019 show that homicides increased in areas where jobs declined due to trade shocks, making it reasonable to assume shocks related to the Great Recession had similar effects. If negative economic shocks led to more violence, the bias from their omission will lead to an overestimate of the effects of the Drug War. While Velásquez (2019) only uses state fixed effects and does not control for unobservable, state-time varying shocks, several of the papers listed above do by using instrumental variables. Specifically, Coronado and Saucedo (2019) use lagged violence and men age 15 to 24 in the informal sector as instruments, while Utar (2018) uses the entrance of the federal army after 2007, interacted with the presence of drug trafficking organizations in a municipality, interacted with changes in U.S. cocaine prices.

In this paper also we employ an instrumental variables strategy, instrumenting for the

homicide rate using kilometers of federal toll highways interacted with the quantity of cocaine seized by Colombian authorities over a given period (Basu and Pearlman 2017). We argue highways capture pre-existing drug distribution routes, and that the majority of violence has been among Drug Traffcking Organizations (DTOs) to gain control of these transport routes. Meanwhile, cocaine seizures from Colombia provide external shocks to the value of these drug distribution routes, but are uncorrelated with other factors that influence non conflict related labor market activity. Castillo et. al. (2018) show that Colombian supply shocks stem from changes in interdiction efforts by Colombian authorities and affect violence in Mexico largely in areas that are close to the U.S. and contested by Mexican DTOs. We further show these shocks are unrelated to measures that may reflect non-conflict labor market activity in Mexico and to drug interdiction efforts by Mexican authorities.

In estimating the impacts of violence, we stratify the sample by sex and age, and head of household status. We argue this captures important differences in the ability and willingness of individuals to change work in response to violence, as the attachment to the labor market and need to provide income to the household will determine if and how individuals respond (Cunningham 2001). This distinction proves important for employment, as we find that increasing homicides reduce employment for young men and women and non-heads of household, but leads to no change for older men and women or heads of household. Framed differently, we only find an employment response among groups that likely have a weaker attachment to the labor market. Therefore the exit in employment, found by previous authors, is likely a result of young workers who are not the main breadwinners, and hence can be more sensitive to violence.

We continue to estimate labor market activity for those who remain employed, and find that increasing homicides changed work activity along various dimensions. First, homicides lead to significant increases in hours worked for all groups, but no change in monthly income. This suggests people shift into lower paid jobs and must work more hours to maintain monthly income. To see if this is the case we investigate changes in job type, and find that individuals indeed shift out of higher paid salaried, formal work and self-employment and into lower paid informal, salaried work. The exit from self-employment is surprising, as this is usually considered the option of last resort and has been found to absorb victims of violence in other contexts (Bozzoli, Bruck and Wald, 2012)). The difference may be due to the concentrated nature of violence during Mexico's Drug War, and the important role that fear played in changing behavior. Overall, the switching of job types highlights another important dimension along which violence can affect the population.

Finally, while we cannot disentangle whether the change in employment, hours and job type is a supply side or demand side response, we try to provide suggestive evidence on each. We find that violence led to a significant increase in self-reported job separation for men, and that this separation was more likely to be voluntary than involuntary. For women we find no change, but do see that violence increased the likelihood of job search for both men and women. We view this as providing suggestive evidence in favor of a story of labor supply shocks, in which case the changes in employment are determined by employees rather than their employers.[3]

The paper proceeds as follows. Section 2 describes the data for labor market activity

[3]This follows Utar (2018), who concludes that labor supply shocks explain the decline in employment among plants in response to violence.

and crime. Section 3 outlines our empirical strategy, including a detailed description of our instrumental variable. Section 4 presents our main results. Section 5 investigates channels. Section 6 presents robustness checks. Section 7 concludes.

2 Data

2.1 Homicide Data

In the analysis we focus on the five-year time horizon that spans the beginning of the Drug War in the fourth quarter of 2006 to the peak of the violence in the fourth quarter of 2011. To measure violence from the drug war we use data on homicides from state death records, compiled and made publicly available by the National Statistical and Geographical Institute (Instituto Nacional de Estadística y Geografía, or INEGI). From this we construct quarterly homicide rates per 100,000 inhabitants, by state, using population data from the National Council on Population (CONAPO).[4]

The geographic variation of focus is the state. This is the finest level of geographic detail we can achieve, as our source for labor market data is not representative at the municipal level. There are reasons to believe, however, that individuals form expectations and respond to violence at the state level. First, it is not uncommon for homicide statistics to be quoted in the press and by government officials at the national or state level, instead of the municipal one. One example is victimization surveys, which largely are representative only at the state or national level in Mexico. Second, given changes in the

[4]We interpolate quarterly population numbers from the CONAPO yearly totals to avoid jumps in homicide rates from the last quarter of one year to the first quarter of the next. Our results are robust to using non-interpolated population data which assigns the year total to every quarter in that year.

location of the fighting among DTOs and the government, and uncertainty over when and where shifts in violence might occur, it is reasonable that individuals use more aggregated measures to form expectations about local violence in the future. This might explain why, in nationally representative victimization surveys (the ENSI), a larger percentage of respondents say that their state of residence is unsafe than their municipality of residence.[5] Finally, data from the ENSI show that state level homicides are significant predictors of feelings of insecurity and reported changes in behavior, even after controlling for individual victimization and municipal level homicides.[6]

Figure 1 shows the trajectory of average homicide rates across states from the first quarter of 2005 until the fourth quarter of 2011. The graph clearly shows the sharp rise in violence that follows the federal crackdown on drug trafficking that began in the fourth quarter of 2006 (represented by the dashed vertical line). The widening disparity of violence across states is shown in Table 1. The yearly standard deviations increase almost seven fold, and while the minimum homicide rate remains relatively constant, the maximum rises close to nine hundred percent. According to the Trans-border Institute, in 2010, the peak of the drug war, fifty six percent of all drug related killings occurred in just four states– Chihuahua, Sinaloa, Tamaulipas and Guerrero (Rios and Shirk 2011). Figure 2, which shows homicides rates across states at four different time periods, demonstrates this uneven trajectory of violence. While a handful of states experienced sharp increases in homicides, many others experienced small ones. The map also shows that the homicide

[5]For example, in the 2008 ENSI 49.7% of respondents say the municipality they live in is unsafe, while 64.5% say the state they live in is unsafe. Furthermore, increases in the percentage of respondents who say the state they live in is unsafe is similar across states that saw large increases in violence and those that saw negligible ones.

[6]Reported changes in behavior include stopping eating out, taking public transport, and attending events such as concerts and movies.

trajectories lack any distinct regional trend. High violence states are not concentrated in areas which, ex-ante, one would suspect to face higher levels of drug trafficking, such as the U.S. border. This shows that geography alone cannot explain why some states were more affected by the drug war than others.

2.2 Labor Market Data

The data on labor market activity come from the Mexican National Survey of Occupation and Employment (ENOE), a rotating labor force survey conducted by the National Institute for Statistics and Geography (INEGI). The ENOE follows urban and rural households for five quarters and is our preferred dataset as it is the only one with detailed information on labor market activity, high frequency time variation (quarterly) and is representative at a sub-national level (the state). The time variation is necessary for our identification strategy, since it allows us to capture exogenous changes in violence across areas over time.

