Banco de México

Working Papers

N° 2022-11

Internal Migration and Drug Violence in Mexico

Lorenzo Rodrigo Aldeco Leo
Banco de México

Jose A. Jurado
Carnegie Mellon University

Aurora A. Ramírez-Álvarez
El Colegio de México

November 2022

Documento de Investigación
2022-11

Working Paper
2022-11

Internal Migration and Drug Violence in Mexico*

Lorenzo Rodrigo Aldeco Leo†
Banco de México

Jose A. Jurado‡
Carnegie Mellon University

Aurora A. Ramírez-Álvarez§
El Colegio de México

Abstract: This document studies the effect of the homicide rate on internal migration in Mexico. Reduced form evidence shows that net migration of skilled workers decreases into local labor markets where homicide rates increased after 2007, suggesting workers prefer destinations with lower homicide rates. This result is due to lower inflows, without effects on outflows, pointing to the existence of moving costs. To quantify the welfare cost of increasing homicides, we use workers' migration decisions and a spatial equilibrium model. Skilled workers' average willingness to pay to decrease the homicide rate by 1% is estimated at 0.58% of wages. The welfare cost is in the order of several points of GDP per year, depending on the assumptions. Workers who do not migrate bear the largest share of the overall welfare cost.
Keywords: Internal Migration, Homicide Rates, Instrumental Variables, Structural Estimation
JEL Classification: K42, O15

Resumen: Este documento estudia el efecto de la tasa de homicidios sobre la migración interna en México. Evidencia de forma reducida indica que se redujo la migración neta de trabajadores calificados hacia municipios donde aumentó la tasa de homicidios después de 2007, sugiriendo que los trabajadores prefieren menores tasas de homicidios. El resultado se debe a menor inmigración, sin efectos sobre emigración, indicando que existen costos de migración. Para cuantificar el costo en bienestar del aumento de la tasa de homicidios, se usan las decisiones de migración de los trabajadores y un modelo de equilibrio espacial. En promedio la disposición a pagar de los trabajadores calificados por reducir la tasa de homicidios local en 1% corresponde a 0.58% de su salario. El costo en bienestar total es de varios puntos del PIB por año, dependiendo de los supuestos. Quienes no migran en respuesta a las mayores tasas de homicidios cargan con la mayor parte de este costo.
Palabras Clave: Migración Interna, Tasas de Homicidio, Variables Instrumentales, Estimación Estructural

*Agradecemos a Matthew Turner, Jesse Shapiro, y Pedro dal Bó por su asesoría cercana a lo largo del proyecto, al igual que a dos dictaminadores anónimos por comentarios que ayudaron a mejorar el artículo de manera sustancial. También agradecemos a Alejandrina Salcedo, Jorge Pérez, Rebecca Diamond, Emilio Gutiérrez, Catalina Ravizza, Brian Knight, Ken Chay, y a participantes en seminarios en Brown University, Banco de México, ITAM, y Colegio de México.

† Dirección General de Investigación Económica. Email: lorenzo.aldeco@banxico.org.mx.

‡ Heinz College, Carnegie Mellon University. Email: jjuradov@andrew.cmu.edu.

§ Centro de Estudios Económicos, El Colegio de México. Email: aurora.ramirez@colmex.mx.

1 Introduction

According to the United Nations Office on Drugs and Crime, since the start of the twenty first century, organized crime has caused as many homicides as armed conflict (United Nations Office on Drugs and Crime, 2019). While possibly less destructive than war, the violence that organized criminal groups carry out, often against other criminal groups, can be harmful for the communities that experience it.

Homicide related to organized crime is an especially important challenge in the Americas. There, drug trafficking organizations engage in violent conflict for control of routes and shipments, contributing to the region having the largest homicide rate in the world as of 2019 (United Nations Office on Drugs and Crime, 2019). Homicides disrupt communities' social, economic and institutional life (United Nations Office on Drugs and Crime, 2019) in principle inducing individuals to move away and propagating their effects within countries –even if crime is confined in space. In order to understand the effect of homicides on a country's welfare and population, and labor markets, it is key to study individuals' migration decisions.

This paper studies the effects of homicide rates on internal migration in Mexico between 1995 and 2015. The homicide rate in Mexico almost tripled between 2000 and 2015. As conflict between drug trafficking organizations (DTOs) intensified, homicides became salient within communities.[1] This kind of violence became a feature of some cities and day-to-day life is likely to have been affected as a result. By 2011, over 60 percent of Mexicans identified insecurity as their main concern, over poverty and employment (ENVIPE, 2011). However, violence did not increase everywhere, it rose most in municipalities close to drug traffic routes. This uneven change created, in principle, opportunities for individuals to decrease their exposure to violence by adjusting their migration decisions.

In this paper we first analyze migration in the reduced form and later estimate a structural model to quantify the welfare and population effects of increased homicides in Mexico after 2006. The model also lets us understand the role of moving costs and general equilibrium effects: that is, the adjustment of local wages to migration flows. First, we study how municipality level inflows and outflows changed with violence. Changes in DTO alliances and the location of conflict on drug trafficking routes serve to instrument for violence. As DTOs join or splinter, conflicts over routes change in intensity and location. In turn, municipalities that find themselves in a region with more conflict face higher homicide rates, independently

[1] DTOs fought in streets and businesses, giving these homicides a public dimension. See for instance Villareal's chapter in Campbell (2016) for a description on day-to-day life in a Mexican city exposed to high homicide rates.

of other local characteristics. Using this variation, we find high homicide rates cause net migration away from locations, driven mainly by lower inflows of skilled individuals, defined as those with over 12 years of schooling. This is consistent with the homicide rate acting like a disamenity, and with large costs of relocation. Unskilled workers' migration behavior appears less affected by the increase in violence.

Second, we estimate a structural spatial equilibrium model, following Diamond (2016). Migration choices depend on the relative characteristics of locations, which are well captured by a discrete choice model. We use migration shares to destinations to identify the mean utility of municipalities, and the share of migrants within and across commuting zones to pin down the cost of moving. Using our conflict measure and Bartik shocks as instruments for violence and wages, we identify how much individuals value wages, violence, and moving costs. Skilled individuals reveal to be willing to accept a .41% to .58% decrease in monthly wages to decrease the local homicide rate by 1%. We estimate moving costs several orders of magnitude larger than the utility costs of homicide rates. This is consistent with existing research on spatial equilibrium in developing countries, where large gaps in observed predictors of quality of life do not generate large reallocations of population across space (Gollin et al., 2017 and Chauvin et al., 2016).

With the estimated model, we study the role moving costs and general equilibrium (GE) play in determining the effect of homicide rates. In our model of labor, general equilibrium effects refer to the adjustment of local wages to local population, which is affected by migration. First, we provide an estimate of the total welfare loss caused by the increase in violence, and the margins through which migration responded.

Under the assumptions of the model, the welfare costs are suggested to be in the order of 10% of GDP in 2010, with a majority of individuals not altering their migration decisions due to high migration costs - these estimates are very large but are only indicative, as land markets are likely to adjust and compensate locals for the worsened amenities. However, they are consistent with existing estimates for Colombia, where Rozo (2018) finds gains from the decrease in homicides in that same order of magnitude. The estimated welfare costs are similar when individuals have no adjustment margins.

To the extent violence affected migration, we find evidence it did so by modifying migrant destinations, rather than increasing displacement.[2] The number displaced has attracted significant attention from government agencies, human rights advocate groups, and academics in other social sciences (Díaz Pérez and Romo Viramontes, 2019, Pérez Vázquez et al., 2019,

[2]The number displaced is commonly reported as a measure of the intensity or social cost of conflict –for example see United Nations (2016).

Rubio Díaz-Leal, 2014, IDMC, 2012). Social costs can be large in the presence of little displacement, and migration patterns can be distorted in other ways, such as altering destination choices. These results point to the limitations of studying only the number displaced as a demographic outcome of violence.

Last, we study general equilibrium effects, i.e. the role changing prices have in determining welfare when these are allowed to adjust. We use the estimates of the elasticity of wages to migration in Mexico from Mishra (2007) to calculate a counterfactual equilibrium distribution of population, letting local wages adjust. We find that general equilibrium effects minimally modify the effect of violence on population and welfare.

The rest of the paper is structured as follows. Section II discusses related literature. Section III describes our data. Section IV presents descriptives and reduced form evidence about the relationship between violence and migration inflows and outflows in Mexican municipalities. It also introduces our instrumental variable for violence, predicted drug route conflict. Section V introduces and estimates the model of labor supply. Section VI shows our counterfactuals, and discusses the welfare effect of violence and its interaction with moving costs. Section VII concludes.

2 Literature Review

Our paper contributes to two branches of the literature in economics. The first studies the effects of conflict on economic outcomes.[3] We add to this literature by studying the migration consequences of the low intensity, but long lasting violence generated by organized crime. Migration is related to all these outcomes, as local economic conditions depend on local population and its skill composition. Our paper then sheds light on the demographic consequences and causes at work in the literature.

So far in the twenty first century organized crime has caused as many killings as armed conflict, making this contribution especially important to understand the cost of contemporary conflict. (United Nations Office on Drugs and Crime, 2019). Particularly, our findings speak to the growing literature on the effects of drug violence in Mexico on different socioeconomic indicators, such as economic growth (Bel and Holst, 2018; Enamorado et al., 2014) and GDP per capita (Mascarúa, 2022); labor market outcomes (Osuna-Gómez, 2021;

[3]Previous work studies the consequences of conflict on outcomes such as per capita GDP (Abadie and Gardeazabal, 2003; Gaibulloev and Sandler, 2008, 2009), foreign direct investment (Abadie and Gardeazabal, 2008; Enders et al., 2006), global capital markets (Chen and Siems, 2004), consumption per capita (Eckstein and Tsiddon, 2004), and human capital accumulation (Chamarbagwala and Morán, 2011).

Robles et al., 2013); housing prices (Ajzenman et al., 2015); foreign investment in financial services, commerce, and agriculture (Ashby and Ramos, 2013); and educational performance (Michaelsen and Salardi, 2018; Orraca-Romano, 2018).

Some work has studied the effect of drug violence on migration flows in Mexico. Orozco-Aleman and Gonzalez-Lozano (2018) study the drug war's role in the decline in immigration from Mexico into the United States. Using electoral cycles to instrument for violence, they find that violence at the municipality of residence increased migration; while, violence on the route to the United States deterred individuals from migrating. We complement their work by focusing instead on internal migration. Our work relates most closely to two recent papers. Ríos (2018) first documented that drug violence is related to larger errors in population projections, suggesting negative net migration in violent municipalities. Basu and Pearlman (2017) estimate the impact of violence on gross out migration rates at the municipal and state levels using the 2010 Mexican Census and labor surveys. They find a puzzling muted response of out migration to violence in the municipal cross-section. They also find little evidence of increased international migration at the municipal level. We build on this strand of work in several ways. First, by studying out and in-migration separately and by using municipal-level panel variation, we can show that the results on the last two papers are compatible. We show net domestic migration into violent municipalities decreases, driven by lower inflows. Second, we leverage a different source of exogenous variation in violence by constructing an instrument that exploits changes in drug cartel alliances and the location of conflict on drug trafficking routes. Finally, and more importantly, by estimating a structural model we can estimate the welfare effects of increased violence and study their channels more closely. This allows us to provide estimates of the number of Mexicans displaced by violence, which has received independent attention.

A report by CONAPO (Díaz Pérez and Romo Viramontes, 2019)[4] reviews this literature, which focuses on displacement as a social cost of local violence. Existing work focuses on using survey data on individuals' migration behavior and their reported motives. Estimates of the number displaced range from the order of 100 thousand over a 13 year period to 800 thousand between 2009 and 2010. The large variation in results calls into question the precision of the amounts of violence-induced migration stated in surveys. Possible explanations for this include migration depending on several factors, individuals misreporting motives, and inconsistent definitions or methods across surveys. In contrast, we estimate a very small number of displaced using a model and migration choices, and meaningful welfare effects.

[4]Mexican Population Council, a dependency of the Mexican government.

Therefore our results highlight that displacement is only a partial measure of the social costs of violence.

Second, our paper contributes to the literature that studies the spatial equilibrium framework in the developing world. Chauvin et al. (2017) test the spatial equilibrium hypothesis in Brazil, China, and India and conclude that the implications of the standard spatial equilibrium model, which in some cases assumes low or null migration costs, are rejected in some countries. Gollin et al. (2017) find that a spatial equilibrium is not the right description for twenty developing countries in sub-Saharan Africa. We add to this literature by documenting evidence of large migration costs in Mexico, which are consistent with both of the cited works: if individual migration is costly, then spatial equilibrium without them may be an inappropriate modelling tool. In this sense our results highlight the importance of models of spatial equilibrium with moving costs, such as that developed in Ahlfeldt et al. (2020).

3 Data

This section describes our data. We study the panel of all Mexican municipalities and three migration periods. These cover the years between 1995 to 2015. All our sources are public.

Migration is our main outcome variable. Individual data on migration, along with years of education, wage, and employment by occupation comes from decennial Censuses (2000, 2010), and an Intercensal Survey (2015). These databases are representative at the municipal level. We observe individuals' municipality of residence at the time of the survey and five years prior. We define $inflows_{jt}$ for municipality j at year t as the number of individuals who lived in municipality j at year t, but not at year $t-5$. By analogy, $outflows_{jt}$ is the number of individuals living in municipality j at time $t-5$, but not at time t. In the labor supply estimation, we use population flows between all municipality pairs as migration choices.

