# Mental Health and Labour Supply: Evidence from Mexico's Ongoing Violent Conflicts

Maren M. Michaelsen*

Ruhr University Bochum, RUB Research School

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**Abstract**

In Mexico, conflicts between drug-trafficking organisations result in a high number of deaths and immense suffering among both victims and non-victims every year. Little scientific research exists which identifies and quantifies the monetary and non-monetary consequences of ongoing violent conflicts on individuals. Using the Mexican Family Life Survey (MxFLS) for 2002 and 2005, in this study the causal effect of mental health (symptoms of depression/anxiety) on labour supply for working-aged men and women is estimated. Measures of the ongoing drug-related violent conflicts both at the macro level using intentional homicide rates by region, and at the micro level indicated by the presence of armed groups in the neighbourhood, serve as instruments for mental health. The results show a significantly increasing impact of the conflicts on anxiety for men and women. Based on IV-Tobit model results, a worse mental health state decreases individual labour supply strongly and significantly for men. The findings demonstrate that Mexico's population not only suffers from the violent conflicts between drug-trafficking organisations by anxiety or even depression but also indirectly from less income through less work which in turn has consequences for Mexico's social development and economic growth.

*Keywords*: Mental health, labour supply, violent conflict, Mexico

*JEL classifications*: J22, I19, O12, D74

*Maren M. Michaelsen, Ruhr University Bochum, Faculty of Economics, 44780 Bochum, Germany. *Email:* maren.michaelsen@rub.de; *Phone:* +49-234-32-23938; *Fax:* +49-234-32-14311. – Acknowledgement: The author would like to thank John P. Haisken-DeNew, Marcus Klemm, Tilman Brück, Matthias Sinning, Ingo Isphording, Catalina Amuedo-Dorantes, participants of the DIW Development and Security research seminar in Berlin in October 2011, participants of the research seminar at Universidad Autónoma Metropolitana in Mexico City in November 2011 and participants at the Households in Conflict Network Workshop in Barcelona in November 2011 for valuable comments and suggestions.

# 1 Introduction

In the last two decades, the drug-related conflicts in Mexico, where drug trafficking organisations (DTOs) fight over trafficking routes into the United States has increased dramatically. A high number of crimes, such as corruption, assaults, kidnappings, torture, rapes and homicides, are being committed not only by cartel members but also by national security forces and police members. The extent to which the lack of national security is detrimental to Mexico's social and economic development and consequences of wars and conflicts on individuals in general have received little attention in scientific research (Blattman and Miguel, 2010). Only a few studies explicitly focus on the effects of violent conflict on labour market outcomes, such as Abadie and Gardeazabal (2003); Calderón and Ibáñez (2009); Menon and van der Meulen Rodgers (2011); Miaari and Sauer (2011) and Bozzoli et al. (2011). For a better understanding of the monetary and non-monetary consequences of violent conflict on civil society, in this study the impact of Mexico's drug-related conflicts on mental health measured by symptoms of depression/anxiety (SDA) – a main determinant of mental health – and to which extent deteriorated mental health affects individual labour supply is investigated. While a reduction in individual labour supply has negative consequences on income, deterioration in mental health can also induce substantial non-monetary costs for example on the dependent children of the anxious/depressed adult.

Within the Mexican population, anxiety/depression is a serious health issue. Belló et al. (2005) estimate that 4.5% of the population aged 18 to 65 is affected by depression and an even higher rate has experienced a period of depression of more than 12 months in life. While higher proportions have been found among women and in rural areas, access to medical treatment is low in rural areas. Often, medical treatment is sought with several months delay (Wagner et al., 1999; Belló et al., 2005). The effect of mental illnesses such as depression, anxiety or psychological distress on labour market participation and labour supply has been investigated in many studies for different countries, mainly using instrumental variable (IV) approaches to control for the reverse causality between mental health and labour supply. Recent innovative approaches are, e.g., Chatterji et al. (2005) who use early onset psychological disorders and religious activities as instruments in a sample of Latin American and Asian immigrants in the U.S., Ojeda et al. (2010) who use measures of social support and Frijters et al. (2010) who use the incidence of the death of a close friend in the Household, Income and Labour Dynamics in Australia survey. All find a large negative effect of bad mental health on participation or labour supply. For developing countries and countries hit by armed conflicts, the literature is almost non-existent with one notable exception: Das et al. (2009) use mental health surveys from five developing and transition countries (Bosnia and Herzegovina, Indonesia, Mexico, India

and Tonga) and study correlations between mental health, socio-economic status and labour market participation.

This study is based on data from the Mexican Family Life Survey (MxFLS, or ENNVIH in Spanish), a large representative household survey, for the years 2002 and 2005 – years in which drug-related violence has been intense but not as severe as it became in 2008, when drug-related homicides have dramatically increased by approximately 600% from one year to another (Shirk, 2010). Overall, drug-related homicide rates have accumulated to 20,000 in the last decade (Shirk, 2010).

The MxFLS includes a battery of questions to determine a person's emotional well-being and a large number of other health, socio-economic and labour market variables. An individual's emotional well-being is measured via a 20-item questionnaire with four different answering possibilities. The latent variable from these 20 items is derived using the partial-credit Rasch model, deduced from item response theory (IRT) (Masters, 1982). Similar to the studies cited above, an IV approach is employed. Exploiting regional variation in violence data to instrument mental health allows identifying the causal effect of violent conflicts on anxiety/depression among the Mexican population and to which extent economic outcomes in terms of labour supply are indirectly affected by violent conflicts. That exposure to armed conflicts and violence has severe impacts on mental health has been documented in a large number of studies by practitioners, health researchers and social scientists (e.g. Kessler, 1997; Kendler et al., 1999; Latkin and Curry, 2003; Giacaman et al., 2007). It is assumed that exposure to violent conflicts as they happened in Mexico during the first half of the 2000s in these particular areas in which the survey has been conducted does not directly affect individual labour supply but only via deterioration of mental health. This implies that no demand shocks exist which are correlated with conflict intensity. Anecdotal evidence by CAMEXA (2010); Osorio (2011); Ríos (2008) supports this assumption. Deterioration of mental health may simply imply sleeping problems but also capture severe anxiety and depression symptoms measured by the SDA questionnaire. Due to potential corner solution problems in the dependent variables, Tobit and IV-Tobit models are estimated.

The empirical findings reveal that exposure to violent conflicts has large and significant effects on anxiety and suggest that Mexico's society suffers severely from the ongoing violent conflicts. Furthermore, men who suffer from SDA worked both fewer weeks in the last year and fewer hours in the previous week. For women, no effects on labour supply are found in the IV and IV-Tobit models. The causal effects found show that the conflicts indirectly affect labour income through reduced work which in turn may have long-term impacts on Mexico's social development and economic growth. The findings have implications for social policies: Apart from addressing drug-related crime more

effectively, the provision of psychological counselling services for those suffering from SDA is a necessary tool to counteract reduced labour supply induced by anxiety or depression symptoms.

The analysis helps to understand the monetary and non-monetary consequences of low to medium level intensity of violent conflicts in general and in Mexico in particular. To the author's best knowledge, no study exists which identifies the causal effect of anxiety on labour supply in violent conflict settings. Furthermore, the analysis contributes to the literature on violence in Mexico which is small so far and only looks at the determinants of violence and violence intensity rather than the consequences.[1]

The outline of the study is as follows. The next section gives some background information on the drug-related conflicts in Mexico and summarises the literature on (1) the relationship between armed conflicts and mental health and (2) studies dealing with the impact of mental health on labour market participation and labour supply. Section 3 describes the data and the methodological approach. Subsequently, the results are being presented in Section 4 and Section 5 concludes.

## 2 Background

Mexico's location has served as the transit for drug trafficking between Central America and the United States for decades. Drug trafficking has increased since the 1980 when Colombia's largest trafficking organisation co-operated with Mexican cartels to transport cocaine into the U.S. (Felbab-Brown, 2009). While Mexico's DTOs focused mainly on the demand for drugs in the U.S. during the 1980s and 1990s, domestic demand has also gained importance in recent years (Pacheco, 2009). As a result, the DTOs do not only fight over trafficking routes but have also started to fight over local domestic end-user markets in Mexico. Through the death or arrest of cartel leaders, fluctuations in size, number and power of DTOs occur. Violent conflicts exist between DTOs, within DTOs where hierarchical levels can be imposed through violence, and between DTOs and security forces. Often, former police and military employees established and/or rule DTOs. For example, the Guadalajara cartel, one that was most influential during the 1980s, was founded by a police officer (Mahadevan, 2011). This provides an indication for the influential role of corruption and bribery in Mexican institutions which also occurs among its political leaders (Shirk, 2010).