We limit our scope to working age adults between the ages of 18 and 65. For employed individuals we only include those in the private sector to avoid capturing changes in employment directly linked to the Drug War (increased employment by the army and police). Summary statistics on labor force variables are presented in Table 2. All values are weighted to be representative of the population. We show statistics for the full sample and separately by sex.

In addition to employment status, we consider weekly hours worked and monthly wage income (in thousands of 2005 pesos).[7] We also focus on work type, as individuals may

[7]We use ENOE's definition for employed, which captures if someone reports having a job. This category includes individuals who did not work in the week they are administered the survey, due to

adjust by changing jobs rather than changing hours in an existing job or leaving the labor market altogether. To do this we divide jobs into three categories: formal salaried work, informal salaried work, and self-employment.[8] Salaried work is defined as having a boss, while self-employment is defined as working for yourself or being an employer. A job is defined a formal if the worker is registered with the Mexican Institute for Social Security (IMSS). This is a common definition used for formality in Mexico, as Mexican labor regulation requires employers to register workers with IMSS when they are hired (Cano-Urbina 2015). We note that more than 99% of self-employed workers in the sample are informal. We use these categories to define work type as opposed to using the worker's education or occupation to discern the skill level of a job. We think having a boss and formality (or their absence) better capture differences in the ability of people to enter and exit a sector and adjust their work hours once there. Furthermore, shifts across job types can happen at all skill levels, and may impact total income since there are large wage differences across each group. For example, as shown in Table 3 the average monthly income for salaried, formal workers is 80% higher than for informal, salaried workers and 46% higher than for self-employed workers.

3 Empirical Strategy

We outline the following model of labor market outcomes and violence:

$$Outcome_{isqy} = \beta_0 + \beta_1 HomicideRate_{sqy} + X_{iqy} * \gamma + M_{sy} * \lambda + \delta_i + \delta_q + \delta_y + \epsilon_{isqy} \quad (1)$$

illness, vacation, strikes, etc., but do report having a job. We convert monthly income using the CPI values from INEGI.

[8]Unpaid work is the fourth job type, and comprise 4.8% of workers in our sample.

The dependent variable is the labor market outcome for individual i in state s in quarter q in year y. This is modeled as a linear function of the log of four quarter (annual) homicides per 100,000 inhabitants, individual-time varying characteristics (marriage and household size), state-time varying characteristics (yearly real GDP per capita and unemployment), individual, quarter, and year fixed effects.[9] We use an individual fixed effects model to control for unobservable, individual characteristics that may be correlated with labor market outcomes and aggregate violence.[10] The model also controls for state fixed effects as the survey does not follow people who move. We therefore control for state, time-invariant characteristics, such as institutional quality, that may explain both homicide levels and labor market outcomes.

A fixed effects estimator β_1 will be inconsistent if there are state-time varying factors that jointly determine violence and labor market outcomes. This is very likely in our case, since the escalation of the Drug War coincides with the Great Recession, which differentially affected areas in Mexico. Indeed, Dell et. al. 2019 document that homicides increase in response to employment declines resulting from trade shocks. It is reasonable to assume employment shocks from the Great Recession would operate similarly.

We therefore instrument for the homicide rate using kilometers of federal toll highways interacted with quantity of cocaine seized by Colombian authorities in the same period (Basu and Pearlman 2017)). We argue the instrument captures exogenous changes in the value of drug distribution networks, and outline the rationale behind this interacted variable below.

[9] Annual homicides are the sum of the previous four quarters. For GDP growth and employment we use yearly values for state-level, as neither is calculated on a quarterly basis.

[10] For example, individuals who have higher returns to criminal activity may be more likely to separate from existing jobs and join drug trafficking organizations once these organizations grow in size and power.

3.1 Instrumental Variable

The beginning of the Drug War coincides with the federal government crackdown on drug trafficking organizations (DTOs), which was launched in December 2006 by newly elected president Felipe Calderón. This marked the first time federal authorities engaged directly with DTOs, and one thing that distinguished the strategy from previous ones was a focus on capturing or killing DTO leaders (Guerrero-Gutiérrez, 2011). The effort to remove kingpins was successful, but resulted in a weakening of previously oligopolistic organizations. This, in turn, led to turf wars and rising violence, as organizations fought for control of the operations of their weakened rivals (Calderón et.al. 2015, Osorio 2015). Since the majority of Mexican DTO's profits are from drug trafficking rather than production (more on this below), the increased competition was most severe over access to distribution networks-and specifically land transport routes- to the U.S., the largest drug consumer market in the world (Rios 2011, Dell 2015, Calderón et.al. 2015).

The sharp increase in violence following the federal assault on DTOs is apparent by looking at Table 1, but also has been documented by several authors. Dell (2015) finds violence increased most sharply in areas where the government directly confronted drug trafficking organizations. Osorio (2015) finds that law enforcement efforts increased violence between DTOs, particularly in areas contested by multiple organizations. Finally, Calderón et.al (2015) find that the removal of a kingpin did increase violence, and the impact is larger in areas along transport routes to the U.S. This suggests drug distribution networks help predict which areas became more violent during the Drug War.[11]

[11]Other potential explanations for the violence, including increased political competition and Mexico taking Colombia's place as the major distribution of drugs to the U.S. either pre-date the conflict by many years or cannot be timed exactly to late 2006. These factors may have helped set the stage for the explosion of violence and work in conjunction with the government crackdown to perpetuate the violence

This leads to federal toll highways, which we use to measure drug distribution networks in a state. The logic behind this is as follows. First, the majority of transport of goods and people from Mexico to the U.S. occurs via highway. The North American Transportation Statistics Database indicates that in 2011, approximately 65% of Mexican exports to the U.S. were transported via highway, while 82% of Mexican travel to the U.S. occurred via highways and rail. Second, federal highways are the highest quality road routes, with more stretches of paved roads and roads with four, as opposed to two, lanes. Federal highways, particularly the toll ones, frequently are the fastest and easiest way to travel between areas in Mexico. Third, the federal highway system includes the most transited and valuable routes, many of which run to and cross the U.S. border.[12] For example, the federal highway system has seven crossing points into the U.S, as compared to only one crossing point into Mexico's southern neighbor, Guatemala. Finally, the U.S. Department of Justice (2010) estimates that most drugs are smuggled into the U.S. via land routes using commercial or private vehicles, and that the drugs are then transported across the U.S. using highways.[13] It therefore is likely that many drug shipments are transported through Mexico using the same routes as legal goods and the routes used within the U.S. To ensure that more recent factors linked to homicide rates and labor market outcomes do not determine highway placement, we use federal highway values from 2005- which pre-dates the Drug War.

The problem with using highways alone is that the exclusion restriction may not hold.

after 2007, but in isolation they cannot explain the timing of the increase (Shirk and Wallman 2015).

[12]Federal highways consist of free highways, for which no toll is charged, and toll highways. The data come from the Annual Reports for each state, available from INEGI.

[13]In the National Drug Threat Assessment, the U.S. Department of Justice (2010) states that most drugs are smuggled into the U.S. over land, and not via the sea or air. The report also talks about major corridors for trafficking within the U.S., all of which are along highway routes.