We study migration behavior separately for low and high skilled individuals. This serves two purposes. First, we expect different behavior from the two types –in other settings, mobility is much larger for the highly educated. In addition, education proxies for socioeconomic status and we expect the effect of violence to depend on it. We classify individuals as skilled or unskilled based on their education. A skilled person in our definition has 12 years of education or more after early childhood education, which corresponds to finishing high school in Mexico. We calculate average wages for each j and t by skill group. When studying these subgroups separately, we use their conditional mean wage.

Our object of interest is the effect of violence. We measure violence using the local homicide rate per 100,000 population. The National Statistics Office (INEGI) reports homicides for each municipality and year. Population projections at the municipality level come from the National Population Council (CONAPO). We average the homicide rate over each five-year migration period, and take logarithms to construct a municipality level measure of violence.[5] Since some municipalities report zero homicides in some periods, we add the smallest observed homicide rate to all municipality years.[6] This normalization guarantees that the number of municipalities is constant in every period. Centro de Investigación y Docencia Económicas (CIDE) has made a separate dataset with murders attributed by a government panel to DTO's. We chose the more comprehensive measure of all homicides from INEGI instead for two reasons. First, CIDE's measures only covers 2006-2010, and second, the process of classifying homicides as "drug-related" is not transparent enough to understand possible measurement errors that could impair estimation.

We construct lists of drug traffic origins and destinations as inputs to our model of cartel conflict. Some drugs are more valuable to drug trafficking organizations (DTOs) than others, and so are more likely to attract conflict (Camilo Castillo et al., 2020, DEA, 2015). For this reason, we speculate that routes that transport different kinds of drugs to cause different levels of violence, and model them separately.

Our data allows us to separately infer the source locations of marihuana, poppy seed, and imported drugs, such as cocaine.[7] Marijuana, heroin, and cocaine make up the bulk of the drug trade from Mexico into the United States. The Mexican Secretariat of Defense measures the area of marijuana and poppy fields destroyed in its eradication efforts for each municipality (Sedena, 2018). We define production locations as those in the top 5% by total eradicated area over our study period.[8] This set of municipalities accounts for over 80% of all eradicated area, pointing to concentrated production in a few rural regions.

DTOs import drugs from other countries to bring them into the US. Cocaine is a notable example, as it is not produced in Mexico. Imported drugs come into the country through maritime ports, illegal landing strips, international airports, railroads, etc. Due to the high volume of freight transport, we focus on maritime ports. Thus, we define drug import locations as ports with substantial cartel presence according to the 2015 National Drug Threat Assessment (NDTA) map on Areas of Dominant Influence and Key Areas of Conflict, published by the United States' Drug Enforcement Administration (DEA). This report also lets us identify the

[5]Homicide data is available beginning in 1998. Thus, for the 1995-2000 migration period, the homicide's average corresponds to 1998 to 2000.

[6]The smallest non zero homicide rate observed across municipality years is 0.42 per 100,000 population.

[7]Poppy seed is the main input in heroin production.

[8]Approximately half of all municipalities report destruction of crops.

predominant cartels present in each location. Since we compute routes over land, we ignore coastal locations near the southern border of the country, in the states of Quintana Roo and Chiapas, as possible origins of land shipments. These are far from points of entry into the US and unlikely to serve as origins for land traffic routes.

According to DEA (2015), most of the drugs moving from Mexico to the US over the study period enter through land. The NDTA identifies points of entry (POE) into the US with significant cartel presence on the border between Mexico and the US. These define drug route destinations in our model.

We construct Bartik shocks to instrument for wages in the preference parameter estimation. These are calculated using municipality level employment shares by sector from the 1995 Intercensal Survey and the Economic Census of 2004 and 2009.

Rent is notably absent from the regressions and model, for two related reasons. Rent data is sparse in national surveys and is not available for every municipality: no source of rent data exists that is representative at the municipal level and available over our whole period of study. This precludes us from taking full advantage of the fine migration data available in the Census if we restrict to using only periods and places for which we observe measures of rent.[9] Second, specific features of Mexican housing institutions make rent adjustments to local amenities less quantitatively important. The rate of Mexicans who live in a family-owned home is substantial, approximately 67.7 percent.[10] The Mexican Federal government promotes homeownership through several programs, including mandatory paycheck deductions into a mortgage fund for all formal workers and subsidized loans. Self-built homes in slums or unregulated lands are also typical. High homeownership rates imply that the share of population for whom rent prices matter for location decisions is relatively small. In addition, the empirical evidence suggests that rent prices, which are a usual regulating mechanism in systems of cities models, seem to respond little to changes in local amenities. Ajzenman et al. (2015) find that a 100% homicide rate increase decreases home prices by approximately one percent, and only for low income housing in Mexico. In order to further test the weak rent response to violence, we use available data to estimate the elasticity of rent to the homicide rate. The housing component of the National Consumer Price Index (*INPC* in Spanish) indexes a fixed set of homes over time in some cities in the country. While the spatial coverage of these series is restricted to a few municipalities, the design implies that home character-

[9] The national ENIGH survey includes a question about rent expenses, but is not representative at the municipality level and does not cover all municipalities in the country. In addition, home characteristics are relatively sparse, making detailed hedonic rent estimation difficult.

[10] 2015 Intercensal Survey, INEGI.

istics are fixed over time.[11] This is advantageous to estimate the response of rent prices to changes in local homicides keeping home characteristics fixed, which we cannot achieve with the repeated cross-sectional data available in expenditure surveys. However, we do use the national expenditure survey (National Household Income and Expenditure Survey of 2010, *ENIGH* in Spanish) to obtain rent as a share of income, which we use to calculate welfare costs taking into account rent changes. This data is also used to estimate the elasticity of rent as supportive evidence that this unstudied channel is unlikely to bias our utility parameter estimates substantially. We keep the limitations implied by the lack of detailed rent data in mind as we interpret our results throughout.

4 Descriptives and Reduced Form Estimation

Homicides increased sharply in Mexico after 2007.[12] Figure 1 shows monthly homicides from 2000 to 2016. Aside from the direct effect on homicide victims, it is likely that rising violence also affected local residents where these events ocurred. As the literature and journalistic accounts indicate, homicides became more frequent and tended to be carried out in more public manners: these drug related homicides cause increased fear and a sense of insecurity (Gutiérrez-Romero, 2015), and are related to depression symptoms in the local population (Martínez and Atuesta, 2018). Sociological work documents how fear and "spectacular violence" may have hindered daily life in some Mexican cities (Campbell, 2016).

If households dislike living where the homicide rate is high, then it would be expected to observe net migration out of those locations, all else constant. This is especially true if violence did not increase across the whole country, allowing individuals to substitute away from violence if they have enough resources. Figure 2 shows that violence was concentrated in space, resulting in large regional differences in log mean homicide rates in 2010. Table 1 shows measures of mean municipality violence for the three periods reported in the Censuses: 1995-2000, 2005-2010, and 2010-2015. The mean municipal homicide rate increased

[11]The list of covered municipalities is: Mexico City (taken as a whole), Mérida, Morelia, Guadalajara, Monterrey, Mexicali, Ciudad Juárez, Acapulco, Culiacán, León, Puebla, San Luis Potosí, Tapachula, Toluca, Torreón, Veracruz, Villahermosa, Tampico, Chihuahua, Hermosillo, Monclova, Córdoba, Aguascalientes, Tijuana, Matamoros, Colima, La Paz, Chetumal, Jacona (Michoacán), Fresnillo, Iguala, Huatabampo, Tulancingo, Cortazar (Guanajuato), Jiménez (Chihuahua), Durango, Tepic, Oaxaca, Querétaro, Cuernavaca, Tlaxcala, San Andrés Tuxtla, Campeche, Tepatitlán (Jalisco), Tehuantepec, Ciudad Acuña, Atlacomulco, Cancún, Coatzacoalcos, Esperanza, Azúcar de Matamoros, Pachuca, Saltillo, Tuxtla Gutiérrez, and Zacatecas.

[12]Among the explanations for the upsurge in violence in Mexico since 2006 are changes in government enforcement strategies in Mexico (Dell, 2015) or Colombia (Camilo Castillo et al., 2020) and an external demand shock for heroin (Sobrino, 2020).

between the first and second period, and further in the third.

Internal migration patterns depend on individual characteristics as well as those of origins and destinations. As stated above, we study skilled and unskilled individuals separately, in order to take into account differentiated labor market behavior. A central feature of internal migration flows is that they are stronger between proximal locations (see e.g. a recent treatment in Poot et al. (2016)). In particular, agents might find it attractive to relocate within a short distance, to avoid local disamenities but preserve their social and economic networks. We will include this dimension in the analysis by distinguishing migration within and across commuting zones. Commuting zones are sets of municipalities linked together by strong commuting links. These are built following Fowler et al. (2016), with 2010 commuting data.

Figure 3 shows kernel density estimates of the distribution of origin and destination log distances of internal migration flows over 2000-2015. The distribution of total migrants has two modes, but becomes unimodal when we restrict the analysis to movers across commuting zones in figure 4. This fact partially reflects that about one third of internal migration occurs within commuting zones (see table 2). Due to this we perform our statistical analysis separately for movers across and within commuting zones. The large mass of within commuting zone migration flows indicates these may behave differently and should be studied separately, as we do.

We also study migration for skilled and unskilled individuals separately. Preferences for local characteristics, mobility, and spillovers of migration are likely to vary by skill level as documented in Diamond (2016). While Table 3 shows that the unskilled represent a larger share of the population above 15 years of age, Table 2 indicates that skilled workers move at substantially higher rates, both within and across commuting zones. Therefore, both groups' internal migration behavior can be quantitatively important.[13]

Tables 5 and 6 show the OLS estimates of the effect of log mean homicide rate on log inflows and outflows across and within commuting zones, controlling for municipality fixed effects, time fixed effects, and interactions of year dummies with the share of 1995 population who migrated to the US, the share of female population in 1995, and the share workers by sector in 1999.

[13]There exist other dimensions of heterogeneity that could be studied: gender, for instance. Since most of the victims of homicide after 2008 were young men, it's natural to expect that migration behavior might respond differently for more victimized demographics. Indeed, we do find that the rate of internal migration seemed to increase in men relative to women over the study period: in the 1995 - 2000 period 1.08 men women migrated per each 1 migrating man, while by 2010-2015 only 1.02 women migrated per every man. However, we focus only on the skill dimension following the literature, e.g. Diamond (2016), Moretti (2011). In addition, conditional on migrating men and women have very similar behavior, as shown in the distribution of origin-destination distances in Figure 5.

People with lower skills or from certain regions may emigrate on average more to the US than those with higher skills. International migration is an alternative not observed in our data that can respond to violence in Mexican municipalities. A municipality with a higher propensity to migrate to the US in a given period would show, for example, lower internal migration "outflows" when the homicide rate increases, possibly biasing the estimation of the parameters of interest if it is not observed this propensity to migrate. To control for this geographic and temporal variation in the propensity to migrate to the US, we include the interaction of year indicator variables with the proportion of the municipality's population that migrated internationally between 1995 and 2000. This variable is a "proxy" of the probability of migrating internationally because as Munshi (2003) argues, if a municipality has a higher proportion of its original inhabitants living in the US, the expected benefit of migrating internationally is greater. His work shows that the size of the existing network in the US at a given time is an important determinant of migratory patterns from municipalities in Mexico to destinations in the US. The inclusion of this variable in the estimates thus mitigates the risk that international migration presents to the identification of the parameters of interest, which are the effects of violence on internal migration.

Let the outcome migration variable be $Y_{jt} \in \{\ln(outflows)_{jt}, \ln(inflows)_{jt}\}$, where j index municipalities and t census waves. We estimate:

$$Y_{jt} = \psi_t + \psi_j + \beta_1 \times \ln homrate_{jt} + X_{jt} + \varepsilon_{jt} \tag{1}$$

OLS estimates show a noisy effect of violence on migration by decreasing total immigration for every skill level. However, these effects are not significant.

4.1 Predicted route conflict

Violence is unlikely to be exogenous in the migration equation. If some unobserved municipal characteristics correlate with violence and migration, or if migration causes violence, then OLS estimates are biased. There is some evidence of the former: Dell et al. (2018) find that violence increased more where local labor markets were depressed. They argue that weak local labor demand makes it easier for cartels to hire. While we control for labor market conditions using municipality-level time varying controls, this is likely to be an incomplete measure. The unobserved quality of local institutions, such as police or courts, can also affect migration rates and violence. An instrumental variable is then needed to estimate the effect of violence on migration.

We construct our instrument for violence by modelling the location of cartel conflict over drug routes in time. If DTOs fight for traffic routes, and by doing so increase local violence, then we can capture some of the variation in violence by predicting where conflict is likely. To the extent that the location of conflict does not depend on other municipality characteristics that matter for migration, the exclusion restriction will hold.

The exact location of traffic routes and DTO conflict is unobserved, so we assemble a model to predict them. To do so, we bring together information on where drugs are produced, imported, and trafficked into the United States, the identities of the DTOs present in each of these locations, and the profile of alliances and conflicts between them over time. Next we describe their construction.

First define, for each period, an alliance as a group of DTOs documented to be collaborating in that period. Journalistic accounts (Hernández, 2010), text analysis of messages left by DTOs (Atuesta and Pérez-Dávila, 2018), and the National Drug Threat Assessment documents from the DEA (DEA, 2015) detail the formation and dissolution of alliances between DTOs, as well as conflicts. These accounts cover the period until 2015, so despite new Population Census data becoming available, we restrict our study period to that covered by the 2000, 2010, and 2015 Censuses and Intercensal Surveys.