The competition between the DTOs over trafficking routes and markets has led to an increased number of fights and stronger violence. Among intentional homicide are

[1] One exception is Dell (2011) who looks at the effect of drug-related violence on formal and informal wages after 2008. However, she states that these results have to be interpreted with caution.

kidnapping, assault, torture and battery common crimes which are being committed by cartel members. In 2002 and 2005, the years of investigation of this study, homicide rates on the state level ranked between 1 and 40 per 100,000 inhabitants.[2] Figures 5 and 6 show the incidence of drug-related homicides for the years 2002 and 2005 based on data from ICESI. The rates suggest that drug-related violence is not only a problem at the border to the U.S. but also in other parts of the country, where trafficking routes exist.

From a civilian's point of view, the fights between DTOs are likely to harm everyday life by arousing anxiety and fear or even depression symptoms also in non-victims, not only because of reports in the newspapers but also because of increased presence of police and security forces on the streets.

The effect that conflict settings, civil wars and other stressful life events have on mental disorders and illnesses has well been documented by psychologists, health researchers and social scientists. There is no doubt that mental health is impaired by such events.[3] For instance, Cornaglia and Leigh (2011) investigate the impact of crime on mental health of non-victims, arguing that the cost of crime on non-victims' mental well-being may be even higher than the cost induced for direct victims. Variation in local crime rates is used to estimate the impact of crime on mental well-being of the population in the certain localities. They find that violent crime and newspaper coverage of criminal incidents have the highest impact on emotional well-being.

De Jong et al. (2003) use epidemiological surveys to look at post-war mental disorders. They find that post-traumatic stress disorders and anxiety disorders are the most common health issues in their samples and state that post-conflict health programmes should focus on a variety of mental health problems. Kendler et al. (1999) use a twin survey and estimate the causal effect of stressful life events on depressive syndrome. They find that events such as assault, divorce and job loss have serious effects on depression. Furthermore, Murthy and Lakshminarayana (2006) give an overview of the effects of war on the mental health states of civil society in Southeast Asian countries and the Middle East. They summarise that women and children are affected most severely and that social and psychological support is associated with better mental health.

Based on data from the German Socioeconomic Panel, Brück and Müller (2009) show that both crime and terror lead to worries among both victims and non-victims. Based on a survey of Palestinian adolescents Giacaman et al. (2007) investigate mental health states after collective and individual exposure, trauma and violence through the military. They find that collective exposure to conflict has a strong and similar effect as individual

[2]Instituto Ciudadano de Estudios sobre la Inseguridad (ICESI), 2011, "Estadísticas oficiales", retrieved: May 3rd, 2011, from http://www.icesi.org.mx/estadisticas/estadisticas_oficiales.asp.

[3]See Kessler (1997) for an overview on the literature.

personal exposure on mental health.

The latter two studies show that not only direct victims of violence are affected by mental distress, but also that indirect or common exposure may affect individual mental health. This justifies the use of drug-related homicides and the presence of armed groups in the neighbourhood as measures of exposure to violent conflicts in Mexico, rather than, for example, focusing on individuals who have directly been involved in a violent act or have lost a family member due to conflict. The latter cannot be used as instruments as they may be directly affect individual labour supply through physical damage and lack in household income, respectively.

Instrumental variable approaches are commonly used in this context due to the reverse causal relationship between mental health and labour supply, i.e. mental illness leads to lower labour supply, while working few hours or weeks affects mental health simultaneously. One example is a study in which the incidence of death of a close friend is used as an instrument for mental health to estimate the causal effect of mental health on labour market participation (Frijters et al., 2010). Using the Household, Income and Labour Dynamics in Australia survey, the authors find a large negative effect of worsening mental health on participation, especially for women and older individuals. Other instruments that have been used are early onset psychological disorders and religious activities (Chatterji et al., 2005), measures of social support (Ojeda et al., 2010), and information on mental health history and mental health of the respondent's partner (Ettner et al., 1997). The studies commonly find negative effects of mental illness on labour market outcomes, with differences by socio-economic groups. So far, no study on this matter exists which focuses on countries which are currently affected by violence.

An important fact that has been highlighted in some studies is that diagnostic data is only seldom available (Ettner et al., 1997; Chatterji et al., 2005). In many surveys, mental health is self-assessed which may lead to a substantial attenuation bias in the estimated effect of mental health on labour market outcomes. The here used MxFLS also allows the use of diagnostic data, exhibiting a strong advantage to other household surveys.

The findings of this study reveal the impact of the violent conflicts in 2002 and 2005. It appears likely that the consequences of violent conflicts have become even more severe with the escalation in 2008, just little more than one year after the start of Felipe Calderón's presidency. In 2006, he declared 'war' against the drug cartels, and military troops entered the streets of civil society (Shirk, 2010). The 'drug war' accelerated in 2008, counting more than 6000 drug-related homicides in that year committed by cartel

members, policemen, the military and other security personnel.[4]

# 3 Data and Methodology

## 3.1 Data

The data used is the Mexican Family Life Survey, a large household panel collected in 2002, 2005 and 2008. The first two waves, which are available at present, are exploited in this study. The MxFLS collects data on about 8,400 households with a re-contact rate of 90% (Rubalcava and Teruel, 2006). It is representative on the national level and covers rural and urban households. A variety of topics is covered by the questionnaires, ranging from education, employment and crime to health status, and many more. After deleting observations with missing or implausible information, almost 25,000 person-year-observations remain for male and female individuals aged 20 to 65. Excluded from the sample are individuals who retired, students, and those unable to work due to disabilities and prolonged sickness.

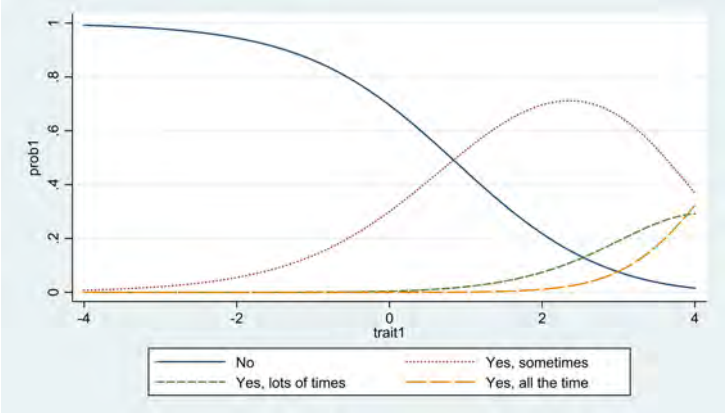
The individuals' mental health status can be interpreted from the responses to a mental health questionnaire which was adapted by researchers of the Mexican Institute of Psychiatry (Calderon, 1997) on the basis of the depression scale of the Center for Epidemiologic Studies (CES) (see Radloff, 1977).[5] Its purpose is the quantitative diagnosis of depression/anxiety symptoms using a battery of 20 questions, such as "In the last four weeks, have you had a hard time sleeping at night?" to "In the last 4 weeks, have you wished you would die?". Each question could be answered with four response categories indicating the intensity. Each answer is given points from 1 (no) to 4 (yes, always). The scale consists of the sum of the responses with equal weights, consequently ranging from 20 to 80 (Calderon, 1997). According to Calderon (1997), individuals can be classified into four categories: normal persons (89.6%), persons with a certain level of anxiety (8.5%), persons with an average depression (1.7%) and persons with severe depression (0.2%). The numbers do not necessarily coincide with estimates by e.g. Belló et al. (2005) due to different diagnostic methods used. Based on these questions, an increase in the scale does not necessarily imply the diagnosis of anxiety or even depression. Rather, an increase can be due to e.g. light sleeping problems or it can indicate whether someone felt sad or angry during the last four weeks. The fact that somebody is tired, angry or anxious is likely to influence his or her taste for work or ability to work.

[4]Shirk (2010) uses the number of killings reported in Mexican newspapers, which differ among each other and from government statistics. As it is difficult to judge if governmental statistics or newspaper counts are more reliable, this statistic is used here to give some intuition of how intensive the conflict has become.

[5]The scale of the Center for Epidemiologic Studies has widely been used and its properties are highlighted in, e.g., Radloff (1977); Roberts (1980); Weissman et al. (1977).