For example, highways might capture changes in economic activity due to linkages to the U.S. Following Castillo, Mejia and Restrepo (2018) we use changes to the quantity of cocaine being shipped from Colombia to Mexico to capture exogenous variation in the value of drug distribution networks to the U.S. over time. Unlike other drugs that reach the U.S. from Mexico, such as marijuana or heroin, cocaine is not produced in Mexico. All of the cultivation of coca leaves, the main input into cocaine, and the refinement of these leaves into cocaine occurs in three countries: Peru, Bolivia and Colombia (UNODC World Drug Report 2010), with Colombia being the dominant producer. According to the 2010 United Nations World Drug Report, Colombia was responsible for 54% of all coca cultivation and 61% of all cocaine production in 2007. These numbers remain high despite a large-scale anti-drug policy enacted by Colombian authorities in the late 1990s.[14] Furthermore, cocaine distribution is estimated to account for 45-68% of all revenues of Mexico drug trafficking organizations (Kilmer et. al. 2010). This is more than twice the estimated revenues from the distribution of marijuana, more than eight times the estimated revenues from heroin produced in Mexico, and more than five times the estimated revenues from methamphetamines produced in Mexico (Kilmer et. al. 2010).[15]

The amount of cocaine reaching Mexican borders partially depends on the efforts of Colombian authorities to combat drug trafficking and seize cocaine supplies. In recent years Colombia increased its interdiction efforts, leading to greater external shocks to the

[14]In an earlier year (2000) Colombia was estimated to produce 79% of the world's cocaine supply.

[15]Mexico is a producer of opium and marijuana, two other drugs whose production and transport make up a portion of drug trafficking organizations' profits. We check if either is significantly associated with violence, using data on seizures of both drugs from the Mexican Defense Ministry (SEDENA). Seizures are the best proxy measures for production in absence of regular estimates from satellite images. We test for a correlation between Mexican seizures and violence using quarterly data on all homicides from the period of Q12006 to Q42011. We find no significant correlation between opium seizures and homicides and a negative and significant correlation between marijuana seizures and homicides. Thus changes to the supply of opium and marijuana in Mexico do not appear to be strongly associated with changes in violence. These results are available upon request.

supply of cocaine reaching Mexico (see Castillo, Mejia and Restrepo, 2018 for details). These shocks likely alter the use of highways to transport drugs to the U.S., and have been documented to increase violence in areas contested by Mexican drug trafficking organizations. To measure these external shocks we use data from the Colombian Defense Ministry on metric tons of cocaine seized by Colombian authorities in each year.[16] These totals are presented in Figure 3 and show no clear upward or downward trajectory over the Drug War period. Thus the cocaine seizures do not appear to capture a parallel time trend to that of homicides over the period considered.

The validity of our instrument rests on the assumption that Colombian cocaine seizures capture external shocks to the supply of drugs being transported through Mexico but are uncorrelated with events in Mexico that impact non-DTO labor market outcomes. While we cannot directly test this assumption, we can provide indirect tests. First, we estimate the relationship between monthly cocaine seizures in Colombia and monthly trade flows of legal goods using measures of exports from the IMF Direction of Trade Statistics (DOTS) over the period of January 2004 (first available in DOTS) to April 2012. As shown in Appendix Table A1, there is no significant relationship between cocaine seizures in Colombia and: (1) bilateral trade flows between Colombia and Mexico; (2) bilateral trade flows between the U.S. and Colombia; (3) trade flows between Colombia and the rest of the world; (4) bilateral trade flows between the U.S. and Mexico; and (5) trade flows between Mexico and the world. This provides evidence that cocaine seizures are not

[16] We are grateful to Juan Camilo Castillo for providing us with these data. We use total metric tons of cocaine seized by Colombia authorities rather than an estimate of total cocaine production as the latter depends upon estimates of potential cocaine production, which come from the United Nations Office on Drugs and Crime. In the 2013 World Drug Report, UNODC notes that due to a new adjustment factor for small fields the estimated figures for 2010 and 2011 are not comparable to those from earlier years. The 2010 estimate shows a significant decline from earlier years.

correlated with other trade activity.

Second, we examine the relationship between Colombian cocaine seizures and Mexican seizures of opium and marijuana by Mexican authorities, using data obtained from the Mexican Ministry of Defense (SEDENA). The results of this analysis are shown in Appendix Table A2. We find no significant correlation between Colombian cocaine seizures and seizures of either opium or marijuana. This suggests a reduction in cocaine arriving in Mexico did not coincide with increased seizures of other drugs cartels transport. Finally, we estimate the relationship between Colombian cocaine seizures and quarterly homicides in Mexico, to see if the former simply captures a time trend. These results are shown in Appendix Table A2. We find no relationship between Colombian cocaine shocks and homicides in Mexico by quarter.

3.2 First Stage Results

We present first stage results in Table 4. They show that highways interacted with quarterly cocaine seizures are strong predictors of homicides, as the coefficients on the instrument are positive and significant and the F statistics are large.[17] For interpretation, the unit of the instrument is kilometers times thousand metric tons, such that 1 kilometer of federal toll highways times one thousand metric tons of seized Colombian cocaine would yield a value of 1. The mean value of the interacted variable is 9.9 and the standard deviation is 8.9. Thus, from the coefficient in column one (0.035) a one standard deviation increase in the instrument is associated with an increase in the homicide rate of approximately 31%. Thus changes in the instrument generate substantive predicted

[17] We show results for the sub-samples of men and women and for second stage outcomes with more observations (employment) and fewer observations (monthly income, which is limited to employed individuals and has higher non-response rates).

increases in the homicide rate.

4 Second Stage Results

4.1 Employment, Hours and Income

We start by showing second stage results for employment, and hours worked and monthly wage income for those who remain employed. We stratify the sample by sex and age, and head of household status, as there likely is heterogeneity in the ability and willingness of individuals to change work in response to violence.[18] In particular, the attachment to the labor market and need to provide income to the household will determine if and how individuals respond. Ex-ante we expect older individuals and heads of households to have a more muted response than younger individuals and non heads of household. We therefore divide men and women into younger (ages 18 to 34) and older (ages 35 to 65) age cohorts.

Panel A in Figure 4 shows the outcomes for employment. We find that young men and women and non-heads of household are significantly less likely to be employed as a result of increased homicides, but older men and women and heads of household are not. Framed differently, we only find a negative employment response among individuals who likely have weaker attachment to the labor market. Individuals with a stronger attachment, perhaps due to their role as a main income earner in the household, exhibit no declines. This difference highlights one margin across which employment responses vary, and suggests that aggregating by gender alone may mask different responses among these groups.

[18] Cunningham (2001) examines an earlier period in Mexico and finds that household role is an important determinant of labor market responses to negative economic shocks.

Panels B and C in Figure 4 show changes in weekly hours worked and monthly labor income for those who remain employed. We find that weekly hours worked increase for all working adults, including older and younger men and women. The only group where the increase is insignificant is female heads of household. Despite the increase in hours worked, however, we find no increase in monthly income for any group. This could be driven by a switch into lower paid work, and we investigate this further below.

4.2 Job Type

The results on hours and monthly income suggest that individuals who remain employed are changing the types of jobs they do. We therefore estimate changes in job type, where the categories are salaried, formal; salaried, informal; and self-employed. Since we estimate individual, fixed effects regressions, the results are driven by individuals who change job type during the quarters they are in the sample.