For a given period and alliance, we define drug origins as municipalities where drug crops were destroyed by the Mexican Army or ports with high drug-trafficking activity according to the DEA, where some member of the alliance is present. Section 3 describes the origin data in more detail. We consider three types of origins, according to the kind of drug sourced: poppy seed and marihuana, grown in Mexico, and imported drugs that enter the country through ports (e.g. cocaine). For each of these origins, we model drug routes as the shortest highway route that connects that origin to a destination on the US border, *where the alliance is present*. Finally, we define conflict as a function of the number of alliances that are present in a given municipality.

We implicitly assume in our model that origins and destinations of drug trafficking routes are controlled by the same DTOs throughout the period of study. We believe this is reasonable, as DTOs defend their home turfs and access points to the US, since they are essential to their business. Most news reports mention the same DTOs in origins and destinations in time. Thus, the time variation is given by changes in routes that occur when a new alliance is formed or when it breaks down. This redefines the set of possible destination points for a given origin. Second, routes from competing DTOs might be joined into a single route if they become allies. The opposite is also true: a splintered alliance may lead to an increase in the number of routes that go through a given municipality.

Contested routes vary in time with the profile of alliances and conflict between cartels. These are caused in general by conflict and agreements between high-level members of cartels, and so we hypothesize them to be unrelated to local municipality characteristics other than violence. Therefore, we speculate our measure of predicted conflict to only affect migration through violence, meaning it satisfies the exclusion restriction.

The relevance of our instrument depends on two assumptions: that violence increases where cartels fight, and that they do so to control traffic routes or drug shipments. If so, municipalities on a route that DTOs fight over will experience higher levels of violence. Both assumptions find support in the literature. Trejo and Ley (2018) find cartel conflict changes the geographic pattern of violence over time. On the other hand, Camilo Castillo et al. (2020) find that periods and locations where cocaine shipments are presumably more valuable see increased violence.

Define a route for drug d, $r^d_{a_t}$ starting at an origin o, where alliance a is present, as the path over federal highways that minimizes distance between o and a destination where a is present. Denote the variable R^d_{jt} for municipality j in time t as the number of alliances with drug d routes that pass through j at time t.[14]

$$R^d_{jt} = \sum_{\tau=t-5}^{t} \sum_{a} \mathbb{1}(\text{j is 40 km or less from } r^d_{a\tau}) \tag{2}$$

To allow violence to respond more flexibly to predicted routes, our instruments are dummy variables corresponding to intervals of route-years. Our instrument vector Z_{jt} includes then, for each drug, two variables: $Z^d_{jt1} = \mathbb{1}(R^d_{jt} \in [1,5])$ and $Z^d_{jt2} = \mathbb{1}(R^d_{jt} > 5)$. These definitions distinguish three kinds of municipalities over each five year period. First, in the ommited category, those that had no routes passing through them during the period, corresponding to the case $R^d_{jt} = 0$. Second, those that necessarily had two conflicting alliances present in some year, corresponding to $R^d_{jt} > 5$ (if at most one alliance was present in each year, then R^d_{jt} would be at most 5). Last, the intermediate cases, where a single alliance may have been present throughout the whole period or rival alliances were present in only some years, with no routes in others. Since we hypothesize conflict between alliances to affect the local homicide rate, then violence should depend on R_{jt} in a nonlinear way, justifying this construction.

Figure 6 shows the predicted network of routes of two alliances, numbered 1 and 2, and the logarithm of the homicide rate. From this picture, we see that some of the most violent municipalities in the country lie within a close distance of contested routes –routes used by

[14] Since cartels enter and exit alliances at times that do not match our migration periods, we calculate routes by cartel alliance periods and aggregate them.

both alliances. The routes we use to construct the instrument are modelled and not observed, so we are likely to miss some important variation. In particular, we cannot account for change in routes due to conflict. However, it is likely that the most direct routes we model will be attractive for DTOs and therefore generate conflict when contested.

We reestimate (1) using instrumental variables to obtain the causal effect of the homicide rate on migration. The identification condition in this equation is that being on a route affects migration only through violence, conditional on the controls. Origin and destination municipalities may be influenced by confounding factors related to local economic conditions and homicides (for example, extra labor demand associated with production and trafficking across the US border and larger presence of firearms and DTO associates). As a consequence, we remove origin and destination municipalities from both the OLS and IV analyses.

Table 4 shows the first stage corresponding to IV estimation of equation 1. Municipalities with over 5 predicted route-years of marihuana traffic display larger homicide rates, consistent with our hypothesis of conflict along routes where more than one alliance is present. Sanderson-Windmeijer F statistics reject the instruments are weak at the 5% level.

Table 5 shows IV estimates of the effects of the log homicide rate on log inflows and outflows, for unskilled individuals. Table 6 shows the analog results for the skilled group. The first column shows effects on log total migration, while the second and third columns report effects on migration across and within CZ. We find that that violence affects migration through decreased inflows of high skilled individuals, with no effects on outflows nor on unskilled migration. An increase of 1% in log homicide rate implies a .63% decrease in total inflows of skilled individuals. The effect on skilled inflows is driven by changes in immigration across commuting zones: a 1% increase in homicides implies a reduction of skilled across-CZ migration of .72%. Hansen J statistics do not reject that the identification equations hold for this outcome and subgroup.

Violence causes negative net migration of skilled individuals, indicating that this group finds the homicide rate to be a disamenity, which is consistent with the homicide rate acting like a disamenity, and with large cost of relocation. These effects are due exclusively to decreases in inflows, indicating that the skilled are less likely to choose destinations where the homicide rate is larger only conditional on moving. The null effects on unskilled inflows are evidence that this group's migration choice is less sensitive to the homicide rate. The null effects on outflows, on the other hand, point directly to migration costs that are large relative to the utility cost of violence. For outflows to respond to local conditions, the disamenity imposed by increased homicide rates would need to cover the cost of moving. Since we do not find effects of this kind, for both skill groups, migration costs appear to outweigh the disamenity cost of violence. The lack of effects on outflows, for both groups, is consistent with Basu and Pearlman (2017), who also find no outmigration in response to increased homicides studying the 2010 Census cross-section. We interpret migration flows in terms of workers' preferences, but we acknowledge that homicides may affect local labor demand as well. We control for sector shares in the pre period interacted with time dummies, which we take as a proxy variable of changes in local demand. However, we acknowledge that to truly identify labor supply parameters we must rely seriously on labor demand shocks - we do so when we estimate labor supply in section 5.1.

Our results suggest that the local homicide rate may affect the relative supply of skill at the local level, by preventing the arrival of skilled individuals to violent labor markets from other locations. Table 7 shows IV estimates of the effect of the homicide rate on the skill ratio, defined as the ratio of skilled to unskilled employment in a municipality-year. The effects are large and statistically significant: a 1% increase in the homicide rate decreases the skill ratio by 5%. However, this reduced form result is not necessarily driven exclusively by migration. It is possible that violence decreases relative demand of skill, or relative supply through channels other than decreased inflows. This observed decrease of the skill ratio may be driven in part by increases in the demand for unskilled labor in places with high homicide rates, for instance protection services.

Since IV estimates are larger than OLS ones, we conclude that violence assigned at random has a larger negative effect on skilled immigration than equilibrium assigned violence. This implies that the bias is positive: homicides relate to positive unobserved drivers of immigration. As we will see in the counterfactual exercises, locations that are relatively attractive for migration also appear to display larger increases in homicide rates.

5 Labor Market Model and Structural Estimation

Overall, the reduced form results point to skilled individuals disliking to live in violent places, but finding that moving costs are large relative to the disutility imposed by local violence. However, these results do not speak fully to the welfare consequences of increased homicides: low migration is consistent both with large or small welfare losses from the increasing violence. Individuals may not relocate because the associated utility changes are economically small, implying low welfare costs, or instead due to high costs of adjustment. While the hypothesis of large moving costs is implicit in the literature that focuses on internal displacement as a metric of the social cost of conflict (Díaz Pérez and Romo Viramontes, 2019, Pérez Vázquez et al., 2019, Rubio Díaz-Leal, 2014, IDMC, 2012), a quantitative model can provide guidance on the magnitudes of welfare effects and the channels through which they operate.[15] In this section we set up and estimate a model to quantify migration in response to homicide rate increases after 2006, as well as to assess the magnitude of the welfare changes and the role of moving costs and general equilibrium effects.

An estimation of the overall welfare cost depends on preference parameters associated to local violence and wages, migration costs, the geographical pattern of migration and violence, as well as how much local labor and land markets respond to changes in population. We follow the spatial equilibrium models of Moretti (2011) and Diamond (2016) closely. In them, a local amenity decrease in municipality j (such as higher violence) has consequences through several channels. Marginal workers move and pay the moving cost, which depends on whether the destination belongs to the same commuting zone or not. Inframarginal workers live with the decreased amenity, and, if prices respond to local population, with higher wages, and lower rents. The overall effects depend on the relative sizes of the preference parameters that govern the migration choice, as well as the elasticities of prices to local changes in population.

In subsection 5.1, we estimate a discrete choice model to quantify labor supply as a function of local characteristics. Since we do not observe land or rent prices at the municipality level, we do not model them explicitly. This lack of a land market will constitute an important limitation of the structural estimation. According to the systems of cities models cited above, rents will adjust to compensate for changes in local conditions. This would in principle bias our estimates of the utility coefficients associated to local characteristics, both for homicides and wages. Since rent is an unobserved variable correlated with a municipality's mean utility, wages, and homicides, it would cause omitted variable bias. Reassuringly, when we use available data to estimate the elasticity of rent to homicides in section 5.2, we find a very low value. This is consistent with existing literature (see Ajzenman et al. (2015)), and implies that the rent channel is unlikely to be quantitatively important in our setting. Then our IV estimates of preference parameters are likely to not suffer from large biases due to the lack of rent data.

[15] In principle, substantial migration in response to homicide rates would also be consistent with both large or small welfare effects. If large migration resulted from low substitution costs to attractive alternate locations then violence may not imply a large welfare cost even in the face of large internal displacement.

5.1 Labor Supply

We write labor supply using a simple discrete choice model. It will constitute the central piece of the preference parameter estimation. Labor supply at municipality j at time t depends on individuals' utility of living in a given city. Let V_{ijt} be individual i's value function when choosing to live in j at time t. Define $viol_{jt}$ as municipality level violence [16], w_{jt} as local wages [17], and β_{ij} as moving cost between i's origin location and j. This cost will vary by whether the origin and destination are the same, different but belonging to the same commuting zone, or belonging to different commuting zones. ε_{ijt} is an individual preference shock, distributed Type 1 Extreme Value. ξ_{jt} are unobserved, time varying city characteristics that affect all individuals' location choices.

$$V_{ijt} = \beta_v viol_{jt} + \beta_w w_{jt} + \gamma_j + \gamma_t + \xi_{jt} + \beta_{ij} + \varepsilon_{ijt} \tag{3}$$

This value function depends on i through the individual shock and the location at the beginning of the period, which we take as exogenous.

[16] We use aggregate homicide rates because we consider that the aggregate homicide rate reflects the general conditions of violence and insecurity in the country's municipalities, and therefore a homicide reduces the well-being of the population where the homicide occurs, regardless of the characteristics of the victimized person. The murder rate, and organized crime in general, disproportionately victimize certain demographic groups, especially by gender. For example, homicides are heavily concentrated among young men, but in exploratory exercises, we did not find a relationship between the groups that migrate and the groups most victimized by homicides. Migratory behavior is remarkably similar between genders, as can be seen in figure 5. The distribution of destinations of men and women conditional on migrating is practically identical, which is reflected in the density of distances between origins and destinations conditional on migrating. This indicates that the behavior of these two groups is similar, so we decided not to incorporate this dimension of heterogeneity and focus instead on the differences between ability groups.

[17] We include destination average wages instead of individual wages for two reasons: first because existing work shows that destination average expected income is a major factor in internal migration decisions, and second, to reduce the role of self-selection in the migratory decision within the model. Kennan and Walker (2011) show that, in the US destinations' average income is a central determinant of the migratory decision. Under their model, which explains the main empirical regularities of internal migration, the income of individuals in a given location has two components: one that depends only on the location and corresponds to the average salary in the destination, and a component that depends on the "match" between an individual and a given place. Both components are important, but only the average income is known for the individual before migrating. The "match" component is known once the individual is in her new place. This is the main reason for using aggregate wages: they are closer to what individuals observe when deciding whether and where to migrate. Furthermore, individuals may decide to migrate again upon observing a "bad" performance of the locational match, which explains the high propensity for return migration (i.e. back to the sites of origin after a migration event). Thus, the migration decision and wages are endogenously related, and this correlation is greater with individual wages than with average wages (because migration affects individual wages through the "locational match" but does not affect the average wage). Although average wages can also be endogenous to migration, it is possible to generate instrumental variables that modify average wages at the municipal level such as Bartik shocks as in our case.

Define

$$\delta_{jt} = \beta_v viol_{jt} + \beta_w w_{jt} + \gamma_j + \gamma_t + \xi_{jt} \tag{4}$$

Then

$$V_{ijt} = \delta_{jt} + \beta_{ij} + \varepsilon_{ijt} \tag{5}$$

Equation (3) implies that the share of i's origin population that moves to j in t is

$$S_{ijt} = \frac{\exp\left(\delta_{jt} + \beta_{ij}\right)}{\sum_l \exp\left(\delta_{lt} + \beta_{ij}\right)} \tag{6}$$

We can estimate δ_{jt} and β_{ij} using maximum likelihood for $t = 2000, 2010, 2015$. This amounts to choosing the values of δ_{jt} and β_{ij} that make the model match the share of individuals observed to live in each j at each t, and the share of movers within and across commuting zones over the three periods.