A person's mental health state is actually not observable and is being tried to capture via the 20 items of the CES questionnaire. Item response theory offers statistical models to measure the latent variable. A partial-credit Rasch model is the appropriate model for measuring SDA based on the 20 items with 4 response categories. The mathematical background and rationale is explained in Masters (1982), it has previously be used in, e.g., Cole (2004); Covic et al. (2007); Ryan and Sinning (2009) and is implemented in Stata as explained in Zheng and Rabe-Hesketh (2007). Figure 1 displays the category probability curves.

Figure 1: Category Probability Curves

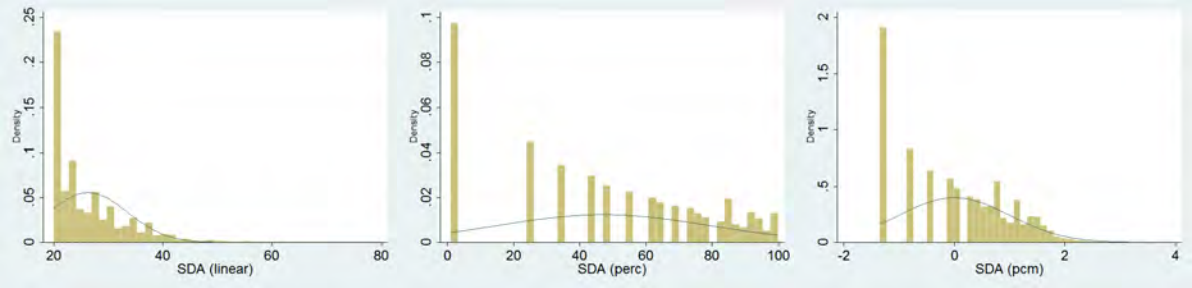



Source: Authors' calculations based on MxFLS using gllamm (Zheng and Rabe-Hesketh, 2007).

For robustness and different interpretation purposes, different versions of the SDA scale are used to estimate the effect of violent conflicts on SDA and the subsequent effect of SDA on individual labour supply. The three versions of the obtained SDA scale are: (1) the linear additive (linear), ranging from 20 to 80 with equal weights, (2) the linear version divided into percentiles (perc) and (3) the derived latent variable from the partial-credit Rasch model (pcm). The percentiles of the scale are used to have a better reference to the sample average. As can be seen in Figure 2, which plots the density and normal distribution, the scale is strongly right-skewed and the percentile version slightly evens this out.

The dependent variables are (a) *working* which is a dummy variable equal to 1 if individual labour supply possesses positive values and zero otherwise, (b) number of weeks worked during the last 12 months (*weeks worked*) and (c) number of hours worked in the previous week to the interview (*hours worked*). The variable *working* is not identical to "labour market participation" as usually analysed in the literature because here, registered unemployed individuals are not considered as being working. However, registered unemployment is very low in Mexico (approx. 3.3%, Table 1). In Table 1 it can be seen that 92% of the male sample and 36% of the female sample have been working during

Figure 2: Distributions of Symptoms of Depression/Anxiety (SDA) Scales




Source: Authors' calculations based on MxFLS.

the 12 months before the interview. The number of weeks worked in the last 12 months are on average 46 weeks for men and women. Men work on average 45 hours per week and women 36 hours per week.

A large number of controls on the individual, household, municipality and state level are included in the regressions. Individual and household level controls are age, living in a rural area (less than 2,500 inhabitants) as compared to an urban area, belonging to an indigenous group, the educational level (primary education, secondary education, or more than secondary education), household size, household wealth proxied by house ownership, and whether or not the family has savings, whether or not the individual has ever changed residence (migrant), and whether or not the respondent has been a victim of a criminal incident in the past, and the region in which the respondent lives and whether or not the neighbourhood can be considered deprived, meaning that abandoned buildings are present. One concern could be that in regions with high conflict rates, informal employment shares are also high and informal employment is associated with lower labour supply. Since the data at hand does not provide evidence for this, it is not necessary to control for it. At the municipality level, indices on health standards, educational levels and income levels are included. These indices are obtained from UNDP[6] for the years 2000 and 2005 and are used to calculate the human development index (HDI). Unfortunately, HDI data on municipality level are not available for 2002, hence the UNDP data for 2000 is matched to the 2002 wave of the MxFLS data[7] and the 2005 data is matched to the 2005 wave. Additionally, state level emigration rates, GDP (at 2005 prices)[8] and registered and unregistered unemployment rates[9] are included.

[6]United Nations Development Programme (UNDP), "Índice de Desarrollo Humano Municipal en México 2000-2005", retrieved July 15th, 2011, from http://www.undp.org.mx/spip.php?article893.

[7]Although the data is from different years, matching the 2000 HDI data with MxFLS data from 2002 seems to be a better approach than not controlling for municipality characteristics at all.

[8]Data retrieved from Sistema Estatal y Municipal de Bases de Datos (SIMBAD) from Instituto Nacional de Estadística, Geografía e Informática (INEGI) at http://sc.inegi.org.mx/sistemas/cobdem/creararbolfiltroservlet.

[9]INEGI "Encuesta Nacional de Ocupación y Empleo (ENOE)", retrieved May 5th, 2011 at

Table 1: Descriptive Statistics

| | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std.Dev. | Min | Max | Mean | Std.Dev. | Min | Max |
| *Dependent variables* | | | | | | | | |
| Working | 0.92 | 0.27 | 0 | 1 | 0.36 | 0.48 | 0 | 1 |
| Weeks worked previous year | 46.86 | 11.84 | 0 | 52 | 45.82 | 13.64 | 0 | 52 |
| Hours worked previous week | 44.79 | 17.29 | 0 | 84 | 36.43 | 19.40 | 0 | 84 |
| *SDA Scales* | | | | | | | | |
| SDA (linear) | 24.14 | 5.78 | 20 | 80 | 27.39 | 7.61 | 20 | 80 |
| SDA (perc) | 36.31 | 30.35 | 1 | 100 | 52.42 | 32.04 | 1 | 100 |
| SDA (pcm) | 0 | 1 | -1.11 | 4.54 | 0 | 1 | -1.52 | 3.68 |
| *Instruments* | | | | | | | | |
| Homicides/100,000 inhabitants | 10.97 | 8.13 | 1.20 | 40.28 | 11.12 | 8.54 | 1.20 | 40.28 |
| Armed groups neighbourhood | 0.09 | 0.29 | 0 | 1 | 0.10 | 0.30 | 0 | 1 |
| *Individual Characteristics* | | | | | | | | |
| Age | 38.76 | 12.21 | 20 | 65 | 38.38 | 12.09 | 20 | 65 |
| Indigenous | 0.12 | 0.33 | 0 | 1 | 0.12 | 0.32 | 0 | 1 |
| High school | 0.08 | 0.28 | 0 | 1 | 0.08 | 0.27 | 0 | 1 |
| College | 0.10 | 0.30 | 0 | 1 | 0.06 | 0.24 | 0 | 1 |
| House owner | 0.81 | 0.40 | 0 | 1 | 0.80 | 0.40 | 0 | 1 |
| Savings | 0.24 | 0.42 | 0 | 1 | 0.23 | 0.42 | 0 | 1 |
| HH size | 9.69 | 4.56 | 1 | 37 | 9.73 | 4.50 | 1 | 37 |
| Children $< 2$ in HH | 0.28 | 0.45 | 0 | 1 | 0.28 | 0.45 | 0 | 1 |
| Migrant | 0.28 | 0.45 | 0 | 1 | 0.32 | 0.47 | 0 | 1 |
| Death of HH member | 0.08 | 0.28 | 0 | 1 | 0.08 | 0.28 | 0 | 1 |
| Victim | 0.13 | 0.34 | 0 | 1 | 0.07 | 0.26 | 0 | 1 |
| Rural | 0.40 | 0.49 | 0 | 1 | 0.40 | 0.49 | 0 | 1 |
| North-West | 0.22 | 0.42 | 0 | 1 | 0.21 | 0.40 | 0 | 1 |
| North-East | 0.20 | 0.40 | 0 | 1 | 0.20 | 0.40 | 0 | 1 |
| South | 0.20 | 0.40 | 0 | 1 | 0.20 | 0.40 | 0 | 1 |
| West | 0.20 | 0.40 | 0 | 1 | 0.20 | 0.40 | 0 | 1 |
| Central | 0.16 | 0.37 | 0 | 1 | 0.17 | 0.37 | 0 | 1 |
| Federal District | 0.02 | 0.14 | 0 | 1 | 0.02 | 0.14 | 0 | 1 |
| *Regional characteristics* | | | | | | | | |
| Deprived neighbourhood | 0.41 | 0.49 | 0 | 1 | 0.41 | 0.49 | 0 | 1 |
| Emigration rate | 0.12 | 0.11 | -0.13 | 0.40 | 0.11 | 0.08 | -0.09 | 0.33 |
| UR, registred | 3.31 | 1.24 | 0.63 | 6.15 | 3.28 | 1.26 | 0.63 | 6.15 |
| UR, unregistered | 14.50 | 5.77 | 6.25 | 27.13 | 14.50 | 5.67 | 6.25 | 27.13 |
| HDI health | 0.85 | 0.06 | 0.59 | 0.99 | 0.85 | 0.06 | 0.59 | 0.97 |
| HDI education | 0.82 | 0.06 | 0.50 | 0.90 | 0.82 | 0.06 | 0.50 | 0.90 |
| HDI income | 0.69 | 0.10 | 0.23 | 0.88 | 0.69 | 0.10 | 0.23 | 0.88 |
| N | 10227 | | | | 14733 | | | |

Note: UR = unemployment rate.