The results, shown in Figure 5, provide evidence that individuals indeed shift out of higher paid salaried, formal work and self-employment and into lower paid informal, salaried work. As shown in Panel A, there are declines in formal salaried work for all groups, regardless of sex, age and head of households status (although the decline is only significant for male, non heads of household). We also find declines in self-employment for all groups except male non heads of household (Panel C). Meanwhile, as shown in Panel B, this is complemented by significant increases in informal, salaried work for all groups, except female heads of household.

The self employment results are notable, because this is usually considered the option of last resort and has been found to absorb victims of violence in other contexts. For example, Bozzoli, Bruck and Wald (2012) in the context of Colombia find an increase

in self-employment in areas affected by violence and in areas that received displaced individuals. The difference may be due to the concentrated nature of violence during Mexico's Drug War, and the important role that fear played in changing behavior. For example, according to the ENOE the self-employed are significantly more likely to work in non-fixed locations, perhaps making them more vulnerable to violence or to downturns in activity due to fear of violence from customers.

We also examine differences the response of hours worked and monthly income by job type. Ex-ante we might expect informal salaried and self-employed workers to exhibit a more flexible short term response to violence than salaried, formal ones. Since we found that all groups increase work hours, to simplify the analysis we stratify individuals by sex only. The results are shown in Table 5. For women we indeed find a larger change in hours worked for self-employed women, however, informal and formal salaried women also increase work hours. For men, however, self employed individuals are the only ones who do not register an increase in hours worked. Both formal and informal male workers increase hours, with the latter exhibiting the larger increase. For all groups we continue to find no significant change in monthly income. Thus increased hours do not translate into higher income, even for those who do not change job type.

5 Channels

Violence due to the Drug War can affect the probability of employment, work intensity, and changes in job type through two channels. First, violence can change labor demand, if it leads firms to change their operations, shrink or close. From the standpoint of an employee this would result in involuntary separation from a job. Second, violence can affect

labor supply if individuals decide to leave employment or change hours worked or jobs to reduce exposure to violence or mitigate a realized shock. From the standpoint of an employee this would result in a voluntary separation from a job. While no dataset would allow us to establish the extent to which labor demand or supply explain the previous results, questions in the ENOE do allow us to assess how much job separation occurred, and whether this separation was involuntary or voluntary. The ENOE asks working age individuals if they had a job that ended either this year or last. In the case of jobs that ended, individuals are asked the reason, which include: losing the job (involuntary separation); resigning (voluntary separation); and closing the business. We include the last category to account for self-employed workers, where the distinction between voluntary and involuntary separation is more vague. Finally, individuals also are asked if they have looked for a new job in the past three months. This may capture the desire to switch jobs, and thus potential separation, among those who currently are employed.

We estimate all of the outcomes above using our original model, and present the second stage results in Figure 6. In the interest of space we only present results by sex and age.[19] As shown in the the first graph, homicides led to a significant increase in job separation for both younger and older men, but no significant change for women. The next two graphs provide some evidence these separations were more likely voluntary for young men, but non-voluntary for women. For the self-employed, we find no evidence that violence led to a change in business closure. Finally, violence led to an increase in job search for all groups, although the coefficient is the largest and only significant for older men. In total, while we cannot rule out labor demand shocks, we view this as suggestive evidence in

[19]Results by sex and head of household status are available upon request.

favor of a story of labor supply shocks. In other words, it appears more of the changes in employment are determined more by employees rather than their employers.[20]

5.1 Robustness Checks

5.2 Attrition

While the ENOE is the only panel data set that is representative at the sub-national level and conducted frequently, on downside is that it suffers from high rates of attrition. Attrition stems either from the household failing to be located for several survey rounds or from an individual in a household moving away.[21] We do not know the reasons for attrition, but its existence raises concerns that it is driven by violence and/or labor market outcomes, leading our sample to be skewed towards those with particular responses. This concern is partially alleviated by the nature of the ENOE itself, which replaces households that attrit so that the sample is representative at the national and state level in any quarter. These replacement households are in our sample and appear in the fixed effects regressions if they have more than one quarter of data. Thus as long as attrition is not concentrated in the fifth survey round, our sample is representative of the population of Mexican workers.

Nevertheless, to address the concern we estimate our model on the sample of individuals who do not attrit or are not replacements for those who attrit. In other words, we estimate the model on the sample who appears in all five survey rounds. The results are

[20] This follows Utar (2018), who concludes that labor supply shocks explain the decline in employment among plants in response to violence.

[21] Approximately 20% of our sample does not complete all five survey rounds. Households that cannot be located for two consecutive quarters are replaced. The replacement households carry out the remaining survey waves of those who attrit, and thus are interviewed for fewer than five quarters. For example, if a replacement household enters the sample in the third survey round, they are marked as being in their third interview, despite the fact that it actually is their first. They rotate out of the sample at the same time the original household would have. This information on the ENOE, are provided on INEGI's website.

shown in Panel B of Table 6. For ease of exposition we estimate results just for men, and do not split the sample by age. For comparison we estimate our original model on this same group (all men). The results for the no attrition sub-sample are shown in Panel B, and our original sample in Panel A. In all cases the coefficients all are very close to those from the original model, suggesting sample selection due to attrition does not drive our results.

5.3 Selective Migration

A related concern is over selective migration and the possibility that individuals with characteristics that impact their labor market outcomes are more likely to move in response to violence. In this case β_1 is biased, as it partially reflects changes in the types of people who live in a particular state. While the ENOE does not contain a residency history, it does ask individuals their state of birth. We therefore define people as potential movers if they live in a state other than their state of birth and exclude them from the sample. Also, following Velásquez (2019), we link individuals to violence in their state of birth rather than their current state of residence, generating intent to treat estimates. The estimates are shown in Panels C and D of Table 6, and are very similar to the original ones in Panel A. This suggests selective migration is not a large source of bias in our estimates.

5.4 Time Trends

We address the concern that our exclusion restriction does not hold because the instrument captures nation-wide time trends in violence and labor market activity. To do this we add linear and quadratic time trends and present the second stage results as well as the

first stage F-statistic in Appendix Table A3. We see no change in our results, suggesting they do not purely reflect general time trends.

6 Conclusions

In this paper we analyze the impact of a large increase in homicides from the Drug War in Mexico on individual's labor market activity. To control for the potential endogeneity of increases in violence we use a fixed effects, instrumental variables model, instrumenting for area level homicides in a period with kilometers of federal toll highways interacted with tons of cocaine seized in Colombia by Colombian authorities. We find that in the short-term violence has a significant effect on employment for young individuals and non-heads of household, but no significant effect on older individuals or household heads. Violence also changes labor market activity for those who remain employed, leading to increasing hours worked, and shifts out of higher paid, formal salaried work and self-employment and into lower paid, informal salaried work.

Our paper contributes to the literature on the economic costs of violence in several ways. First, we provide further evidence that violence leads to widespread changes in economic activity, even in circumstances where the fighting is concentrated among the combatants and where the majority of the population does not expect to be directly affected. In the specific case of Mexico, although most of the homicides have been among members of DTOs, the army and police, the gruesome and unpredictable nature of some of the killings led to large increases in fear among the population, even in areas that experienced no increase in homicides. There is increasing evidence that this fear, in turn, is sufficient to lead to significant changes in behavior.