5.1.1 Labor Supply: IV Estimation

We want to estimate the preference parameters associated with specific location characteristics. We proceed using a two step estimator similar to the one used in Diamond (2016). We follow that work and treat the δ_{jt} as data, acknowledging that these are parameters estimated with uncertainty.[18] With estimates for δ_{jt} in hand, we can estimate equation 4 using IV. Instrumental variables are necessary here because we know that unobserved local characteristics ξ_{jt} will change with violence. Local home values and rents are likely to respond to changes in local wages and homicides, and are unobserved for the national sample, as discussed above. We proceed aware of this limitation and will take it into account when interpreting results. We are interested in estimating β_w and β_v, in order to calculate willingness to pay for decreases in violence.

As before, we consider unobserved local labor demand conditions and government institutions jointly determine violence, wages, and migration. Then, we need to instrument for violence and wages to identify β_w and β_v.

To generate variation in local wages, we use Bartik shocks. Let $L_{l\tau}$ be national employment in two digit Sistema de Clasificación Industrial de América del Norte (SCIAN) sector l at time τ, and $s_{lj,t0}$ be the share of employment in j in sector l in 1999, before our study

[18] In the estimation, this estimation error can be accounted for by loading it onto the ξ_{jt} term, which serves as an error in the IV estimation equation.

period begins.[19]

Define Bartik instruments B_{jt} as

$$B_{jt} = \sum_{l} \left(L_{l,t} - L_{l,t-5}\right) s_{lj,t0} \tag{7}$$

These municipality level shocks plausibly affect the desirability of a city $\delta_{j,t}$ only through the labor market, so they serve as instruments. These type of shift-share instruments are based on the premise that the employment growth that is due to the exposure of a municipality to national trends, through their historical specialization, will be exogenous to local conditions. We need a relevant instrument Y_{jt} for violence that plausibly satisfies exogeneity; something that affects average quality of life in a municipality only through violence. We again use our contested route instrument from section 2, and estimate equation 4 using IV.

This yields estimates for β_v and β_w, as well as values for the municipality-year level residuals, $\hat{\xi}_{jt}$. Table 9 shows our estimates for the unskilled group, and 10 for the skilled. We estimate utility coefficients in two ways. First, we instrument each endogenous variable separately, corresponding to the results in the first two columns of both tables. The first procedure includes violence and wages one at a time in the estimating equation, in order to identify each parameter with the variation generated by its own set of instruments: when estimating β_v in the first column of Tables 9 and 10, we include only $viol_{jt}$ as the single endogenous variable. We remove w_{jt} from the set of controls in this case under the assumption that it is endogenous in the equation and will lead to inconsistent estimation of β_v if not instrumented for. Analogously we include only w_{jt} when estimating β_w in the second columns of Tables 9 and 10. In the second estimation procedure, corresponding to the third columns of both Tables, we estimate β_v and β_w in the same equation using both sets of instruments. This guarantees that the estimated residual $\hat{\xi}_{jt}$ are consistent with both the β_v and β_w, since they are all obtained jointly. The tables also report the willingness to pay to decrease the homicide rate by 1%, in wage percentage terms, corresponding to the separately and jointly estimated utility parameters.

Willingness to pay is a central parameter that determines our estimates of welfare costs, and is defined as follows. In equation (3), indirect utility is kept constant if $viol_{jt}$ increases by 1 if w_{jt} increases by $\frac{\beta_v}{\beta_w}$. This is the willingness to pay to avoid the unit increment in $viol_{jt}$, in log wage units.

The homicide rate decreases utility for skilled individuals, in both estimations, consistent

[19] We remove each municipalty's employment when calculating the natonal growth rate that we use in the calculation of its Bartik shock.

with the findings in the reduced form section. For the unskilled, we cannot reject that the preference parameter is zero in the joint estimation, while the separate yields statistically significant estimates with the expected signs: positive for wages and negative for homicides. Larger wages increase utility in a statistically significant manner in all cases and all groups. The associated willingness to pay is lower in both estimation procedures in the unskilled group. This result is consistent with the reduced form section, where migration flows did not reveal changes in response to changes in the homicide rate among the unskilled.

The estimated model suggests that the welfare of unskilled workers when the homicide rate increases by 1% is the same as that when local wages per 100 thousand decreases by .15%, in the separate estimation. The results suggest skilled workers would be willing to accept a homicide rate increase of 1% if they were compensated with a .41% to .58% increase in wages depending on the estimation procedure.

The IV estimation rejects utility coefficients are zero in most cases, but we can compute confidence intervals for the willingness to pay estimates directly by way of bootstrapping. Figure 7 shows densities of bootstrapped WTP estimates, for both groups and estimation procedures. Again we find evidence that the skilled group's willingness to pay for decreases in violence is larger, and we can reject that the parameter is zero for the separately estimated procedure at the 5% level.

Confidence intervals for the unskilled group are very large, indicating there is substantial mass at the tails of the distribution of willingness to pay estimates. These may be attributable to estimates of the β_w denominator term that are close to zero.

In general, our estimation of the willingness to pay parameter parallels our findings from the reduced form section: skilled workers display more sensitivity to increases in the homicide rate than unskilled ones. With these parameter estimates in hand, we proceed in section 6 to the welfare calculations.

Moving cost estimates, shown in Table 11 follow theory, in the sense that moving to a further destination implies a larger utility decrease, for both skill groups. Moving cost estimates are larger for moves across commuting zones than for moves within a same commuting zone, which in turn are larger than those of not moving.

Our moving cost estimates are consistent with findings in Bryan and Morten (2019), who document that a gravity relationship holds for internal migration in Indonesian data. The authors document that a 10 percent reduction in the distance between two locations leads to a 7 percent increase in the proportion of migrants who flow between the two locations. Moreover, people who live farther from their location of birth have higher wages: a doubling of distance leads to a 3 percent increase in average wages, suggesting that people need to be compensated to induce them to move away from home.

These costs are very large relative to the utility coefficients shown in tables 9 and 10, as would be expected if unobserved rent or land price adjustments muted the mean utility response to changes in local characteristics. However, since β_{ij} are several orders of magnitude larger than the β_v and β_w, these results still suggest that moving costs are large relative to local changes in characteristics.

Our results are consistent with existing work on urban decline. According to Glaeser and Gyourko (2005), in the face of a decrease in local amenities rents should adjust more than population, as housing is durable and its market's clearing condition will push prices down rather than adjusting quantities.[20] As a consequence, rent is expected to be more elastic with respect to worsening amenities than population. In our setting we find small rent adjustments and no out-migration responses in the affected locations (while identifying violence as a disamenity through the choices of potential immigrants), fitting the model cited above. This model further highlights that rent changes are likely to mute the migration response to homicides, and compensate workers who live in locations with worsening disamenities. For this reason, it's likely that our estimates slightly underestimate the true disutility of violence.

5.2 Housing Demand and Violence

In spatial equilibrium changes in local amenities translate to changes in rents, since agents can move towards locations with better amenities and demand more land in those locations. As local homicides increase (a decrease in local amenities) the spatial equilibrium model predicts rents will decrease as well, mitigating the overall welfare loss.[21] Then, the overall welfare cost of violence depends on the elasticity of rents to the homicide rate. While we do not explicitly model land markets, we estimate the elasticity of rent to the homicide rate on the subsample of homes tracked by the INPC. This estimate allows us to adjust the welfare calculations to take into account the rent change implied by homicide increases, as we describe below.

We estimate the elasticity of rents R_{jt} to homicide rates through the following model. As it's likely that rents are low and homicides are high in locations with e.g. depressed labor demand, we again use our predicted route instrument to overcome the likely endogeneity of the homicide rate to rents. The sample consists of the panel of homes that are tracked by the

[20] While the argument in Glaeser and Gyourko (2005), relies on an open city model that makes no mention of moving costs, these can be thought of as increasing the value of not relocating to the modelled city.

[21] While it is true that high homeownership rates imply few people live in rented housing in our setting, we study this channel for consistency with the usual spatial equilibrium framework.

INPC, averaged to the municipal level, and observed over the study period (1995-2015).[22]

$$R_{jt} = \psi_t + \psi_j + \beta_r \times \ln homrate_{jt} + \varepsilon_{jt} \tag{8}$$

Results are reported in Table 8. Rents show a small but statistically significant negative response to the homicide rate. A 1% increase in homicides translates to a .09% decrease in rents. This estimate is small and in line with the results in Ajzenman et al. (2015), who find that the increase in homicide rates after 2008 decreases home prices but only in low quality housing. The estimated elasticity is also small, in the order of .01%. Reassuringly, this is the same order of magnitude as our results.

The small rent response to homicides implies that welfare losses for agents who do not move away from violence will be relatively large, since these prices will not drop to compensate them. We take this compensating channel into account when quantifying welfare losses from violence in the next section.[23]

5.3 Labor Demand and Housing Supply

Violence may also affect welfare at migration origins and destinations through changing wages, in general equilibrium. In order to quantify this channel we use the average labor demand semielasticity estimate from Mishra (2007).[24] This estimate will have relatively low quantitative effects, as the population movements we predict in counterfactuals tend to be small.

Finally, as mentioned above, the housing market's adjustment will modify the effect of homicides on welfare. To gauge how large this effect is, we estimate rent elasticity in a cross-section of municipalities in the appendix. We estimate an elasticity of 2.4 of rents with respect to population. This elasticity is large, but as we discuss in the next section, small counterfactual population changes imply this parameter is of little consequence in our setting.

[22]In order to match the measure of homicides that we use throughout the paper, we average rents over the three migration periods (1995-2000, 2005-2010, 2010-2015), and use those three periods in estimation.

[23]Rozo (2018) documents that in Colombia the prices of local goods decrease in places where homicides increase. In that sense, changes in local prices work similarly to changes in rents: by allowing them to adjust, they will compensate households when homicides reduce the value of living in a given place. For this reason, and given that housing is the local good with the highest weight in household spending, we concentrate on the adjustment in rental prices.

[24]Despite corresponding to a period without violence, we believe that this semielasticity estimate allows us to formulate a "best guess" of the general equilibrium effects of violence on wages.

6 Counterfactuals and Welfare

The estimated model lets us study the role moving costs and general equilibrium effects play in determining the effects of violence. We calculate the welfare effect of increased homicide rates under different assumptions about the quantities and prices that adjust. In particular, we compare the model with observed violence to one with counterfactual low violence when moving costs are infinite, zero, and the estimated values in partial equilibrium, and finally in general equilibrium. In all the exercises that follow, counterfactual homicide rates are equal to the minimum of 2000 and 2010 levels.[25]

We classify individuals according to their observed and counterfactual destinations, and study each group separately. This allows us to quantify welfare for marginal and inframarginal individuals, highlighting the role of mobility. In what follows, we say an individual is displaced if they move from their places of origin due to the increase in violence. The number displaced is often used as an informal summary statistic of the social cost of conflict (see, e.g. UN Office for the Coordination of Humanitarian Affairs, 2016). Perhaps for this same reason, academics in other social sciences, Mexican authorities, and human rights organizations have shown substantial interest in estimating the number of Mexicans displaced by the increase in homicides (Díaz Pérez and Romo Viramontes, 2019, Pérez Vázquez et al., 2019, Rubio Díaz-Leal, 2014, IDMC, 2012). Our study highlights that under high moving costs, this number may be misleading about the total welfare cost of conflict.

Existing estimates of displacement rely on survey questionnaires. Several national surveys include a question about some measure of internal migration and its cause (see Díaz Pérez and Romo Viramontes (2019) for a detailed survey). Migration may have many simultaneous causes, so self-reported answers may be unreliable. While our model's estimates are only suggestive, our results will highlight that low internal migration is still consistent with substantial welfare costs.

In addition to the displaced, which we separate by whether they move within or across commuting zones, we study inframarginal stayers, inframarginal movers, and other marginal movers. Inframarginal individuals do not change their choices when faced with higher violence. If their destination and origin municipalities are the same, they are stayers - otherwise they are movers. We say a municipality of origin is more violent (which we need to classify agents as displaced) when its homicide rate increased between 2000 and 2010. The last

[25] This decision allows the counterfactual to be unequivocally safer than the observed profile of violence. Our aggregated measure of homicides increased in 1063 of the 2336 municipalities in our sample between 2000 and 2010.

group, other marginal movers, includes the two remaining cases: movers whose destination changes in the counterfactual, and marginal movers from nonviolent origins. We report welfare separately for each of our demographic groups. The following defines the groups and welfare measures precisely.

For each origin i and destination j, define welfare as a function of origin, destination, violence v, and moving costs β_{ij} as follows. We study a single period (2005-2010) and both groups, and we do not show those sub-indices for simplicity. Recall that $\hat{\beta}_v$, $\hat{\beta}_w$, $\hat{\beta}_c$, $\hat{\gamma}_j$ and $\hat{\xi}_{j,2010}$ are our estimates of utility parameters. β_{ij} is the moving cost.

To account for the decrease in local rents in response to higher homicide rates, which partially offset the welfare loss from violence, we calculate the implied utility change through a compensation in wages $w_j(v)$, as follows. For a given counterfactual change in violence, from v_j^o to v_j^c, we use the estimated elasticity of rents to homicides from Table 8 to calculate the implied change in rent in percentage terms in every municipality, $\Delta R_j(v^c) = \frac{v^c - v^o}{v^o}\beta_r$. Then using the share of monthly wages that are spent on rent $S_{j,2010}^{rent}$, which we obtain from ENIGH (the national expenditure survey), we convert this percentage change to a percentage change in wage terms. Intuitively, a given percentage change in violence will translate to a change in rents through the parameter β_r, which in turn is equivalent to a percentage change in wages equal to the share of wages spent on rent times the percentage change in rent. Thus, counterfactual wages depend on the counterfactual level of violence, which we make explicit by denoting them as $w_j(v)$, and are calculated as:

$$w_j(v) = w_j(1 + \Delta R_j(v^c) \times S_{j,2010}^{rent}) \tag{9}$$

Define

$$W(i, j, v, \beta_{ij}) = \frac{\hat{\beta}_v v_j + \hat{\beta}_w w_j(v) + \hat{\gamma}_j + \hat{\xi}_{j,2010} + \beta_{ij}}{\hat{\beta}_w} \tag{10}$$

W_{ij} is the mean utility of a person originating from i and moving to j in log wage units.