Two variables are used to instrument mental health. These variables measure the intensity of the violent conflicts at macro and micro levels, respectively. The intuition of using the two variables related to violent conflicts is that due to the conflicts in Mexico, civil society may have developed a level of anxiety and/or depression symptoms which is higher in regions where the conflict is more intense. The macro level indicator is the number of intentional homicides per 100,000 inhabitants per state provided by ICESI. Since there is almost no time variation in this indicator and interviews were conducted

http://www.inegi.org.mx/est/contenidos/espanol/sistemas/enoe/infoenoe/default.aspx?s=est&c=14042.

from mid-2002 onwards and late 2005 onwards, it seems reasonable to use homicide rates from the respective survey years rather than from the previous years. The fact that mental health is measured via questions which refer to the last 4 weeks before the interview and there are no seasonal patterns in homicide rates, further justifies the use of measures of the respective survey years. Figure 7 indicates in which municipalities interviews have been conducted.

The argument that regional violent conflicts are associated with the development of the regional economy and hence, job opportunities, as has been shown in cross-country and within-country studies for other countries (e.g Deininger, 2003, for an overview), is not a problem here because variation in the conflict measures is only marginally correlated with emigration rates, unemployment, GDP, or health, education and income indices as shown in Table A1 in the Appendix. Furthermore, it is shown that measures of conflict are valid instruments in the respective identification strategy in Figure A1. The development of unemployment rates, as a proxy of labour demand, and homicides rates between 1998 and 2010 are shown for each state in which interviews have been conducted. It can clearly be seen that (a) unemployment has been almost constant in all states over this period of time and (b) no correlation can be observed between unemployment rates and homicide rates. Furthermore, anecdotal evidence by CAMEXA (2010); Osorio (2011) and Ríos (2008) supports this assumption. Measures at a more disaggregated (municipality) level for the respective years were only available for urban areas.[10] When merging this data with the MxFLS, more than two thirds of the observations would be lost, since only half of the Mexican states are covered by each data set and they only coincide partly. Hence, instead of municipality level statistics, the state level homicide rates are used which, on the one hand, exhibit less variation, but, on the other hand, has the advantage of measuring the indirect exposure to conflict rather than the effect of being a direct victim of drug-related violence.[11]

To ensure that intentional homicide rates are not directly correlated with local labour demand shocks, the economic and social development indicators are included in the regressions. Doing this ensures that the homicide rates are a measure of exposure to the conflict – not the regional labour market – and hence are likely to influence mental health by triggering anxiety or even depression symptoms. Finally, the only drawback of this measure is that it is prone to measurement error. Homicide rates in Mexico are unlikely to be exact, especially in those areas where the conflicts are very intense. It is reasonable

[10] Centro de Investigación y Docencia Económicas (CIDE) "Geocrimen – Análisis Espacial y Series de Tiempo", http://geocrimen.cide.edu/.

[11] Another possible data set is death records which provide information on the date and cause of death of (nearly) all individuals who died in a respective years. However, it is not pssible to differentiate between intentional homicide and negligent homicide – which differ by the involvement of violence and is the crucial indicator in this study.

to assume though that this measurement error is uncorrelated with the other regressors and does not cause any problems in the regressions.

The other instrument is the presence of armed groups in the neighbourhood. This information is taken from the MxFLS household crime and victimisation questionnaire. As this variable is a dummy variable, there is less variation than in the other variable. Those respondents who give a positive answer (about 10% of the sample) have a statistically significantly higher mean score in the depression variable; it is 26.9 compared to 25.9 for those who do not live in a neighbourhood where armed groups are present. While this variable is less likely to be measured incorrectly than homicide rates, it may be correlated with the economic development and labour market opportunities of the neighbourhood. For the instrument to be valid, several indicators which measure the economic conditions in the region are used as explained above. Furthermore, to account for the fact that the death of a household member potentially increases the probability of onset of depression symptoms, a variable is included which is equal to 1 if the respondent has lost a household member due to death in the last 5 years and zero otherwise.

### 3.2 Methodology

*Endogeneity*

The estimation of a causal effect of SDA on labour supply is hampered by the reverse causal relationship between these two variables. On the one hand, a depressed person may work less, i.e. have lower labour supply, because there are hours or days in which the person feels unable to leave the house and work. Even at lower levels of SDA, a person may work less because he or she changes routes to go to work to avoid walking or driving alone through insecure areas, or may not work in the evening hours because he or she is too anxious to walk in the dark. Labour migrants may not want to travel long distances anymore leading to lower labour supply and so on. On the other hand, having no job or not being able to work as much as preferred may lead to SDA (Clark and Oswald, 1994; Theodossiou, 1998). Hence, in a simple ordinary least squares (OLS) regression, a causal effect of mental health on labour supply cannot be identified and the OLS estimator is inconsistent. Instead, a partial correlation between the two variables is identified by the coefficient of the mental health variable.

The main, structural equation of interest, the effect of SDA (mental health $m$) on labour supply ($y$), can be written as:

$$y_{it} = \alpha_1 + \beta m_{it} + \gamma_1 X_{it} + \epsilon_1, \tag{1}$$

where $i$ is an index for the individual and $t$ is a time index, $X$ is a vector of controls and $\epsilon$

is the usual error term. To estimate the causal effect of SDA on labour supply, two-stage IV models are employed. The reduced-form model can be written as:

$$m_{it} = \alpha_2 + \gamma_2 X_{it} + \delta c_{it} + \epsilon_2. \tag{2}$$

Given that the variable $c$ is a valid instrument, i.e. $E(\epsilon_1|c) = 0$ and $m$ and $c$ are partially correlated, the IV estimator is consistent and can be interpreted as a causal effect. For reasons explained above, the instruments are – conditionally on the exogenous regressors – assumed to be uncorrelated with the error term of the main equation and can be expected to be valid. The identified causal effect in the case of a binary instrument is a local average treatment effect (LATE), or average treatment effect for a subpopulation of compliers, i.e. those individuals whose mental health outcome deteriorates due to a change in the instrument *armed groups in the neighbourhood* (Angrist and Imbens, 1995). In the case of the continuous instrumental variable (*intentional homicide rates*), the identified effect is the causal marginal treatment effect (MTE), also only for the subpopulation of compliers (Heckman and Vytlacil, 2007). Given that the endogenous regressor SDA is continuous, the effects are weighted by the compliers, where the weights are determined by how the compliers are distributed over the range of the endogenous variable $m$. Hence, the estimated effects have to be interpreted within the scope of the particular subpopulation of compliers and cannot be interpreted as the average effect of the whole sample population. It has to be kept in mind that in the binary instrument *armed groups in the neighbourhood*, only 10% of the population are affected. To increase the number of compliers, the models are estimated including both instruments jointly. When using two instruments, the estimated effect is the weighted average of the causal effects for the two instrument specific compliant subpopulations (Imbens, 2010).

Instrumental Variable Probit models are estimated to identify the effect of SDA on the probability to be working using Maximum Likelihood. In the results tables, marginal effects are displayed. Since the data are an unbalanced panel, observations for each individual are not independent and thus standard errors are clustered on the individual level. In the linear models, standard errors are two-way clustered on both the individual and household level.[12] Standard errors are then also robust to arbitrary within-panel autocorrelation.