Second, in terms of labor market behavior, we show that in addition to violence affecting if and how much people work, it affects the type of work they do. These changes, subsequently, can have economic consequences beyond the workers themselves. For example, the shifts out of formal work and into informal work can negatively impact aggregate productivity, if it decreases labor in the more productive, formal sector and increases labor in the less productive, informal one. These shifts are most salient for developing countries, like Mexico, that have large informal sectors. For such countries the costs of violence can be compounded, as the increasing flow of resources into the informal sector can lower aggregate productivity and, subsequently, economic growth.

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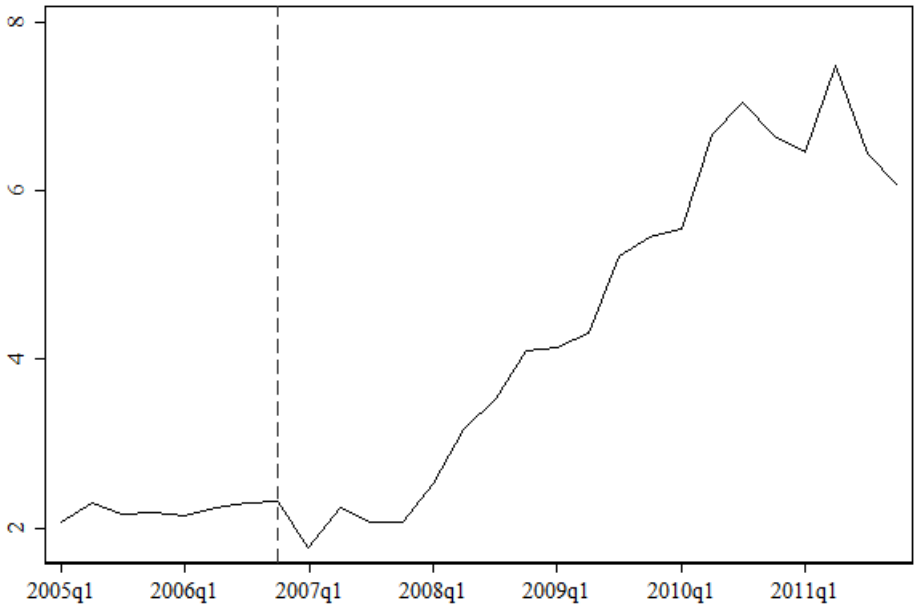
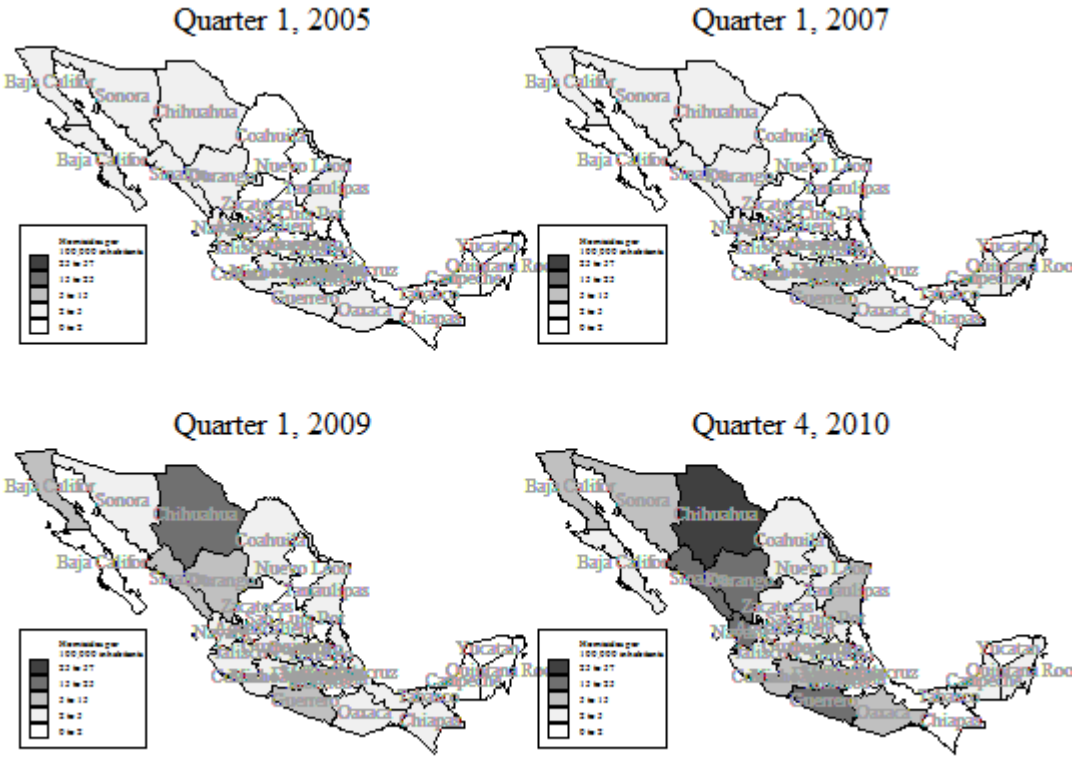
7 Tables and Figures

Figure 1: Average Homicide Rate, Quarterly



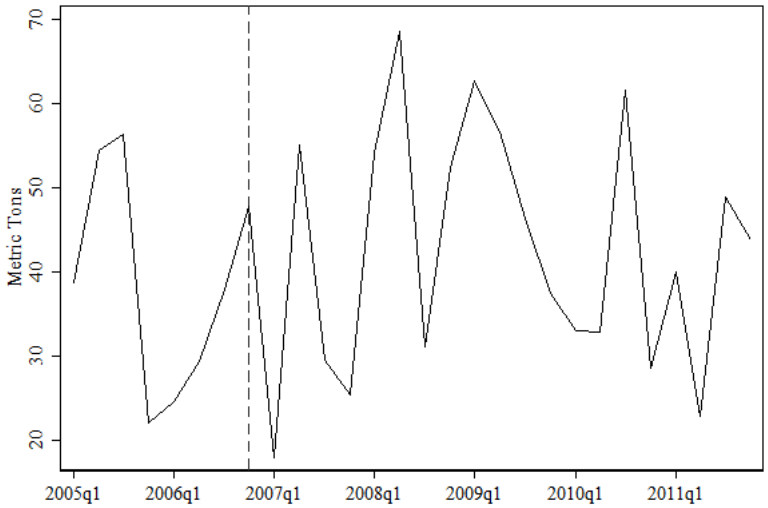
Source: INEGI. Values are average homicides per 100,000 inhabitants across states for each time period
Quarterly data from Q12005 to Q42011. Vertical line placed on Q4 2006