Let o and c index observed and counterfactual choices. Welfare effects from violence depend on individuals' origins, observed destinations, and counterfactual destinations. The following defines the welfare change of an individual originating from i, who chooses j^o under observed violence and j^c in a safer counterfactual. It is the difference in utility measured in log wages and multiplied by nominal mean wage to obtain a measure in pesos.

$$\Delta W(i, j^o, j^c, v^o, v^c, \beta_{ij}) = \overline{wage}_{2010}\left(W(i, j^o, v^o, \beta_{ij}) - W(i, j^c, v^c, \beta_{ij})\right) \tag{11}$$

Notice the above definition reports welfare from the mean utility component, common to all individuals from the same origin and skill group. For this reason, relaxing the constraints associated with large moving costs may decrease measured welfare - individuals may be able to realize utility gains from moving to locations with large idiosyncratic shocks and a worse common utility component.

The number of people who experience welfare change $\Delta W(i, j^o, j^c, v^o, v^c, \beta_{ij})$ is

$$\mu(i, j^o, j^c, \beta_{ij}) = P_i \times S(i, j^o, v^o) \times S(i, j^c, v^c) \tag{12}$$

where $S(i, j, v)$ is the share of people from i who choose j under violence vector v, and P_i is the original population of i. This follows from the independent individual level shocks.

The total welfare effect of increased violence is

$$\sum_i \sum_{j^o} \sum_{j^c} \mu(i, j^o, j^c, \beta_{ij}) \times \Delta W(i, j^o, j^c, v^o, v^c, \beta_{ij}) \tag{13}$$

Adding the values of μ over different sets of i, j^o, and j^c gives us the number of inframarginal stayers and movers, displaced, and other marginal movers. An individual with $j^o = j^c$ is inframarginal, in that their location decision is the same in the observed and counterfactual versions of the world. If a person is inframarginal and $i = j^c$, then we say she is an inframarginal stayer (IS). If not, she is an inframarginal mover (IM)- they move away from their origin to the same destination under both violence levels. On the other hand, if $j^o \neq j^c$ then violence changes the person's migration choice -i.e. they are marginal. We divide marginal movers into displaced and other marginal. First, we call a person displaced (D) if they move away from their origin i only when it turns violent, and report them by whether the move is within or across commuting zones. This means that $i = j^c \neq j^o$, and violence increased in i between 2000 and 2010.[26] Second, we group the rest of the marginal movers (other marginal, OM): those who decided not to move because their preferred destinations became violent, or who move in both states, but to different destinations, or whose origins are not violent.

[26]This definition compares counterfactuals where individual level shocks are fixed, and the utility associated with each alternative varies in the counterfactual.

Population and welfare for each group is:

$$\Delta IS(v_j^c, w_j^c, \beta_{ij}) = \sum_{j^o} \sum_{j^c = j^o} \sum_{i = j^c} \Delta W(i, j^o, j^c, \beta_{ij}) \mu(i, j^o, j^c, \beta_{ij}) \tag{14}$$

$$\Delta IM(v_j^c, w_j^c, \beta_{ij}) = \sum_{j^o} \sum_{j^c = j^o} \sum_{i \neq j^c} \Delta W(i, j^o, j^c, \beta_{ij}) \mu(i, j^o, j^c, \beta_{ij}) \tag{15}$$

$$\Delta D(v_{jt}^c, w_j^c, \beta_{ij}) = \sum_{j^o} \sum_{j^c != j^o} \sum_{i \neq j^o, i \in V, i = j^c} \Delta W(i, j^o, j^c, \beta_{ij}) \mu(i, j^o, j^c, \beta_{ij}) \tag{16}$$

$$\Delta OM(v_{jt}^c, w_j^c, \beta_{ij}) = \sum_{j^o} \sum_{j^c != j^o} \sum_{i = j^o \cup i \notin V \cup i \neq j^c} \Delta W(i, j^o, j^c, \beta_{ij}) \mu(i, j^o, j^c, \beta_{ij}) \tag{17}$$

Having described how we measure welfare, we now lay out our counterfactual exercises and what we learn from each. These exercises vary in two dimensions: moving costs and whether prices at destinations adjust or not. First, we set the cost of moving high enough so that no one moves. Second, we fix moving costs to their estimated value. The difference between these counterfactuals indicates the two effects migration has on welfare: it allows agents to substitute away from worsened local amenities, and also for inframarginal movers to migrate to the locations they find attractive. To the extent these attractive locations become more violent, lower moving costs can worsen welfare as measured by mean utility at destinations. This exercise emphasizes that inframarginal agents, both stayers and movers, still bear the costs of worsened local amenities at their desired destinations. Third, we calculate the effects under perfect mobility in partial equilibrium. Comparing this state of the world to that with estimated moving costs, we learn how the increase in violence interacts with the existing pattern of mean destination characteristics. Indeed, the overall welfare costs of violence depend on the geographical distribution of the resulting homicide rate: if violence increases in municipalities that are relatively attractive for migration and continue to be so under larger homicide rates, then more mobility will increase the welfare losses from the decreased local amenity, relative to a state of the world with less mobility. As we will see, these counterfactuals result in larger welfare costs, indicating that the observed increase in violence happened in relatively attractive locations. Finally, we allow for wages at destinations to respond to local employment changes, under estimated migration costs. The difference between this and the partial equilibrium case quantifies the effect of general equilibrium effects: local wages will respond to migration and so allowing them to adjust will modify the overall costs, in principle. As we will see this channel will result quantitatively unimportant.

Table 12 and 13 show the population effect and welfare effect of violence under these different assumptions. In the counterfactual with no moving, everyone is inframarginal and no one changes location. In this case, the total welfare cost is 231 billion pesos. Mexico's GDP in 2010 was around 13 trillion pesos, so these costs amount to 1.7 percent of GDP per year. The second counterfactual shows the effect of increased violence under estimated moving costs. Our results suggest a very small number of displaced individuals, within and across commuting zones, as well as a small amount of other marginal individuals. As stated before, due to the likely bias from unmodelled rent adjustments, these effects are likely to be lower bounds. I spite of this, the counterfactual is consistent with what we find in section 4: the first order effects of violence operate through changes in immigration flows. We find that to the extent that violence modified the distribution of population, it did so through distorted migration decisions, other than displacement.

Inframarginal stayers account for most of the welfare decrease, with inframarginal movers also suffering welfare drops. At estimated moving costs, the welfare cost of violence is 299 billion pesos, or 2.3% of GDP per year. Moving costs are large enough that the estimated cost environment displays similar welfare drops to the zero mobility case. This finding is consistent with other work studying spatial equilibrium in developing countries, which finds large welfare gaps across locations (Gollin et al., 2017 and Chauvin et al., 2016). Social relationships, networks, and transport infrastructure in less developed countries may make it more costly for individuals to relocate, which may prevent advantageous moves to happen.

Third, when we allow wages at destinations to respond to population changes, welfare losses increase slightly, amounting again 2.3% of GDP per year. Since moving costs are high, and population changes from violence are small, price adjustments have small aggregate effects on both population and welfare.

The last counterfactual shows the welfare effect of violence under no moving costs. Welfare costs are much larger, at 750 billion pesos or 4.5% of GDP per year. This result simply implies that agents would want to move to locations with might mean utility even if it implied greater exposure to homicides, pointing to that violence increased in otherwise relatively desirable locations. This counterfactual, with free mobility and no price adjustments, is unlikely but showcases that homicide increases worsened welfare for inframarginal movers to relatively attractive locations. Overall, our results suggest unskilled workers still may have suffered significant welfare decreases from rising homicide rates, despite displaying little behavioral adjustments.

Finally, tables 14 and 15 show population and welfare effects for the same counterfactuals described above, for the skilled group. The overall pattern is similar to the one observed for the unskilled. Allowing for migration has a quantitatively small effect on welfare, relative to the case with zero mobility, indicating high moving costs are an important driver of the welfare costs of increased homicides. The exercise suggests very few agents are marginal, but that total welfare losses among the skilled may amount to approximately 1.7 trillion pesos, concentrated mainly among inframarginal stayers. This is an economically large amount, owed both to larger willingness to pay and higher wages among the skilled, and representing over 10% of GDP per year. As mentioned above, these results are only indicative: land price adjustments will tend to compensate local labor for worsening amenities. However, they illuminate the magnitudes of changes in welfare implied by the preferences revealed in migration choice. Similarly to the unskilled group, in the presence of small movements of population, general equilibrium effects are very small.

Our welfare estimates are of a similar order of magnitude as in Rozo (2018). She estimates for Colombia that a 49% reduction in the homicide rate corresponds to an increase in the product of 19.6%. Her estimates are greater than those estimated in our paper. In our setting, an increase of approximately 50% in the homicide rate translates into a change in the well-being of approximately 10%. The levels of violence observed in Mexico and Colombia are such that when multiplying our coefficient estimates by the changes in homicides, the aggregate changes in well-being are very high.

7 Conclusions

In this paper we studied internal migration's response to the local homicide rate in Mexican municipalities, first in the reduced form using conflict as an instrumental variable, and later using a model to provide estimates of its welfare costs. The evidence suggests net migration away from high homicide rate commuting zones by skilled individuals in Mexico between 1995 and 2015, implying the homicide rate is a disamenity for this group. This is driven by effects on inflows and not outflows, pointing to important moving costs. Under the assumptions of the structural labor supply model, skilled workers' willingness to pay for a reduction of local homicide rates by 1%. is estimated at .58% in terms of wages. The model's counterfactuals show that large moving costs mute the migration response, but inframarginal agents, both movers and stayers, account for most of the welfare losses among both skill groups. Further, large moving cost estimates suggest these restrictions to mobility are essential to explain the profile and magnitude of the welfare costs of violence. Under the assumption that rent adjustments do not moderate welfare losses, the implied costs imposed by increased homicide rates are suggested to be in the order of 10% of GDP per year, with general equilibrium effects playing a negligible role. Since high moving costs prove to be important in explaining the welfare effect of violence in a developing country context, our results indicate displacement offers only a partial summary of the social cost of the violence caused by organized crime.

References

Abadie, A., & Gardeazabal, J. (2003). The economic costs of conflict: A case study of the Basque country. *American Economic Review*, *93*(1), 113–132. https://doi.org/10.1257/000282803321455188

Abadie, A., & Gardeazabal, J. (2008). Terrorism and the world economy. *European Economic Review*, *52*(1), 1–27.

Ahlfeldt, G. M., Bald, F., Roth, D., & Seidel, T. (2020). *Quality of life in a dynamic spatial model* (CEP Discussion Papers dp1736). Centre for Economic Performance, LSE. https://ideas.repec.org/p/cep/cepdps/dp1736.html

Ajzenman, N., Galiani, S., & Seira, E. (2015). On the distributive costs of drug-related homicides. *The Journal of Law and Economics*, *58*(4), 779–803. https://doi.org/https://doi.org/10.1086/685075

Ashby, N. J., & Ramos, M. A. (2013). Foreign direct investment and industry response to organized crime: The Mexican case. *European Journal of Political Economy*, *30*, 80–91. https://doi.org/10.1016/J.EJPOLECO.2013.01.006

Atuesta, L. H., & Pérez-Dávila, Y. S. (2018). Fragmentation and cooperation: The evolution of organized crime in mexico. *Trends in Organized Crime*, *21*(3), 235–261.

Basu, S., & Pearlman, S. (2017). Violence and migration: evidence from Mexico's drug war. *IZA Journal of Development and Migration*, *7*(1), 18. https://doi.org/10.1186/s40176-017-0102-6

Bel, G., & Holst, M. (2018). Assessing the effects of the Mexican Drug War on economic growth: An empirical analysis. *Southern Economic Journal*.

Bryan, G., & Morten, M. (2019). The aggregate productivity effects of internal migration: Evidence from indonesia. *The Journal of political economy*, *127*(5), 2229–2268.

Camilo Castillo, J., Mejía, D., & Restrepo, P. (2020). Scarcity without leviathan: The violent effects of cocaine supply shortages in the mexican drugwar. *Review of Economics and Statistics*, *102*(2), 269–286. https://doi.org/10.1162/rest_a_00801

Campbell, H. (2016). Violence at the urban margins, edited by javier auyero, phillipe bourgois and nancy scheper-hughes. *Anthropological Forum*, *26*(2), 196–197. https://doi.org/10.1080/00664677.2016.1148562

Chamarbagwala, R., & Morán, H. E. (2011). The human capital consequences of civil war: Evidence from Guatemala. *Journal of Development Economics*, *94*(1), 41–61.