It will be tested for overidentification based on Hansen's J statistic in the models where two instruments are used. Hansen's J statistic is reported rather than the Sargan-Hansen test because of clustered standard errors (e.g. Baum et al., 2007). Furthermore, tests for weak instruments are conducted. First, the Stock and Yogo (2005) test statistic is

[12]To estimate the models in Stata the command *ivreg2* by Baum et al. (2002) is used. The multi-way clustered standard error procedure for non-nested samples is explained in Cameron et al. (2011).

reported. Following this test, the instrument is weak if the minimum Eigenvalue statistic of the first stage (or Angrist-Pischke first-stage F (Angrist and Pischke, 2009) in the case of two instruments which is reduced to the Kleinbergen-Paap rk Walf-F in the case of one instrument) exceeds the critical values. It will be indicated in the result tables whether the Eigenvalue statistics is less than the Stock-Yogo 25% critical value test or not.

*Corner solution*

As described in the data section, 92% (men) and 36% (women) of the sample have positive values for weeks and hours worked and the remaining individuals do not earn income through work. While these individuals possess positive values of weeks/hours worked, the remaining sample has zero values for these variables. Not controlling for this corner solution may lead to potential bias in the estimated coefficients. This is likely to be the case in the coefficient on mental health because a depressed person may have lost his or her job due to SDA. Then, labour supply is not just lower than that of mentally healthy individuals but zero, while the independent variables are fully observed. For some individuals the optimal outcome of the dependent variable may be the corner solution $y = 0$. To account for the corner solution in the dependent variable, a Type-I-Tobit model is applied. Furthermore, to account for endogeneity, an IV-Tobit model is estimated. Since interest is in the causal effect of mental health on labour supply for those individuals who have positive hours of work (the latent variable), marginal effects for the positive values, i.e. $E(y|x, y > 0)$, are presented in the regression tables.

All models are estimated for men and women separately for *weeks worked* and *hours worked*. The OLS and IV models are estimated for $y_{it} > 0$, i.e. for individuals with positive weeks worked and hours worked only. Additionally, Probit models and IV-Probit models for selection into work are estimated.

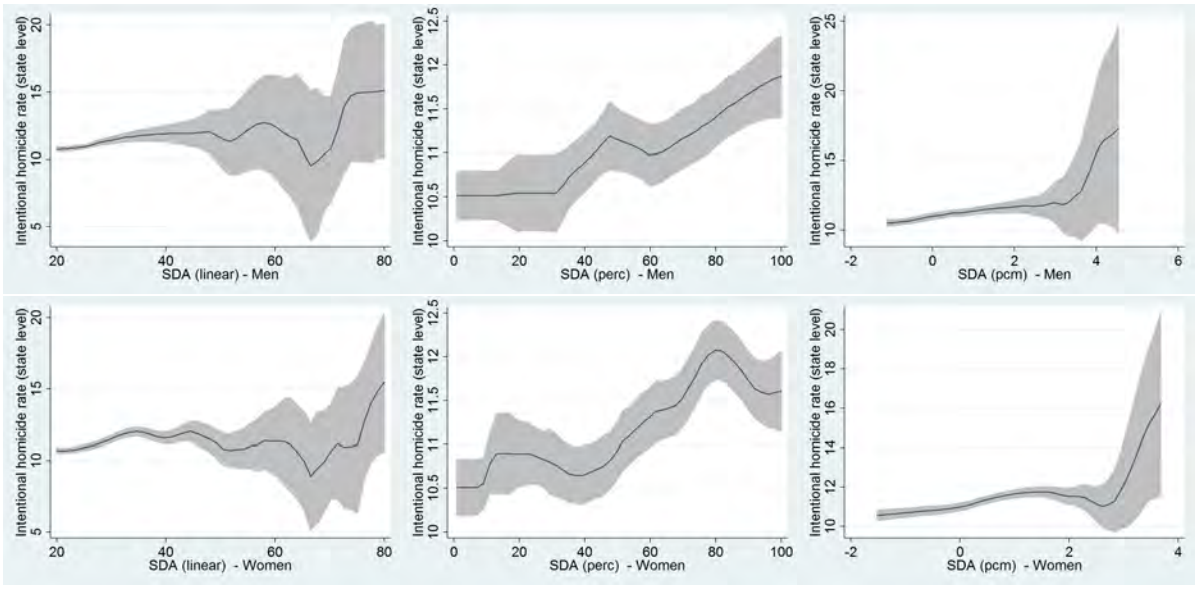
# 4 Results

## 4.1 Violent Conflicts and Mental Health

Figure 3 shows polynominal smooth plots and the confidence intervals of intentional homicide rates on the three versions of the mental health measure for men and women, respectively. For the linear and the partial-credit Rasch-model version, a positive relationship is only vaguely detected. The reason for this may be the low number of observations with more than 45 on the linear SDA scale as suggested by the large confidence intervals. Using the percentile version of the measure, a clearly positive relationship can be seen, which is stronger for men than for women.

Similar plots are shown using the micro measure of violent conflicts in Figure 4: The

Figure 3: Polynominal Smooth Plots of Violent Conflicts (State Level) on SDA




Source: Authors' calculations based on MxFLS and ICESI data.

presence of armed groups in the neighbourhood. Again, the presence of armed groups is associated with higher values on the SDA scale, especially in the percentile version. For the other versions a positive correlation can only be observed for the lower half of the scales and there are very few observations with higher values which may again impede the detection of a clear positive correlation.

Table 2 shows the regression results of the effect of intentional homicide rates on the three versions of the mental health measure for men, controlling for state, municipal, household and individual characteristics. Using the linear additive version of the measure, the coefficient is 0.03 and statistically significant at the 1% level. This means that an increase by 1 intentional homicide per 100,000 inhabitants leads on average to a higher value on the SDA scale by 0.03. Based on the other versions of the SDA scale an increase by 1 homicide per 100,000 inhabitants leads to an increase of 0.14 percentage points in the mean and an increase of 0.004 standard deviations in the mean. In other words, 30 additional homicides per 100,000 inhabitants in one state leads to an increase by 1 point on the SDA scale which is equivalent to being a bit anxious instead of not being anxious, or having strong sleeping problems when previously having only some sleeping problems. The numbers in Table 2 further show that being indigenous is associated with higher values on the SDA scale, while having obtained a high school or college degree leads to lower levels of SDA. As expected, having lost a household member within the last 5 years leads to significantly higher levels of SDA. Household size and financial wealth, as indicated by owning a house or having savings, is not associated with SDA on average.

Table 2: Effect of Conflict Measured by Homicide Rates on SDA – Men

| | SDA scales | | |
|---|---|---|---|
| | linear | perc | pcm |
| Homicides/100,000 inhabitants | 0.030*** | 0.127** | 0.005*** |
| | (0.009) | (0.054) | (0.002) |
| Age | -0.079** | -0.549*** | -0.012** |
| | (0.033) | (0.193) | (0.006) |
| Age sqrd | 0.002*** | 0.011*** | 0.000*** |
| | (0.000) | (0.002) | (0.000) |
| Indigenous | 0.420** | 2.450** | 0.079** |
| | (0.210) | (1.227) | (0.037) |
| High school | -0.605*** | -3.224** | -0.106*** |
| | (0.194) | (1.268) | (0.036) |
| College | -0.842*** | -5.823*** | -0.175*** |
| | (0.186) | (1.194) | (0.034) |
| House owner | -0.021 | -0.200 | -0.004 |
| | (0.156) | (0.961) | (0.028) |
| Savings | -0.290** | -0.967 | -0.032 |
| | (0.147) | (0.880) | (0.026) |
| HH size | -0.001 | -0.066 | -0.001 |
| | (0.015) | (0.095) | (0.003) |
| Children $< 2$ in HH | -0.235* | -1.574* | -0.050** |
| | (0.138) | (0.857) | (0.025) |
| Migrant | 0.023 | -0.024 | 0.006 |
| | (0.138) | (0.804) | (0.024) |
| Victim | 1.075*** | 8.830*** | 0.186*** |
| | (0.184) | (1.023) | (0.031) |
| Death of HH member | 0.552*** | 4.259*** | 0.091** |
| | (0.211) | (1.297) | (0.037) |
| Rural | -0.313** | -2.310** | -0.082*** |
| | (0.158) | (0.952) | (0.028) |
| Regional dummies | Yes | Yes | Yes |
| Regional characteristics | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes |
| N | 10227 | 10227 | 10227 |
| $R^2$ | 0.047 | 0.066 | 0.055 |
| F | 16 | 26 | 20 |

Note: OLS regressions. Standard errors are two-way clustered on individuals and households. Standard errors in parentheses. *,** and *** denote significance levels of 10%, 5% and 1%, respectively.