Figure 2: Homicides per 100,000 inhabitants by State



Source: INEGI

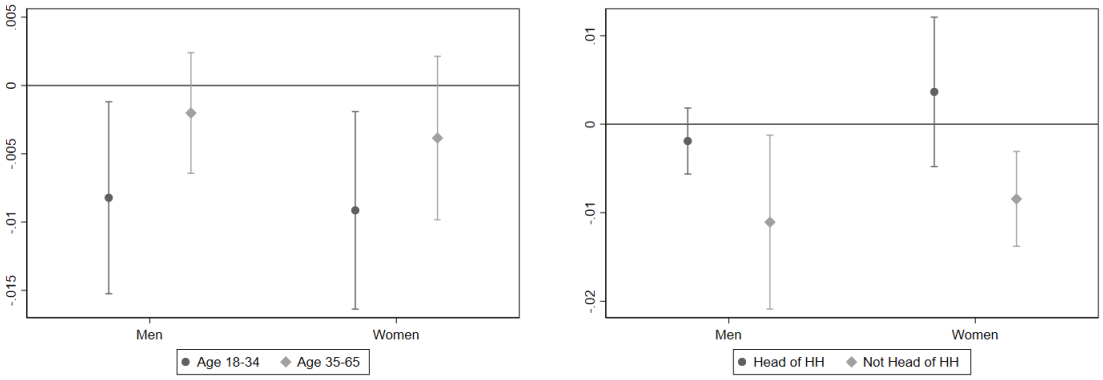
Figure 3: Colombian Cocaine Seizures, Quarterly



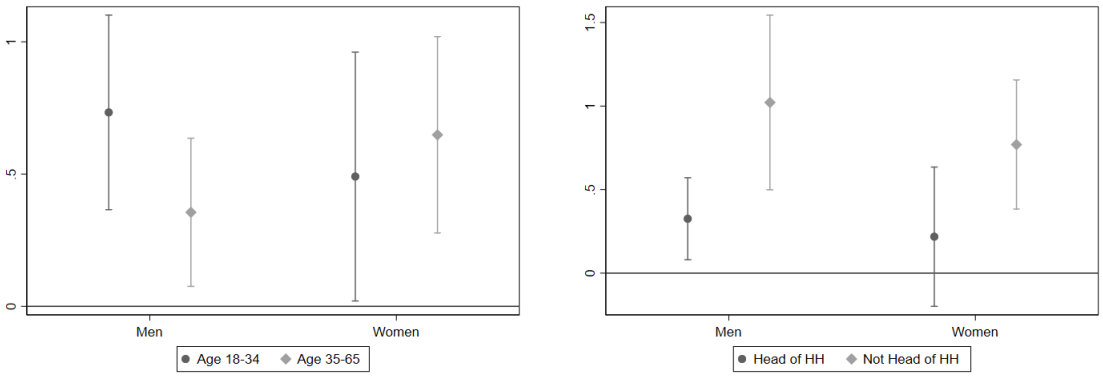
Tons of cocaine seized by Colombian Authorities. Source: Colombian Ministry of Defense.
Quarterly data from Q12005 to Q42011. Vertical line placed on Q4 2006

Figure 4: Second Stage Outcomes

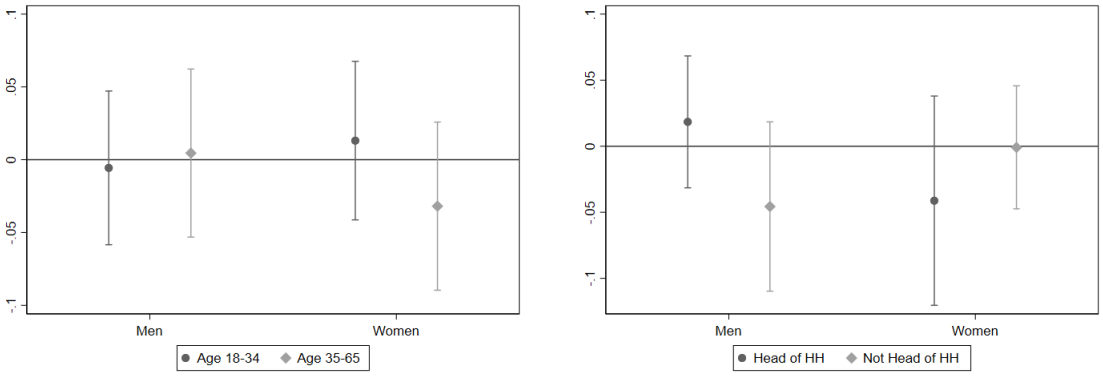
Panel A: Employment



Panel B: Weekly Hours Worked



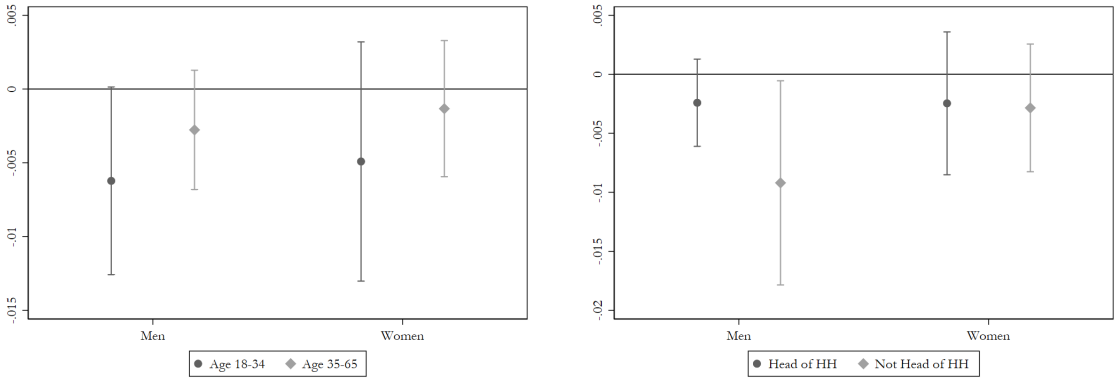
Panel C: Monthly Income



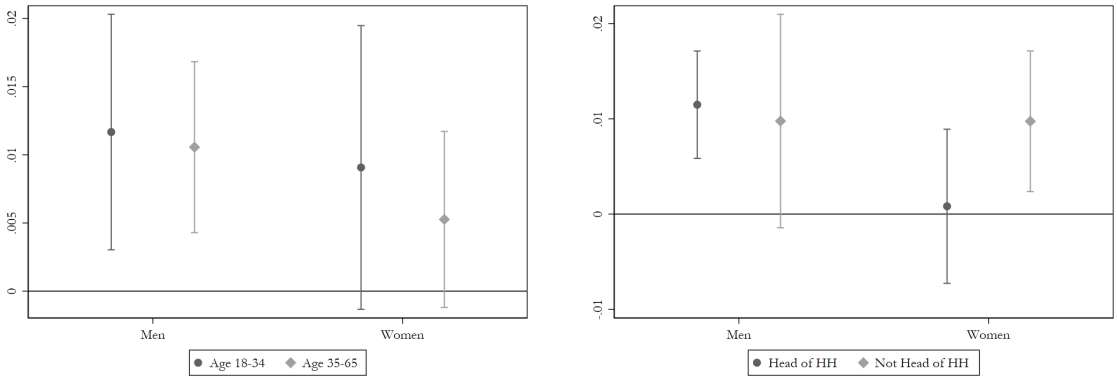
Dots represent second stage IV coefficient on log homicides per 100,000 inhabitants for the previous 12 months. Lines show the 95% confidence intervals. Weekly hours worked and monthly income are only counted for employed individuals in the private sector. Source:INEGI, CONAPO, Colombian Ministry of Defense