Chauvin, J. P., Glaeser, E., Ma, Y., & Tobio, K. (2016). *What is different about urbanization in rich and poor countries? cities in brazil, china, india and the united states* (Working Paper No. 22002). National Bureau of Economic Research. https://doi.org/10.3386/w22002

Chauvin, J. P., Glaeser, E., Ma, Y., & Tobio, K. (2017). What is different about urbanization in rich and poor countries? Cities in Brazil, China, India and the United States. *Journal of Urban Economics*, *98*, 17–49. https://doi.org/https://doi.org/10.1016/j.jue.2016.05.003

Urbanization in Developing Countries: Past and Present

Chen, A. H., & Siems, T. F. (2004). The effects of terrorism on global capital markets. *European Journal of Political Economy*, *20*(2), 349–366. https://doi.org/10.1016/J.EJPOLECO.2003.12.005

DEA. (2015). National Drug Threat Assessment Summary. https://www.dea.gov/sites/default/files/2018-07/2015%5C%20NDTA%5C%20Report.pdf

Dell, M. (2015). Trafficking Networks and the Mexican Drug War. *American Economic Review*, *105*(6), 1738–1779. https://doi.org/10.1257/aer.20121637

Dell, M., Feigenberg, B., & Teshima, K. (2018). The Violent Consequences of Trade-Induced Worker Displacement in Mexico *. *Working Paper*. https://scholar.harvard.edu/files/dell/files/paper%7B%5C_%7Dpost.pdf

Diamond, R. (2016). The Determinants and Welfare Implications of US Workers' Diverging Location Choices by Skill: 1980–2000. *American Economic Review*, *106*(3), 479–524. https://doi.org/10.1257/aer.20131706

Díaz Pérez, M. C., & Romo Viramontes, R. (2019). *La violencia como causa de desplazamiento interno forzado. Aproximaciones a su análisis en México* (M. Márquez Villeda, Ed.). Consejo Nacional de Población. https://www.gob.mx/cms/uploads/attachment/file/456109/Desplaz%7B%5C_%7D2019%7B%5C_%7Dweb%7B%5C_%7Dcolor-comp.pdf

Eckstein, Z., & Tsiddon, D. (2004). Macroeconomic consequences of terror: theory and the case of Israel. *Journal of Monetary Economics*, *51*(5), 971–1002.

Enamorado, T., López-Calva, L. F., & Rodríguez-Castelán, C. (2014). Crime and growth convergence: Evidence from Mexico. *Economics Letters*, *125*(1), 9–13. https://doi.org/10.1016/J.ECONLET.2014.07.033

Enders, W., Sachsida, A., & Sandler, T. (2006). The impact of transnational terrorism on US foreign direct investment. *Political Research Quarterly*, *59*(4), 517–531.

ENVIPE. (2011). Encuesta Nacional de Victimización y Percepción sobre Seguridad Pública, INEGI. https://www.inegi.org.mx/programas/envipe/2011/

Fowler, C. S., Rhubart, D. C., & Jensen, L. (2016). Reassessing and Revising Commuting Zones for 2010: History, Assessment, and Updates for U.S. 'Labor-Sheds' 1990–2010. *Population Research and Policy Review*, *35*(2), 263–286. https://doi.org/10.1007/s11113-016-9386-0

Gaibulloev, K., & Sandler, T. (2008). Growth consequences of terrorism in Western Europe. *Kyklos*, *61*(3), 411–424.

Gaibulloev, K., & Sandler, T. (2009). The impact of terrorism and conflicts on growth in Asia. *Economics & Politics*, *21*(3), 359–383.

Glaeser, E. L., & Gyourko, J. (2005). Urban decline and durable housing. *Journal of Political Economy*, *113*(2), 345–375. http://www.jstor.org/stable/10.1086/427465

Gollin, D., Kirchberger, M., & Lagakos, D. (2017). *In Search of a Spatial Equilibrium in the Developing World* (Working Paper), National Bureau of Economic Research. https://doi.org/10.3386/w23916

Gutiérrez-Romero, R. (2015). Estimating the impact of Mexican drug cartels and drug-related homicides on crime and perceptions of safety. *Journal of Economic Geography*, *16*(4), 941–973. https://doi.org/10.1093/jeg/lbv023

Hernández, A. (2010). *Los Señores del Narco [The Drug Lords]*. Grijalbo.

IDMC. (2012). Forced Displacement Linked to Transnational Organised Crime in Mexico. http://www.internal-displacement.org/sites/default/files/publications/documents/2012005-am-mexico-Mexico-forced-displacement-en.pdf

Kennan, J., & Walker, J. R. (2011). The effect of expected income on individual migration decisions. *Econometrica*, *79*(1), 211–251. https://doi.org/https://doi.org/10.3982/ECTA4657

Martínez, I. F., & Atuesta, L. H. (2018). Mourning our dead: The impact of mexico's war on drugs on citizens' depressive symptoms. *The International journal on drug policy*, *60*, 65–73.

Mascarúa, M. (2022). *Weak laws, informality, and organized crime: An establishment-level approach* (Working Paper Forthcoming). Banco de México.

Michaelsen, M. M., & Salardi, P. (2018). *Violence, Psychological Stress and Educational Performance during the "War on Drugs" in Mexico* (Working Papers tecipa-595). University of Toronto, Department of Economics. https://ideas.repec.org/p/tor/tecipa/tecipa-595.html

Mishra, P. (2007). Emigration and wages in source countries: Evidence from mexico. *Journal of Development Economics*, *82*(1), 180–199. https://doi.org/https://doi.org/10.1016/j.jdeveco.2005.09.002

Moretti, E. (2011). *Local labor markets* (Vol. 4). https://doi.org/10.1016/S0169-7218(11)02412-9

Munshi, K. (2003). Networks in the modern economy: Mexican migrants in the u. s. labor market. *The Quarterly Journal of Economics*, *118*(2), 549–599. http://www.jstor.org/stable/25053914

Orozco-Aleman, S., & Gonzalez-Lozano, H. (2018). Drug violence and migration flows: Lessons from the Mexican drug war. *Journal of Human Resources*, *53*(3), 717–749. https://doi.org/10.3368/jhr.53.3.0215-6948R4

Orraca-Romano, P. P. (2018). Crime Exposure and Educational Outcomes in Mexico. (Violencia y desempeño académico en México). *Ensayos Revista de Economia*, *0*(2), 177–212. https://ideas.repec.org/a/ere/journl/vxxxviiy2018i2p177-212.html

Osuna-Gómez, D. (2021). *The Impact of the Capture of Leaders of Criminal Organizations on the Labor Market: Evidence from Mexico* (Working Paper No. 2021-19). Banco de México.

Pérez Vázquez, B. G., Bachi Morales, D., de Aquino Barbosa Magalhaes, L., & Castillo Portillo, M. (2019). *Episodios de desplazamiento interno forzado masivo en México. Informe 2018* (J. A. Guevara Bermúdez, Ed.). Comisión Mexicana de Defensa y Promoción de los Derechos Humanos. http://www.cmdpdh.org/publicaciones-pdf/cmdpdh-episodios-de-desplazamiento-interno-forzado-en-mexico-informe-2018.pdf

Poot, J., Alimi, O., Cameron, M. P., & Maré, D. C. (2016). *The gravity model of migration: The successful comeback of an ageing superstar in regional science* (IZA Discussion Papers No. 10329). Bonn, Institute for the Study of Labor (IZA). http://hdl.handle.net/10419/149188

Ríos, V. (2018). The role of drug-related violence and extortion in promoting mexican migration. *Handbook of Latin American Politics*, *73*.

Robles, G., Calderón, G., & Magaloni, B. (2013). The economic consequences of drug trafficking violence in Mexico. *Poverty and Governance Series Working Paper, Stanford University*.

Rozo, S. V. (2018). Is Murder Bad for Business? Evidence from Colombia. *The Review of Economics and Statistics*, *100*(5), 769–782. https://doi.org/10.1162/rest_a_00735

Rubio Díaz-Leal, L. (2014). *Desplazamiento Interno Inducido por la Violencia: Una Experiencia Global, una Realidad Mexicana* (P. Rocha, Ed.; Tres picos). Comisión Mexicana de Defensa y Promoción de los Derechos Humanos in collaboration with ITAM. http://www.cmdpdh.org/publicaciones-pdf/libro%7B%5C_%7Ddesplazamiento%7B%5C_%7Duna%7B%5C_%7Drealidad%7B%5C_%7Dmexicana.pdf
With the collaboration of Bachi, Daniela

Sedena. (2018). Eradication of marijuana and poppy crops disaggregated at the municipal level [Available at $(https://datos.gob.mx/busca/dataset/resultados-de-las-operaciones-en-atencion-al-narcotrafico)$].

Sobrino, F. (2020). *Mexican Cartel Wars: Fighting for the U.S. Opioid Market* [Unpublished, Retrieved from https://www.fersobrino.com/publication/thecartelwars/].

Trejo, G., & Ley, S. (2018). Why Did Drug Cartels Go to War in Mexico? Subnational Party Alternation, the Breakdown of Criminal Protection, and the Onset of Large-Scale Violence. *Comparative Political Studies*, *51*(7), 900–937. https://doi.org/10.1177/0010414017720703

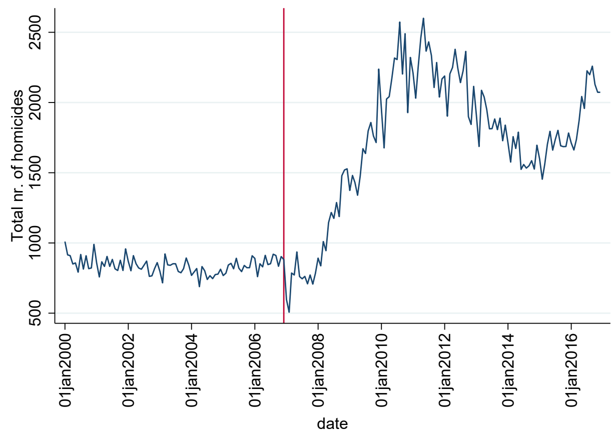
United Nations. (2016). *World humanitarian data and trends 2016*. United Nations. https://www.unocha.org/sites/unocha/files/World%20Humanitarian%20Data%20and%20Trends%202016_0.pdf

United Nations Office on Drugs and Crime. (2019). *Global study on homicide*. Vienna, Austria.

Appendices

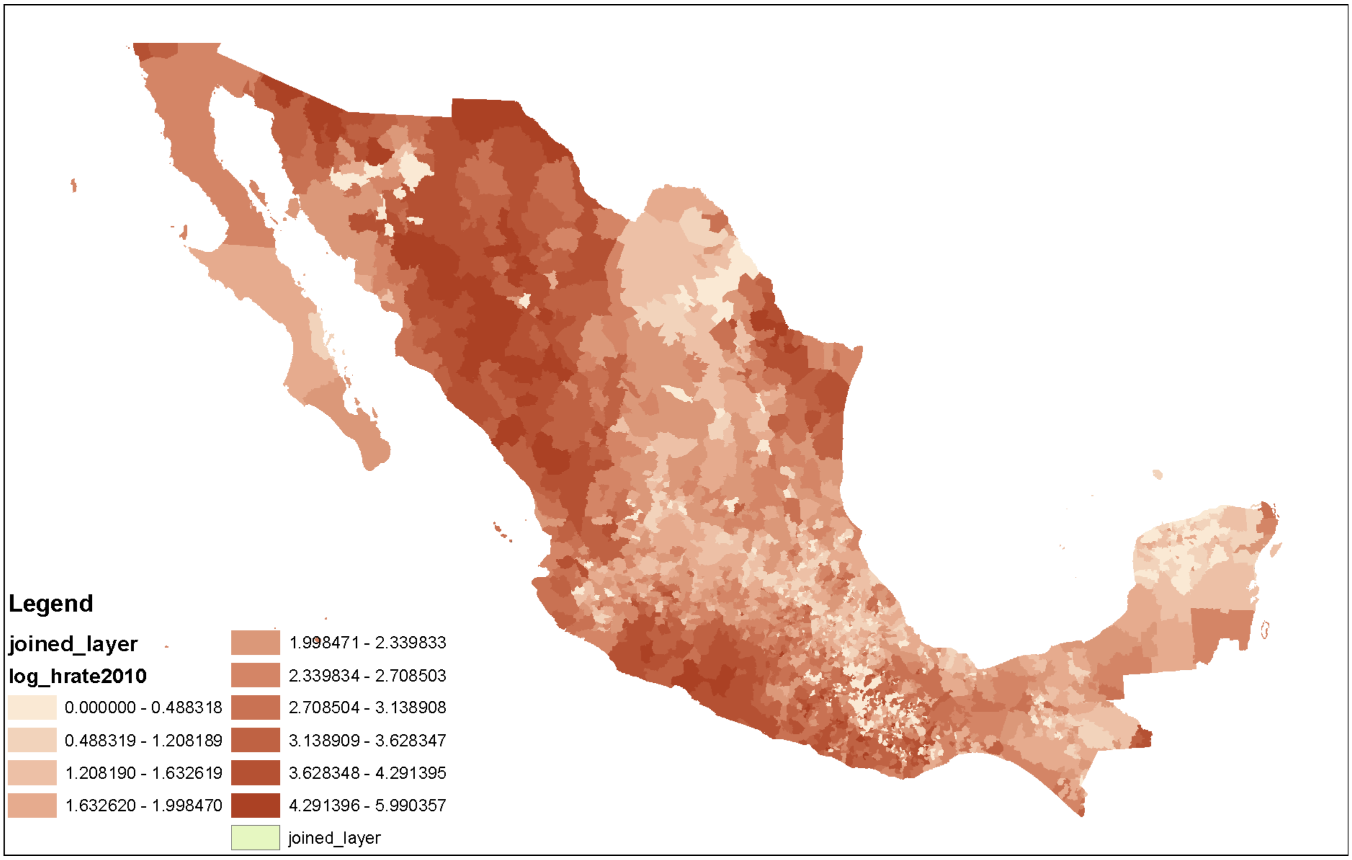
A Figures

Figure 1: Monthly homicides in Mexico, 2000-2015



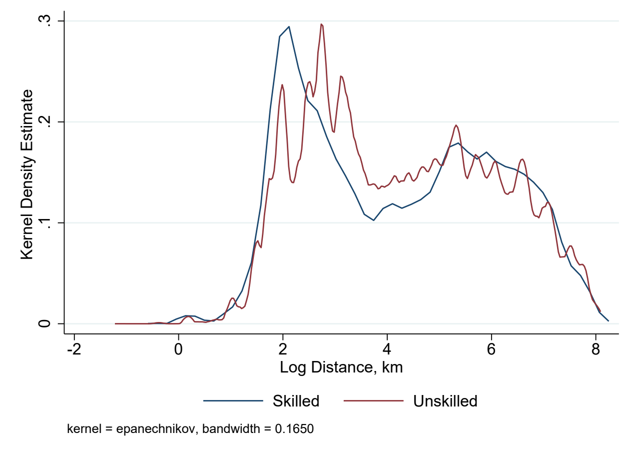
Notes. This figure shows the monthly time series of homicides in Mexico, between 2000 and 2017. Source: Authors' own estimation based on information from INEGI.