For women (Table 3), the effects of homicides rates are very similar to those of men. An increase by 1 intentional homicide per 100,000 inhabitants leads to a statistically significant increase on the SDA scale by 0.04. This effect is larger but not significantly different from the effect for men. Some other regressors are considerably different though. While indigenous women compared to non-indigenous women do not have different average values on the SDA scale, next to a high school or college degree, owning a house and having savings strongly reduces the average value on the SDA scale.

Another, maybe more intuitive interpretation is possible using the indicator for the presence of armed groups in the neighbourhood. The coefficients of the conflict measures on mental health from the different regressions are summarised in Table 4. In this table both conflict measures are included jointly in the regressions and test statistics on their joint significance are presented. The coefficients from joint inclusion and separate estimation do only vary minimally in size and do not require separate discussions. All other

Table 3: Effect of Conflict Measured by Homicide Rates on SDA – Women

| | SDA scales | | |
|---|---|---|---|
| | linear | perc | pcm |
| Homicides/100,000 inhabitants | 0.037*** | 0.142*** | 0.005*** |
| | (0.010) | (0.041) | (0.001) |
| Age | 0.002 | -0.022 | 0.004 |
| | (0.037) | (0.149) | (0.005) |
| Age sqrd | 0.001** | 0.004** | 0.000* |
| | (0.000) | (0.002) | (0.000) |
| Indigenous | 0.368 | 1.556 | 0.041 |
| | (0.236) | (0.960) | (0.031) |
| High school | -1.420*** | -5.574*** | -0.177*** |
| | (0.217) | (0.966) | (0.031) |
| College | -2.382*** | -10.286*** | -0.338*** |
| | (0.229) | (1.078) | (0.034) |
| House owner | -0.553*** | -2.441*** | -0.087*** |
| | (0.183) | (0.743) | (0.024) |
| Savings | -0.397** | -1.680** | -0.047** |
| | (0.171) | (0.702) | (0.023) |
| HH size | 0.011 | -0.004 | -0.001 |
| | (0.017) | (0.072) | (0.002) |
| Children $< 2$ in HH | -0.293* | -1.126 | -0.035 |
| | (0.164) | (0.692) | (0.022) |
| Migrant | 0.355** | 1.960*** | 0.062*** |
| | (0.146) | (0.591) | (0.019) |
| Death of HH member | 0.881*** | 3.625*** | 0.114*** |
| | (0.256) | (0.962) | (0.031) |
| Victim | 1.930*** | 8.455*** | 0.181*** |
| | (0.260) | (0.996) | (0.033) |
| Deprived neighbourhood | 0.753*** | 3.665*** | 0.112*** |
| | (0.145) | (0.598) | (0.019) |
| Rural | -0.514*** | -1.821** | -0.079*** |
| | (0.182) | (0.736) | (0.024) |
| Regional dummies | Yes | Yes | Yes |
| Regional characteristics | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes |
| N | 14733 | 14733 | 14733 |
| $R^2$ | 0.067 | 0.079 | 0.062 |
| F | 36 | 46 | 33 |

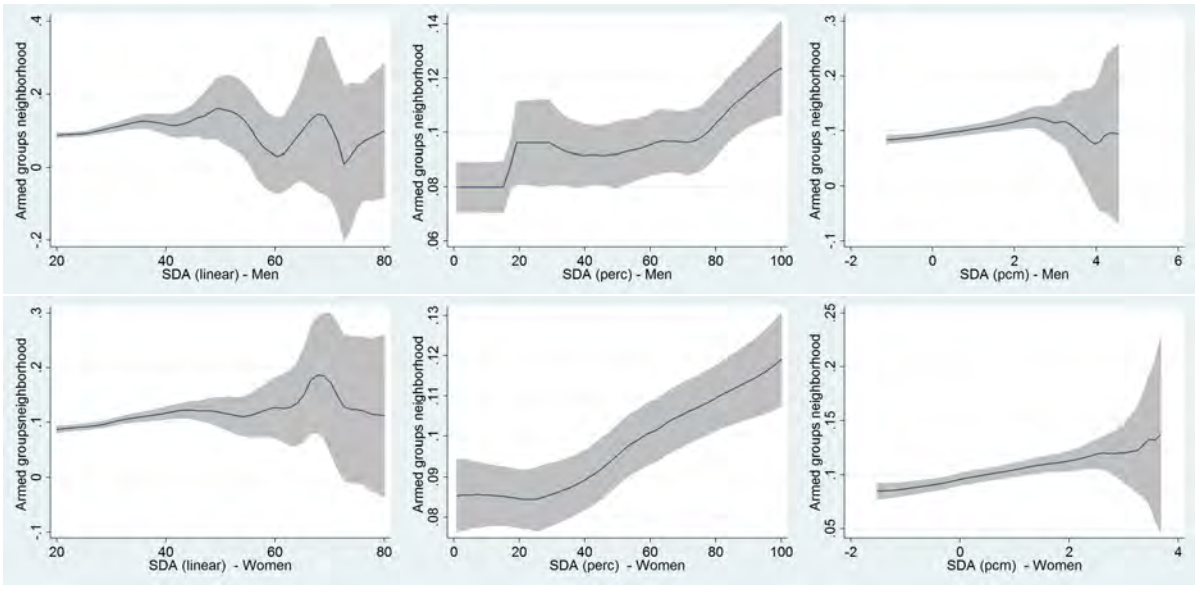
Note: OLS regressions. Standard errors are two-way clustered on individuals and households. Standard errors in parentheses. *,** and *** denote significance levels of 10%, 5% and 1%, respectively.

controls constant, for men, the presence of armed groups is associated with a 0.66 higher score on the linear SDA scale or 3.7 more percentage points on the percentile SDA scale, compared to living in a neighbourhood where no armed groups are present. For women, the effect is very similar and also statistically significant at the 1% level.[13] The conflict measures are jointly significant for both men and women and for all versions of the SDA scale.

These results suggest that both men and women in adult age suffered from the conflict in 2002 and 2005. Taking into account that severely insecure regions are not part of the MxFLS, the overall effects are probably even larger than the effects found here for individuals living in areas with low to medium levels of conflict. However, just the news about another casualty or even the detection of a mass grave is likely to spread

[13]For reasons of brevity, not all regression tables with their regression statistics are presented here. They can be obtained from the author on request.

Figure 4: Polynominal Smooth Plots of Violent Conflicts (Neighbourhood) on SDA




Source: Authors' calculations based on MxFLS.

anxiety among the Mexican population even when they are not directly affected. As noted before, homicide statistics are probably underestimated, hence the here estimated effects are lower bounds. While these results only demonstrate psychological costs of conflict, looking at the subsequent negative effects of SDA on labour supply will provide insights into the economic effects.

Table 4: Effect of Conflict on SDA

| | SDA scales | | | |
|---|---|---|---|---|
| | linear | perc | pcm | N |
| *MEN* | | | | |
| Homicides/100,000 inhabitants | 0.030*** | 0.127** | 0.005*** | 10227 |
| | (0.009) | (0.054) | (0.002) | |
| Armed groups neighborhood | 0.647*** | 3.861*** | 0.117*** | 10227 |
| | (0.224) | (1.313) | (0.039) | |
| *Test of joint significance* | | | | |
| $\chi^2$ (2) | 19.49 | 18.13 | 18.35 | |
| $p$ | 0.000 | 0.000 | 0.000 | |
| *WOMEN* | | | | |
| Homicides/100,000 inhabitants | 0.037*** | 0.142*** | 0.005*** | 14733 |
| | (0.010) | (0.041) | (0.001) | |
| Armed groups neighborhood | 0.837*** | 3.126*** | 0.094*** | 14733 |
| | (0.261) | (1.010) | (0.032) | |
| *Test of joint significance* | | | | |
| $\chi^2$ (2) | 30.54 | 27.76 | 30.58 | |
| $p$ | 0.000 | 0.000 | 0.000 | |

Note: Standard errors are two-way clustered on individuals and households. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. Joint significance test of the two conflict variables which are used as instruments.

## 4.2 Mental Health and Labour Supply

*Participation*

In Table 5, the effect of SDA on labour market status – working vs. not working – for men is presented. All the coefficients are marginal effects and are obtained from different regressions. Column 1 shows the estimates from simple Probit models. A negative correlation between the SDA score and the probability to be working is found and is statistically significant. This effect is very small. It indicates that an increase on the linear SDA scale by 1 point is associated with a reduction of the probability to work by 0.2 percentage points, or an increase in the SDA scale by 1 standard deviation is associated with a lower probability to be working of 1.3 percentage points. In columns IV (1) and IV (2) mental health is instrumented with intentional homicide rates and the indicator for armed groups in the neighbourhood, respectively, and with both variables in the last column.