Figure 5: Work Type

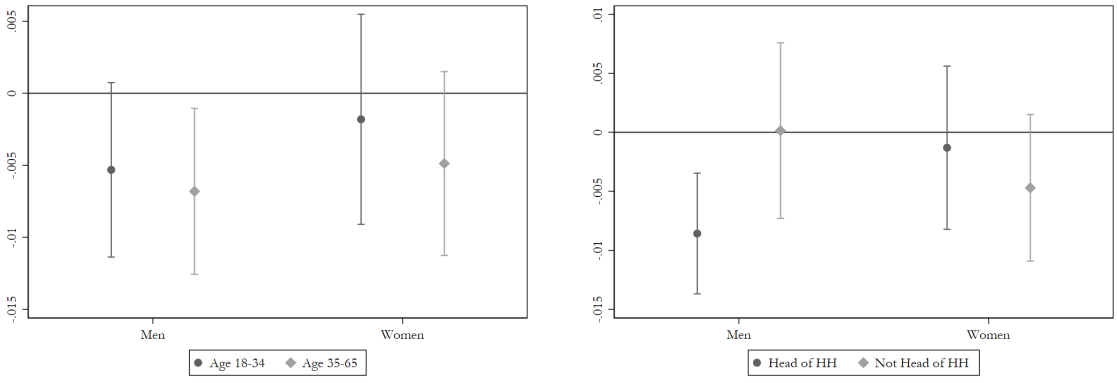
Panel A: Formal, Salaried Work



Panel B: Informal, Salaried Work

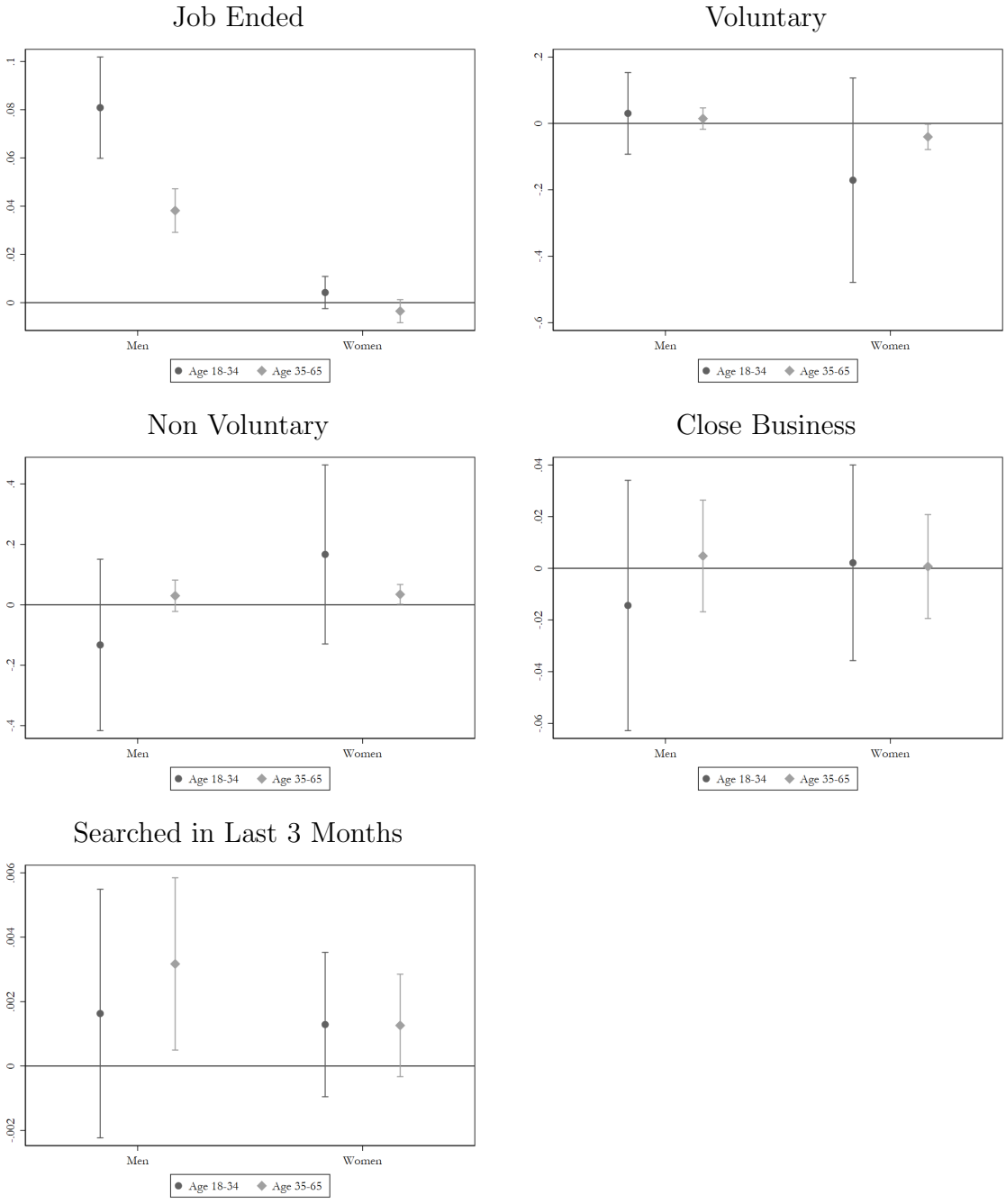


Panel C: Self Employed Work



Dots represent second stage IV coefficient on log homicides per 100,000 inhabitants for the previous 12 months. Lines show the 95% confidence intervals. Work type is limited to employed individuals in the private sector. Source:INEGI, CONAPO, Colombian Ministry of Defense

Figure 6: Labor Supply and Demand



Dots represent second stage IV coefficient on log homicides per 100,000 inhabitants for the previous 12 months. Lines show the 95% confidence intervals. Source:INEGI, CONAPO, Colombian Ministry of Defense

Table 1: Summary Statistics, Annual Homicide Rate

	Year						
Homicides per 100,000	2005	2006	2007	2008	2009	2010	2011
Mean	8.7	9.0	8.1	13.3	19.1	25.9	26.5
Standard Deviation	5.0	6.1	4.8	14.0	22.5	35.3	27.4
Minimum	2.0	2.2	2.6	2.4	1.8	1.8	2.4
Maximum	18.7	24.8	23.9	75.2	106.0	183.3	128.9
Observations	32	32	32	32	32	32	32

Note: Source: INEGI and CONAPO

Table 2: Summary Statistics Labor Force

	(1) All	(2) Men	(3) Women
Employed	0.62	0.81	0.45
	(0.49)	(0.39)	(0.50)
Of Those Employed			
Salaried, Formal	0.35	0.35	0.36
	(0.48)	(0.48)	(0.48)
Salaried, Informal	0.30	0.31	0.28
	(0.46)	(0.46)	(0.45)
Self employed	0.29	0.30	0.27
	(0.45)	(0.46)	(0.44)
Weekly hours worked	41.69	44.81	36.49
	(18.40)	(17.65)	(18.46)
Monthly wage income (thousand pesos)	3.66	4.10	2.95
	(4.42)	(4.80)	(3.60)
Demographic Variables			
Age	36.90	36.50	37.26
	(12.99)	(13.07)	(12.90)
Married	0.64	0.64	0.65
	(0.48)	(0.48)	(0.48)
Household Size	4.66	4.69	4.65
	(2.09)	(2.10)	(2.07)
Observations	4,590,592	2,198,659	2,391,933
Individuals	1,350,697	661,595	689,102