Figure 2: Log homicide rates, 2010



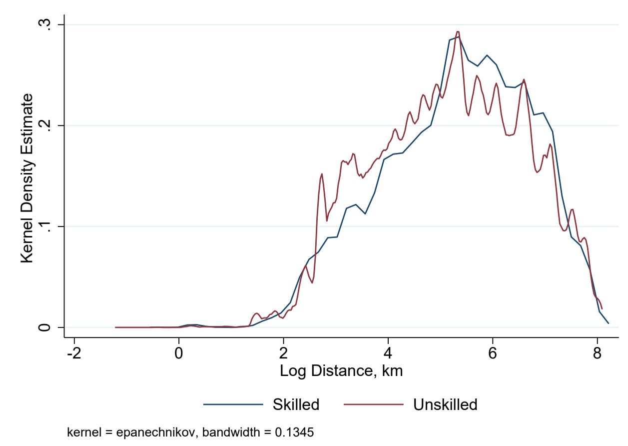
Notes. This figure shows municipality level log homicide rates in 2010.Source: Authors' own estimation based on information from INEGI and CONAPO.

Figure 3: Log Distance Moved, by Skill, 2000-2015



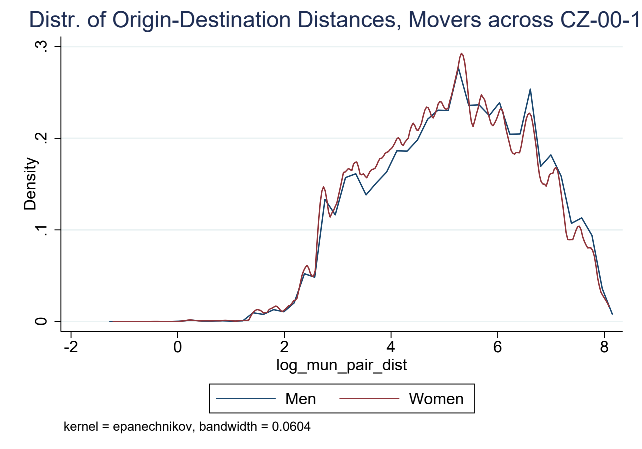
Notes. This figure shows the estimated densities of log kilometers between origins and destinations,for all migration events in the study period, by skill level. Source: Authors' own estimation based on information from INEGI.

Figure 4: Log Distance Moved Across Commuting Zones by Skill, 2000-2015



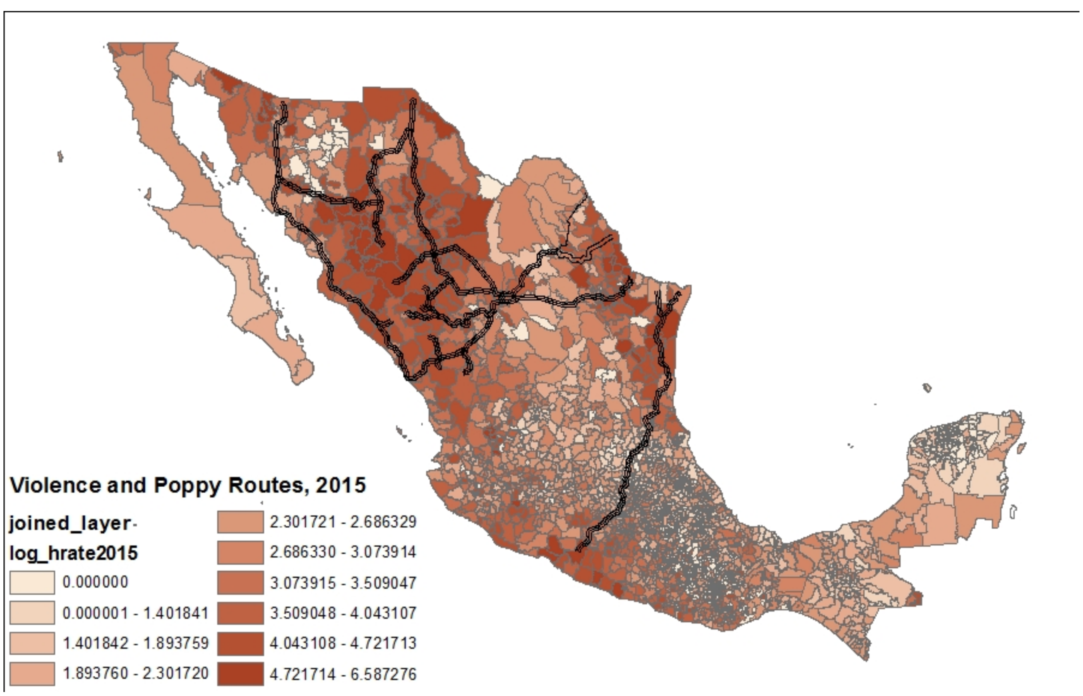
Notes. This figure shows the estimated densities of log kilometers between origins and destinations, for all migration across commuting zones in the study period, by skill level. Source: Authors' own estimation based on information from INEGI.

Figure 5: Kernel Density Plot of Origin-Destination Distances



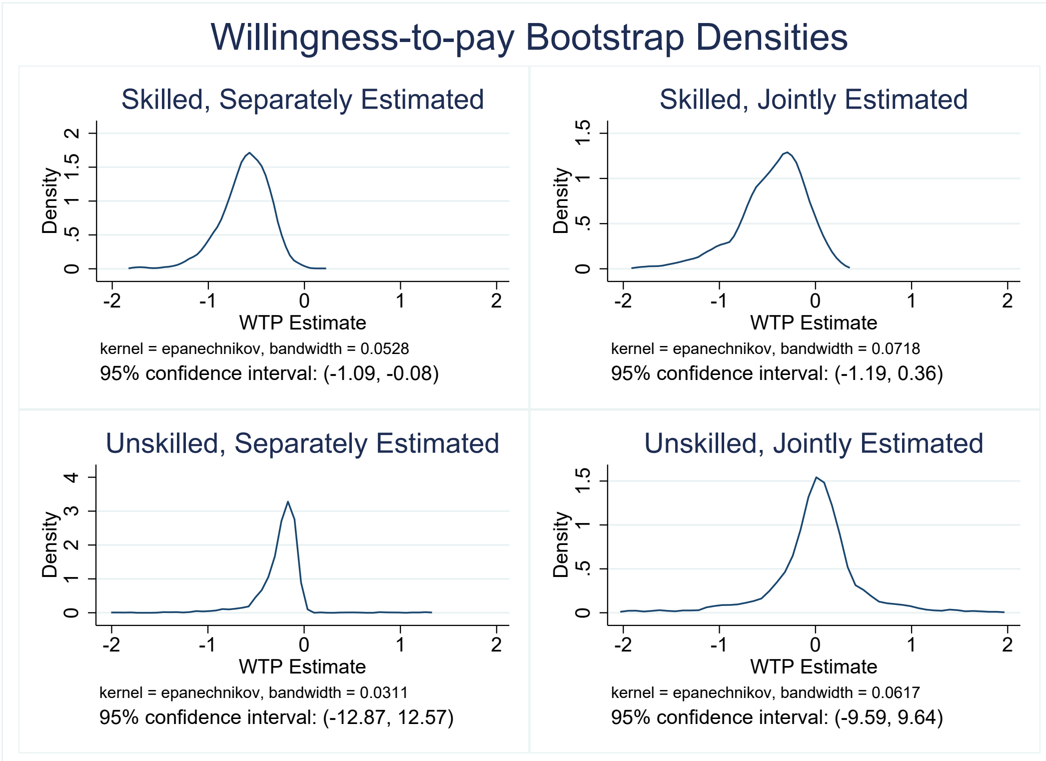
Notes. This figure shows the kernel density plot of the distance between origins and destinations, for the whole study period, by gender. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.

Figure 6: Poppy seed routes in 2015 and the homicide rate



Notes. This figure shows the predicted network of routes operated by alliance 1 and 2, and the logarithm of the homicides rate. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.

Figure 7: WTP Bootstrap Densities



Notes. This figure shows the bootstrap densities of the willingness to pay estimates, by skill level and for the separate and joint computations of the underlying utility coefficients. For the separate computation, utility coefficients were obtained from separate IV regressions of mean utility on endogenous log homicide rates and wages, using the our constructed routes and 1999 sector shares interacted with years as instruments. In the joint case, both coefficients were obtained in the same regression. Ten thousand boostrapped sample with replacement used. Source: Authors' own estimation based on information from INEGI.

B Tables

Table 1: Summary statistics, by migration period

	(1) 1995 to 2000 mean/sd	(2) 2005 to 2010 mean/sd	(3) 2010 to 2015 mean/sd
Homicide rate	11.83	12.68	18.59
	18.64	23.18	33.04
Total homicides	9257.06	10283.38	18515.78
	32891.45	37569.82	72901.61
Observations	2346	2360	2351

Notes. This table shows summary statistics for our measure of violence. Standard deviations for each variable reported below it. Source: Authors' own estimation based on information from INEGI and CONAPO.

Table 2: Inflows and Outflows by Commuting Zones

	Inflows (Unskilled)			
Commuting Zone	**2000**	**2010**	**2015**	**Total**
Within	1,900	1,922	1,681	5,503
Across	4,279	3,423	2,653	10,354
Total	6,179	5,345	4,337	15,861
	Inflows (Skilled)			
Commuting Zone	**2000**	**2010**	**2015**	**Total**
Within	3,563	3,342	3,086	9,990
Across	7,069	6,090	5,010	18,170
Total	10,632	9,432	8,099	28,164
	Outflows (Unskilled)			
Commuting Zone	**2000**	**2010**	**2015**	**Total**
Within	1,890	1,911	1,670	5,471
Across	4,382	3,334	2,490	10,206
Total	6,273	5,245	4,164	15,681
	Outflows (Skilled)			
Commuting Zone	**2000**	**2010**	**2015**	**Total**
Within	3,558	3,328	3,068	9,954
Across	7,148	5,947	4,777	17,872
Total	10,707	9,275	7,848	27,830

Notes. This table shows migration flows for each year and skill level, per 100 thousand individuals, by type (inflows and outflows), and by whether migration is within or across commuting zones, along with corresponding totals. Inflows and outflows do not match exactly due to missing origin municipality data. Source: Authors' own estimation based on information from INEGI.

Table 3: Total Population by year and education

Year	Population (thousands)					
	Unskilled		**Skilled**		**Total**	
	No.	%	No.	%	No.	%
2000	43,957	79	11,996	21	55,953	100
2010	50,565	71	20,661	29	71,226	100
2015	52,103	67	26,091	33	78,194	100

Notes. This table shows total population figures by year and education level in the country, in thousands. Only individuals 15 years and older who reported education level are considered. Source: Authors' own estimation based on information from INEGI.

Table 4: First Stage

	Log Violence
Indicator on [1,5) poppy seed routes	0.036
	(0.137)
Indicator on > 5 poppy seed routes	0.022
	(0.079)
Indicator on [1,5) marijuana routes	0.093
	(0.241)
Indicator on > 5 marijuana routes	0.247*
	(0.100)
Indicator on [1,5) cocaine routes	0.121
	(0.189)
Indicator on > 5 cocaine routes	-0.028
	(0.085)
SWF	2.599
SWFp	0.016

Notes. This table shows the first stage coefficients and Sanderson Windmeijer F statistic corrresponding to the IV regressions of log migration on log homicide rate. The specification is the same as that in the corresponding IV second stages shown below. We include municipality and year fixed effects, and control for the following baseline variables interacted with year dummies: share of employment by two digit sector in 1999, age group shares in 1995 , share of population who migrated internationally in 1995. Instruments are our constructed route variables. * Significant at 5%. ** Significant at 1%. *** Significant at 0.1%. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA, 2015.