The coefficients are only significant when using homicides as instruments and when using two instruments. An overidentification test based on the Amemiya-Lee-Newey minimum 2-statistic (obtained from the two-step rather than the MLE method)[14] indicates that the instruments are valid. For men, the causal effects are much larger than the conditional correlation estimated in the Probit model. Based on the findings with two

[14]Unfortunately, there is currently no test implemented in Stata for the MLE model. In the next section it will also be shown that the instruments are strong for men, while they are not for women, at least not in the linear case. A weak instrument test for non-linear models could not be found.

instruments, an increase in the linear SDA scale by 1 point lowers the probability to be working by 3.9 percentage points, an increase by 1 percentage point of the SDA scale leads to a 0.7 percentage points lower probability to be working, and an increase by 1 standard deviation of the SDA scale leads to a lower probability to work of 23 percentage points.

For women, neither a correlation nor a causal effect of mental health on participation is found (see Table A4). The latter fact is not surprising as women often do not actively participate in the labour market for other reasons than health issues, such as the number and age of their children. Since the effect for men is large and men are usually the main contributors to household income in Mexico, the findings are also economically relevant and indicate the severe effect that the conflict indirectly has on labour market participation.

Table 5: Effect of SDA on Participation – Men

| | Probit | IV Probit | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.002*** | -0.046*** | -0.028 | -0.039***$^A$ |
| | (0.000) | (0.013) | (0.019) | (0.012) |
| SDA (perc) | -0.000*** | -0.009*** | -0.005 | -0.007***$^A$ |
| | (0.000) | (0.002) | (0.003) | (0.002) |
| SDA (pcm) | -0.013*** | -0.274*** | -0.160 | -0.231***$^A$ |
| | (0.002) | (0.078) | (0.110) | (0.071) |
| N | 10279 | | | |

Note: SDA: Symptoms of depression/anxiety. Each coefficient is obtained from a different regression. The numbers are marginal effects. Standard errors are clustered on the individual level. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood. When two instruments are included, a test for overidentification is pursued. The test statistic is the Amemiya-Lee-Newey minimum $\chi^2$-statistic (obtained from the two-step rather than the MLE method) and $^A$ indicates that $p > 0.1$, i.e. instruments are valid.

*Labour Supply*

As shown in the previous section, mental illness restrains some men from working and hence from actively contributing to household income. The indicator to measure mental health does not only measure whether a person is severely depressed but also whether a person is anxious or 'just' unhappy. An increase in the level of SDA may not lead to the complete drop out of the labour market, but can lead to periods in which the affected person is not able to work. These periods could have the length of several weeks or only a day, or just one or two hours in the morning, when the person feels, e.g., unable to get out of bed. When a person feels too anxious to walk home from work when it is dark, this could also reduce the number of hours worked per day. Furthermore, seasonal labour migrants may decide that it is too dangerous to travel to a remote workplace, reducing the number of job opportunities, and hence the number of weeks worked. Several other circumstances can be imagined.

The regression results for men are shown in Table 6 for the dependent variable *weeks worked*. Again, all coefficients are obtained from separate regressions. The results of the first row of Table 6 can also be found in the Appendix in Table A5, which additionally displays the coefficients of the control variables and more regression statistics. The OLS coefficients provide evidence for a negative correlation between SDA and the number of weeks worked. Specifically, a 1 point increase on the scale is associated with 0.114 fewer weeks per year worked, or an increase in SDA by 1 standard deviation is associated with 0.639 fewer weeks worked.

Columns 2 to 4 display the results from the IV models which allow a causal interpretation of the SDA coefficient on weeks worked. Using homicide rates (IV 1) to instrument mental health, the coefficient is much larger than in the OLS regression. An increase in the SDA scale by 1 point, leads in the mean to 2.4 fewer weeks worked. As explained in the methodology section, this effect is the marginal treatment effect for the compliers, i.e. it is the average effect for individuals who respond to conflict with higher SDA. Hence, the effect cannot be interpreted as the impact of deterioration in mental health on the average labour supply in the (sample) population but only for a subpopulation of compliers. Seeing that there exists a subpopulation for which the conflict indirectly reduces labour supply via deterioration in mental health is an important finding, even though it is not externally valid for the entire population.

Using the other instrument, the coefficient measures the LATE: An increase by 1 point on the SDA scale leads to 1.4 fewer weeks worked for the compliers, or a 1 standard deviation increase in SDA leads to about 8 fewer weeks worked in the last year. Although in both models with just one instrument, the instrument is strong and the coefficient is statistically significant, it is worth to estimate the effect of SDA on labour supply using both instruments jointly. This increases the number of compliers and leads to better estimates, given the overidentifying restrictions are valid which is indicated by $^{A}$ in Table 6. The model with two instruments provides the best model statistics, i.e. the overidentifying restrictions are valid and the instruments are strong and, as shown above, jointly statistically significant in the first stage. Based on this model, an increase by 1 point on the linear SDA scale leads to 1.9 fewer weeks worked, a 1 percentage point increase leads to 0.33 fewer weeks worked and an increase by 1 standard deviation leads to 11 fewer weeks worked.

The coefficients from the Tobit and IV-Tobit models have the same sign and are all statistically significant on the 1% level. They are more than 50% larger in size than the linear IV estimates. The causal effect of an increase of 1 point on the SDA scale leads to a decrease in the number of weeks worked by 3.2 and an increase by 1 standard deviation leads to 19 fewer weeks worked per year. These coefficients measure the effect of deteri-

oration in mental health induced by the presence of armed groups in the neighbourhood or an increase in homicide rates for those persons who react to either or both of these instruments with higher SDA.

For women, the conditional correlation obtained from OLS regression is negative but a causal effect cannot be identified. The coefficients are insignificant in the IV and Tobit models and have surprisingly a positive sign in the IV-Tobit models (see Table A6 in the Appendix). However, the model statistics show that the instruments are weak in all models and the overidentifying restrictions are not valid. Hence, no conclusion can be made about the impact of mental illness on women's labour supply using the instruments chosen. The instruments may not be valid for women because (1) the number of observations is too small and/or (2) women's mental health is more reactive to both external and internal influences than men's (Rosenfield, 1989; Piccinelli and Wilkinson, 2000; Sandanger et al., 2004) and the measures of conflict do not lead to more variation in the measurement of SDA in women.

Table 6: Effect of SDA on Weeks Worked – Men

| *Linear Regression* | OLS | IV | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.108*** | -2.500** | -1.501* | -1.973***$^{A}$ |
| | (0.022) | (1.126) | (0.834) | (0.678) |
| *A-P First stage* $\chi^2$ | – | 9.376$^{+}$ | 9.074$^{+}$ | 8.700$^{+}$ |
| SDA (perc) | -0.029*** | -0.578* | -0.247* | -0.349***$^{A}$ |
| | (0.004) | (0.315) | (0.132) | (0.127) |
| *A-P First stage* $\chi^2$ | – | 6.698$^{+}$ | 9.600$^{+}$ | 7.769$^{+}$ |
| SDA (pcm) | -0.820*** | -16.240** | -9.579* | -12.676***$^{A}$ |
| | (0.136) | (7.364) | (5.282) | (4.341) |
| *A-P First stage* $\chi^2$ | – | 8.534$^{+}$ | 8.922$^{+}$ | 8.232$^{+}$ |
| N | 9489 | | | |
| *Tobit Regression* | Tobit | IV Tobit | | |
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.234*** | -3.797*** | -2.567*** | -3.240*** |
| | (0.035) | (0.788) | (0.902) | (0.587) |
| SDA (perc) | -0.040*** | -0.798*** | -0.426*** | -0.586*** |
| | (0.005) | (0.166) | (0.150) | (0.110) |
| SDA (pcm) | -1.331*** | -22.791*** | -14.928*** | -19.106*** |
| | (0.203) | (4.729) | (5.245) | (3.475) |
| N | 10279 | | | |

Note: Each coefficient is obtained from a different regression. In Tobit and IV-Tobit results marginal effects are presented. Standard errors are clustered on individuals in the OLS and Tobit models and bootstrapped with 400 replications in the IV and IV-Tobit models. Standard errors in parentheses. $^{*}$,$^{**}$ and $^{***}$ denote significance level of 10%, 5% and 1%, respectively. The coefficients from the Tobit and IV-Tobit models are marginal effects for E(y|x, y>0). IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood. When two instruments are included, the Hansen's J test for overidentification is pursued. $^{A}$ indicates that the critical value $p > 0.1$, i.e. instruments are valid. $^{+}$ denotes strong instruments (not tested in Tobit models): $\chi^2 >$ Stock/Yogo's (2005) critical value (25% maximal IV size).