Population weighted mean values reported. Standard deviations in parentheses
Source:ENOE

Table 3: Wages and Hours by Work Type

	(1) Formal Salaried	(2) Informal Salaried	(3) Self Employed
Hourly wage	27.74	17.34	23.61
	(29.01)	(23.53)	(45.75)
Monthly wage income (thousand pesos)	5.25	2.86	3.58
	(4.54)	(2.63)	(5.54)
Weekly hours worked	43.97	41.86	40.70
	(15.02)	(18.38)	(20.96)
Observations	1,122,112	813,903	785,352

Population weighted mean values reported. Standard deviations in parentheses
Source:ENOE

Table 4: First Stage, Fixed Effects IV Results

	Employment		Monthly Income	
	(1) Men	(2) Women	(3) Men	(4) Women
Federal Toll Highways^{2005} CocaineSeizures	0.0385	0.0365	0.0487	0.0496
	(0.0031)***	(0.0028)***	(0.0040)***	(0.0051)***
Observations	2,159,159	2,356,962	1,392,144	867,071
A-P F stat	158.20	173.70	150.85	92.90

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

Note: Coefficients on the first stage IV individual fixed effects shown. Outcome variable is log homicides per 100,000 inhabitants. Controls include individual, quarter and year fixed effects, marital status and household size, and state-year real GDP per capita and aggregate unemployment. Standard errors are clustered at the person level.

Source: INEGI, CONAPO and the Colombian Defense Ministry.

Table 5: Response by Job Type

	Men			Women		
	(1) Salaried Formal	(2) Salaried Inormal	(3) Self Employed	(4) Salaried Formal	(5) Salaried Inormal	(6) Self Employed
PANEL A: Hours						
Log 12 month Homicide rate	0.463	1.348	0.195	0.510	1.062	1.280
	(0.132)***	(0.498)***	(0.187)	(0.122)***	(0.579)*	(0.713)*
Observations	616,739	411,598	437,714	399,612	232,105	229,064
PANEL B: Monthly Income						
	(1)	(2)	(3)	(4)	(5)	(6)
Log Homicide Rate	0.030	-0.048	-0.028	-0.022	0.006	-0.048
	(0.028)	(0.047)	(0.050)	(0.018)	(0.068)	(0.091)
Observations	503,450	361,736	326,415	323,055	206,530	185,035

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

Note: Coefficients on the IV individual fixed effects estimate on log homicides per 100,000 shown. Controls include individual and year fixed effects, marital status and household size, and state-year real GDP per capita and aggregate unemployment. Standard errors are clustered at the person level.

Source: INEGI, CONAPO and the Colombian Defense Ministry.

Table 6: Robustness Checks

		Of Those Who Are Employed				
	(1) Employed	(2) Salaried Formal	(3) Salaried Informal	(4) Self Employed	(5) Hours Worked	(6) Monthly Income
PANEL A: Base Results						
Log Homicide Rate	-0.005	-0.004	0.011	-0.006	0.511	0.000
	(0.002)**	(0.002)**	(0.003)***	(0.002)***	(0.113)***	(0.020)
Observations	2,159,159	1,685,604	1,685,604	1,685,604	1,685,604	1,392,144
PANEL B: No Attrition						
	(1)	(2)	(3)	(4)	(5)	(6)
Log Homicide Rate	-0.007	-0.004	0.010	-0.006	0.511	-0.005
	(0.002)***	(0.002)**	(0.003)***	(0.002)**	(0.123)***	(0.022)
Observations	1,918,294	1,538,633	1,538,633	1,538,633	1,538,633	1,274,886
PANEL C: No Movers						
	(1)	(2)	(3)	(4)	(5)	(6)
Log Homicide Rate	-0.007	-0.003	0.014	-0.009	0.585	0.006
	(0.003)***	(0.002)	(0.004)***	(0.003)***	(0.158)***	(0.028)
Observations	1,715,636	1,333,326	1,333,326	1,333,326	1,333,326	1,108,352
PANEL D: State of Birth						
	(1)	(2)	(3)	(4)	(5)	(6)
Log Homicide Rate	0.000	-0.026	0.042	-0.007	1.456	1.848
	(0.015)	(0.015)*	(0.022)*	(0.018)	(0.940)	(0.936)**
Observations	2,149,552	1,678,857	1,678,857	1,678,857	1,678,857	1,387,168

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: Panel A includes all men. Panel B is limited to men who complete all five survey rounds. Panel C excludes potential movers, defined as men who do not live in their state of birth. Panel D links individuals to homicides in their state of birth rather than current state of residence. In all regressions controls include individual, quarter and year fixed effects, marital status and household size, and state-year real GDP per capita and aggregate unemployment. Standard errors are clustered at the person level.

Appendix

Table A1: Colombian Cocaine Seizures and Official Trade, Monthly

	Colombia, Exports			Mexico, Exports	
	(1) Mexico	(2) United States	(3) World	(4) United States	(5) World
Cocaine Seized, Colombia	0.0002	-0.0003	0.0056	-0.0236	-0.0180
	(0.0002)	(0.0063)	(0.0149)	(0.0453)	(0.0613)
Observations	72	72	72	72	72
R^2	0.02	0.00	0.00	0.00	0.00

Monthly data from January 2006 to December 2011

Data on exports in millions of U.S. dollars, from the IMF Direction of Trade Statistics

Cocaine seizures in tons. From the Colombian Ministry of Defense

Table A2: Time Trends in Mexican Economic Activity, Homicides and Drug Seizures

	Economic Activity		Homicides	Mexican Seizures, tons	
	(1) Real GDP	(2) Employment	(3)	(4) Marijuana	(5) Opium
Cocaine Seized, Colombia	-0.0011	-0.0000	0.0113	-0.2872	-0.1571
	(0.0071)	(0.0001)	(0.0251)	(0.1623)	(0.1638)
Observations	24	24	24	24	24
R^2	0.00	0.00	0.01	0.12	0.04

All data is quarterly from the first quarter of 2006 to the fourth quarter of 2011.

Homcides are homicides per 100,000 inhabitants

Real GDP data is from INEGI. Employment are employment rates for 18 to 65 year olds from the ENOE.

Marijuana and Opium seizure data are in tons and are from SEDENA.

Cocaine seizures in tons. From the Colombian Ministry of Defense

Table A3: Robustness Checks, Aggregate Time Trends

	Employed		Salaried Informal		Hours Worked		Monthly Income	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Homicide Rate	-0.005	-0.004	0.011	0.010	0.511	0.361	0.000	0.006
	(0.002)**	(0.002)**	(0.003)***	(0.002)***	(0.113)***	(0.096)***	(0.020)	(0.019)
Observations	2,159,159	2,159,159	1,685,604	1,685,604	1,685,604	1,685,604	1,392,144	1,392,144
A-P F statistic	158.20	215.89	146.74	201.02	146.74	201.02	150.85	197.97
Time Trend	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Note: Coefficients on the IV individual fixed effects estimate on log homicides per 100,000 shown. Controls include individual, quarter and year fixed effects, marital status and household size, and state-year real GDP per capita and aggregate unemployment. Standard errors are clustered at the person level.

Source: INEGI, CONAPO and the Colombian Defense Ministry.