Table 5: Reduced form coefficients, migration and violence. Unskilled individuals

Log Outflows			
	Total	Across	Within
OLS: Log homicide rate	0.028	0.023	-0.001
	(0.021)	(0.023)	(0.020)
Observations	4632	4632	4632
	Total	Across	Within
IV: Log homicide rate	0.023	-0.141	0.032
	(0.191)	(0.218)	(0.251)
Hansen J p-val	0.515	0.072	0.349
Log Inflows			
	Total	Across	Within
OLS: Log homicide rate	-0.003	-0.004	-0.009
	(0.014)	(0.014)	(0.015)
Observations	4632	4632	4632
	Total	Across	Within
IV: Log homicide rate	0.042	-0.084	0.504
	(0.135)	(0.137)	(0.266)
Hansen J p-val	0.220	0.030	0.341

Notes. This table shows OLS and IV estimates of log homicide rate coefficients on log migration flows, for total, across commuting zone, and within commuting zone migration, for unskilled individuals. We include municipality and year fixed effects, and control for the following baseline variables interacted with year dummies: share of employment by two digit sector in 1999, age group shares in 1995 , share of population who migrated internationally in 1995. Instruments are our constructed route variables. The top panel shows effects on log outflows and the bottom on log inflows. Standard errors clustered at the municipality level are in parentheses. * Significant at 5%. ** Significant at 1%. *** Significant at 0.1%. Hansen's J statistics are reported for the null that the overidentification restrictions hold. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA, 2015.

Table 6: Reduced form coefficients, migration and violence. Skilled individuals

Log Outflows			
	Total	Across	Within
OLS: Log homicide rate	-0.016	-0.008	-0.020
	(0.025)	(0.025)	(0.019)
Observations	4632	4632	4632
	Total	Across	Within
IV: Log homicide rate	-0.465	-0.411	-0.034
	(0.282)	(0.294)	(0.275)
Hansen J p-val	0.179	0.071	0.056

Log Inflows			
	Total	Across	Within
OLS: Log homicide rate	-0.006	-0.004	-0.023
	(0.016)	(0.017)	(0.016)
Observations	4632	4632	4632
	Total	Across	Within
IV: Log homicide rate	-0.632**	-0.723**	0.179
	(0.231)	(0.256)	(0.260)
Hansen J p-val	0.540	0.489	0.034

Notes. This table shows OLS and IV estimates of log homicide rate coefficients on log migration flows, for total, across commuting zone, and within commuting zone migration, for skilled individuals. We include municipality and year fixed effects, and control for the following baseline variables interacted with year dummies: share of employment by two digit sector in 1999, age group shares in 1995 , share of population who migrated internationally in 1995. Instruments are our constructed route variables.The top panel shows effects on log outflows and the bottom on log inflows. Standard errors clustered at the municipality level are in parentheses. * Significant at 5%. ** Significant at 1%. *** Significant at 0.1%. Hansen's J statistics are reported for the null that the overidentification restrictions hold. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA, 2015.

Table 7: Skill ratio

IV: Log homicide rate	-0.052**
	(0.019)
Observations	4632
Mean	0.185

Notes. This table shows the estimated effect of the homicide rate on the municipality level skill ratio, obtained from an IV panel regression with municipality and year fixed effects, and controlling for the following baseline variables interacted with year dummies: share of employment by two digit sector in 1999, age group shares in 1995 , share of population who migrated internationally in 1995. Instruments are our constructed route variables. Standard errors clustered at the municipality level are reported in parentheses.* Significant at 5%. ** Significant at 1%.*** Significant at 0.1 %. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA, 2015.

Table 8: Rent elasticity to homicide rates

	OLS	IV	OLS (controls)	IV (controls)
IV: Log homicide rate	-0.010**	-0.140***	-0.002	-0.092**
	(0.003)	(0.031)	(0.004)	(0.032)
Hansen J p-val		0.022		0.000

Notes. This table shows the estimated effect of the homicide rate on the municipality level rent index, obtained from an IV panel regression with municipality and year fixed effects, and controlling for the following baseline variables interacted with year dummies: share of employment by two digit sector in 1999, age group shares in 1995 , share of population who migrated internationally in 1995. Instruments are our constructed route variables. Standard errors clustered at the municipality level are reported in parentheses.* Significant at 5%. ** Significant at 1%.*** Significant at 0.1 %. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA, 2015.

Table 9: Estimated Utiility Coefficients, Unskilled

	Separate Estimation		Joint Estimation
	δ (Unskilled)	δ (Unskilled)	δ (Unskilled)
Log homicide rate	-0.000018***		0.000000
	(0.000005)		(0.000004)
Log wage		0.000122***	0.000022*
		(0.000026)	(0.000010)
WTP	-0.15		0.02
SWF	18.21	1.61	5.96
SWFp	0.00	0.03	0.00
Observations	7030	6992	6992

Notes. This table shows estimated utility coefficients corresponding to the log homicide rate and wages at the municipality level, obtained from an IV panel regression of mean utilities with municipality and year fixed effects. Instruments are our constructed route variables and 1999 sector shares interacted with year dummies. The center and left columns show coefficients with a single endogenous variable, and the right shows coefficients estimated jointly. Standard errors clustered at the municipality level are in parentheses. We reject that the equation is under-identified and instruments are weak. First stage F stat is 4.5. * Significant at 5%. ** Significant at 1%. *** Significant at 0.1%. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.

Table 10: Estimated Utiility Coefficients, Skilled

	Separate Estimation		Joint Estimation
	δ (Skilled)	δ (Skilled)	δ (Skilled)
Log homicide rate	-0.000135***		-0.000077**
	(0.000033)		(0.000026)
Log wage		0.000231***	0.000186***
		(0.000027)	(0.000026)
WTP	-0.58		-0.41
SWF	18.16	12.35	6.10
SWFp	0.00	0.00	0.00
Observations	7024	6975	6975

Notes. This table shows estimated utility coefficients corresponding to the log homicide rate and wages at the municipality level, obtained from an IV panel regression of mean utilities with municipality and year fixed effects. Instruments are our constructed route variables and 1999 sector shares interacted with year dummies. The center and left columns show coefficients with a single endogenous variable, and the right shows coefficients estimated jointly. Standard errors clustered at the municipality level are in parentheses. We reject that the equation is under-identified and instruments are weak. * Significant at 5%. ** Significant at 1%. *** Significant at 0.1%.

Table 11: Moving Cost Estimates, utils

	Unskilled	Skilled
Stay (origin=destination)	1.54	3.05
Move Within CZ	0.03	0.06
Move Across CZ	-1.65	-1.19

Notes. This table shows maximum likelihood estimates of moving costs, by skill level, in utils. These are assumed to be constant across years and match observed moving within and across commuting zone for the 1995-2000, 2005-2010, and 2010-2015 periods. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA, 2015.

Table 12: Counterfactual Population Effects of the Increase in Homicides between 2000 and 2010, unskilled individuals

Counterfactual	Infr. Stayers	Infr. Movers	Displaced Within CZ	Displaced Across CZ	Other Marg.
$\beta_{move} = \infty$, PE	93224.02	0.00	0.00	0.00	0.00
$\beta_{move} = \hat{\beta}_c$, PE	88217.26	5006.60	0.00	0.00	0.16
$\beta_{move} = 0, PE$	58.08	93165.75	0.00	0.00	0.18
$\beta_{move} = \hat{\beta}_c, GE$	88217.26	5006.60	0.00	0.00	0.16

Notes. This table shows estimated population effects for unskilled individuals, in thousand people, for the counterfactual where 2010 log homicide rates remained at their 2000 levels, under partial equilibrium with no moving, partial equilibrium with estimated moving costs, partial equilibrium with zero moving costs, and general equilibrium with estimated moving costs. Columns correspond to groups of individuals by how their choices change in the counterfactual, relative to the baseline: inframarginal stayers (who stay in their origin location under both the observed and counterfactual utility profile of locations), inframarginal movers (those that move to the same place in both scenarios), displaced within and across commuting zones (who stay under the safe scenario and move under the violent one), and other marginal agents (such as those that now stay or move to a different location in both scenarios). Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.

Table 13: Counterfactual Welfare Effects of the Increase in Homicides between 2000 and 2010, unskilled individuals

Counterfactual	Infr. Stayers	Infr. Movers	Disp Within CZ	Disp Across CZ	Other Marg.	Total
$\beta_{move} = \infty$, PE	-231887.58	0.00	0.00	0.00	0.00	-231887.58
$\beta_{move} = \hat{\beta}_c$, PE	-223529.07	-14404.24	0.00	0.00	-0.74	-237934.04
$\beta_{move} = 0, PE$	-112.77	-595927.54	0.00	0.00	-167.21	-596207.52
$\beta_{move} = \hat{\beta}_c, GE$	-223546.82	-14404.98	0.00	0.00	-0.74	-237952.54

Notes. This table shows estimated welfare effects for unskilled individuals, in million pesos per year, for the counterfactual where 2010 log homicide rates remained at their 2000 levels, under partial equilibrium with no moving, partial equilibrium with estimated moving costs, partial equilibrium with zero moving costs, and general equilibrium with estimated moving costs. Columns correspond to groups of individuals by how their choices change in the counterfactual, relative to the baseline: inframarginal stayers (who stay in their origin location under both the observed and counterfactual utility profile of locations), inframarginal movers (those that move to the same place in both scenarios), displaced within and across commuting zones (who stay under the safe scenario and move under the violent one), and other marginal agents (such as those that now stay or move to a different location in both scenarios). Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.

Table 14: Counterfactual Population Effects of the Increase in Homicides between 2000 and 2010, skilled individuals

Counterfactual	Infr. Stayers	Infr. Movers	Displaced Within CZ	Displaced Across CZ	Other Marg.
$\beta_{move} = \infty$, PE	93173.20	0.00	0.00	0.00	0.00
$\beta_{move} = \hat{\beta}_c$, PE	85378.98	7794.01	0.00	0.22	0.00
$\beta_{move} = 0, PE$	60.69	93112.51	0.00	0.00	0.00
$\beta_{move} = \hat{\beta}_c, GE$	85378.98	7794.01	0.00	0.22	0.00

Notes. This table shows estimated population effects for skilled individuals, in thousand people, for the counterfactual where 2010 log homicide rates remained at their 2000 levels, under partial equilibrium with no moving, partial equilibrium with estimated moving costs, partial equilibrium with zero moving costs, and general equilibrium with estimated moving costs. Columns correspond to groups of individuals by how their choices change in the counterfactual, relative to the baseline: inframarginal stayers (who stay in their origin location under both the observed and counterfactual utility profile of locations), inframarginal movers (those that move to the same place in both scenarios), displaced within and across commuting zones (who stay under the safe scenario and move under the violent one), and other marginal agents (such as those that now stay or move to a different location in both scenarios). Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.

Table 15: Counterfactual Welfare Effects of the Increase in Homicides between 2000 and 2010, skilled individuals

Counterfactual	Infr. Stayers	Infr. Movers	Disp Within CZ	Disp Across CZ	Other Marg.	Total
$\beta_{move} = \infty$, PE	-1781014.33	0.00	0.00	0.00	0.00	-1781014.33
$\beta_{move} = \hat{\beta}_c$, PE	-1716840.01	-119672.73	0.00	-7.50	0.00	-1836520.24
$\beta_{move} = 0, PE$	-757.63	-2979051.86	0.00	0.00	0.00	-2979809.49
$\beta_{move} = \hat{\beta}_c, GE$	-1716889.90	-119675.38	0.00	-7.50	0.00	-1836572.78

Notes. This table shows estimated welfare effects for skilled individuals, in million pesos per year, for the counterfactual where 2010 log homicide rates remained at their 2000 levels, under partial equilibrium with no moving, partial equilibrium with estimated moving costs, partial equilibrium with zero moving costs, and general equilibrium with estimated moving costs. Columns correspond to groups of individuals by how their choices change in the counterfactual, relative to the baseline: inframarginal stayers (who stay in their origin location under both the observed and counterfactual utility profile of locations), inframarginal movers (those that move to the same place in both scenarios), displaced within and across commuting zones (who stay under the safe scenario and move under the violent one), and other marginal agents (such as those that now stay or move to a different location in both scenarios). Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.

C Rent Elasticity

In order to evaluate welfare, in principle we also need to know how elastic the supply of housing is. If housing supply is inelastic, then population inflows due to violence might decrease welfare even in nonviolent locations.

Rent data is not available in the census, so we are forced to estimate the rent elasticity in a cross-section of municipalities. Letting j index municipalities, R_j be monthly rent, N_j be employment at j, $pop_{2005,j}$ be population in 2005, and B_j the population employment supply shock detailed above, we estimate the following equation using IV.

$$\log(R_j) = \alpha + \beta_s^r + \log(N_j) + \beta X_j + \varepsilon_j \tag{18}$$

Define reduced form housing supply as follows, assuming each individual consumes the same amount of housing

$$rent_j = \alpha^h + \beta^h empl_j + \xi_t^h$$

We estimate this equation using 2SLS, instrumenting for levels this time with $B^s_{j'}$ on the cross section of municipalities for which we observe rent in the expenditure survey.

Table 16 shows results from the IV estimation. Rents at destinations also seem to be elastic to population inflows. We conclude that violence may affect both land and labor prices through its effect on population changes.

Table 16: IV estimates of rent elasticity

Log employment 2010	-5.113***	2.371***	1.850***
	(-368.85)	(332.87)	(188.30)
Log mean executions, 2006-2010	-0.147***		
	(-456.57)		
logpob2005	5.637***	-2.349***	-1.800***
	(380.89)	(-312.26)	(-171.42)
Hom. rate 2010 (all)		0.000211***	
		(39.86)	
Log mean non-narco homicide rate 100k, 2006-2010			0.0364***
			(226.58)
Constant	-10.56***	1.936***	1.070***
	(-453.72)	(174.31)	(64.87)

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes. Standard errors are in parentheses. Dependent variable is the logarithm of the monthly rent, controlling for home characteristics. First model uses homicide rate as push variable to construct the instrument. Second model uses the logarithm of homicide rate as push variable to construct the instrument.* Significant at 5%. ** Significant at 1%. *** Significant at 0.1%. Source: Authors' own estimation based on information from INEGI, CONAPO, and DEA.