For men, qualitatively similar effects are found when using *weeks worked* as the de-

pendent variable. Each instrument is strong and when both instruments are used, the overidentifying restrictions are valid. While the instrument *intentional homicide rates* leads to a high and statistically significant coefficient of -3.2 with the linear SDA scale, including the other instrument leads to a smaller, still negative but statistically insignificant coefficient. Again, the results from the model with two instruments provide the best model statistics and are used for interpretation. The IV regression results reveal that an increase in SDA by 1 standard deviation leads to an average of 11.7 fewer hours worked in the previous week for compliers. The results from IV-Tobit models are – as with *weeks worked* – about 50% larger than with linear IV regressions. When controlling for the fact that some individuals do not supply labour due to symptoms of depression/anxiety or other reasons, for those individuals who supplied at least one hour of labour in the previous week, an increase in SDA leads to 3.3 fewer hours worked. When using the pcm-version of the SDA scale, the magnitude of the effect becomes apparent: An increase in SDA by 1 standard deviation reduces hours worked for compliers by 19.5 hours in the previous week on average. This is approximately two thirds of the average number of hours worked in Mexico in 2002 and 2005.[15] For women, causal effects cannot be identified using *hours worked* for reasons similar to those associated with *weeks worked*.

The effects found for men are large and imply a considerable impact of SDA on labour supply and thus labour income. Since men are usually the household head and the main household income contributors, an increase in the level of anxiety consequently has negative impacts on household expenditure. Given that poverty is still very high in Mexico, reduced household income induced by mental illness can have considerable consequences for poor families.

Most worrying is the strong impact of the violent conflicts on anxiety. The data only represent the years 2002 and 2005 – years in which organised crime and death rates have been considerably high. However, with the start of Felipe Calderon's presidency in 2006, the military entered the streets to "fight the war on drugs". Since the beginning of 2008, homicides have increased dramatically. Furthermore, violence has reached other dimensions – children were involved recently in an event to spread terror by parties involved in the "drug war" (The New York Times, 2011). The increasing number and severity of the events is likely to increase the onset of symptoms of depression/anxiety even more – with consequences for labour supply – among others. In turn, lower labour income leads to lower household expenditure which has consequences on Mexico's whole economy – together with possibly decreased private investments in industry production. Apart from calling for an end of the conflict, corruption and crime, from a policy perspective,

[15] According to OECD statistics (http://stats.oecd.org/Index.aspx?DataSetCode=ANHRS), average annual hours worked per person were 1,888 in 2002 and 1,909 in 2005, which is about 36-37 hours per week.

Table 7: Effect of SDA on Hours Worked – Men

| *Linear Regression* | OLS | IV | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.089*** | -3.170** | -0.752 | -2.002**$^{A}$ |
| | (0.031) | (1.425) | (1.013) | (0.848) |
| *A-P First stage* $\chi^2$ | – | 8.694$^{+}$ | 8.165$^{+}$ | 7.891$^{+}$ |
| SDA (perc) | -0.018*** | -0.608** | -0.131 | -0.350**$^{A}$ |
| | (0.005) | (0.297) | (0.176) | (0.158) |
| *A-P First stage* $\chi^2$ | – | 6.723$^{+}$ | 7.657$^{+}$ | 6.795$^{+}$ |
| SDA (pcm) | -0.504*** | -19.118** | -4.387 | -11.750**$^{A}$ |
| | (0.178) | (8.831) | (5.920) | (5.072) |
| *A-P First stage* $\chi^2$ | – | 7.943$^{+}$ | 7.991$^{+}$ | 7.457$^{+}$ |
| N | 9333 | | | |
| *Tobit Regression* | Tobit | IV Tobit | | |
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.244*** | -4.709*** | -1.628 | -3.313*** |
| | (0.038) | (0.921) | (1.010) | (0.692) |
| SDA (perc) | -0.032*** | -0.989*** | -0.270 | -0.578*** |
| | (0.006) | (0.193) | (0.169) | (0.129) |
| SDA (pcm) | -1.401*** | -28.266*** | -9.468 | -19.446*** |
| | (0.220) | (5.529) | (5.876) | (4.094) |
| N | 10279 | | | |

Note: Each coefficient is obtained from a different regression. In Tobit and IV-Tobit results marginal effects are presented. Standard errors are clustered on individuals in the OLS and Tobit models and bootstrapped with 400 replications in the IV and IV-Tobit models. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood. When two instruments are included, the Hansen's J test for overidentification is pursued. $^{A}$ indicates that the critical value $p > 0.1$, i.e. instruments are valid. $^{+}$ denotes strong instruments (not tested in Tobit models): $\chi^2 >$ Stock/Yogo's (2005) critical value (25% maximal IV size).

the onset and increase of anxiety and depression symptoms needs to be counteracted, e.g. by an increase in psychological counselling services.

## 5 Robustness Checks

Several robustness checks have been conducted. First, in the model where the presence of armed groups in the neighbourhood serves as an instrument, state dummies are included in the model to account for state fixed effects which could potentially affect labour supply through labour demand patterns which may be related to violent conflicts. The results do not significantly change by including state dummies.

All models are estimated using homicide statistics on the municipality level (from INEGI) which cover mainly urban areas and only overlap partly with the MxFLS. While this imposes more variation in the conflicts measure, a loss of more than half of the observations hinder the detection of statistically significant results. In fact, in some cases the effect of SDA on labour supply is rendered insignificant. However, the overall picture still suggests a strong impact of deterioration in mental health on labour supply induced

by violent conflicts.

Moreover, as individual unobserved characteristics may influence the decision or ability to work, Fixed Effects-IV models are estimated which control for unobserved heterogeneity correlated with both SDA and labour supply. Since only two waves are available for the study, and little time-variation exists in the variables of interest and in the controls, no effects can be identified. This result should not be interpreted as weakness of the findings above. Rather, it shows that in this context, a Fixed Effects model is inappropriate. Instead, clustering of standard errors on the individual level is the suitable alternative. Standard errors are clustered on both individual and household levels in the IV-Models, but not in the IV-Tobit models where standard errors are bootstrapped.

Finally, all models are also estimated using two other transformations of the SDA scale. Due to the highly right-skewed distribution of the SDA variable, the logarithm of the initial scale also seems reasonable to use. However, the log-version is distributed between 3 and 4.4 and it seems unrealistic that an individual's mental health deteriorates by 1 log-point due to a change in the conflict variables. Indeed, in the regressions, the effects are very large and unreasonable. However, all effects identified with the log version are of the same sign and statistical significance, supporting the robustness of the results obtained with the other forms of the SDA scale. As the questionnaire consists of 20 questions of partly similar nature, e.g. several questions relate to sleeping problems, it might be reasonable to use several factors from a combination of these questions instead of one factor obtained from the whole sum of questions. Using factor analysis, principal-component factors are obtained via orthogonal transformation of a set of observations of correlated variables into a set of values of uncorrelated variables (Jolliffe, 2002). Only one factor has a high Eigenvalue of approx. 7 for men and women, respectively, implying that no clusters in questions exist. This principal-component factor (pcf) is standardised such that it has a mean of 0 and standard deviation of 1 and ranges from -0.69 to 9.83 for men and -0.94 to 7.01 for women, equal to the simple standardisation of the original variable. The results are almost identical to those obtained from the partial-credit Rasch model version of the SDA scale. These results can be obtained from the author on request.

## 6 Conclusion

Active participation in the labour market and labour supply are usually the main determinants of household income. Whether an individual can participate and how much an individual can work is affected by his or her mental health status. In this study the effect of symptoms of depression/anxiety (SDA) – a main determinant of mental health – on participation and labour supply in Mexico is estimated using the Mexican Family Life Survey (MxFLS / ENNVIH) for the years 2002 and 2005.

The estimation of a causal effect of mental health on labour supply is hampered by reverse causality: Better mental health does not only increase the probability to be able to work per se or work a preferred number of weeks per year or hours per week; higher levels of mental health are also affected by actively participating in the labour market, since a job is usually associated with social interaction, structured time schedules and labour income. To overcome the problem of two-way endogeneity, mental health is instrumented by two new instruments which refer to the ongoing violent conflicts in Mexico. Drug-trafficking organisations are fighting over trafficking routes into the U.S. and increasingly over domestic markets. With the local and federal police, and recently also the military, being involved in the "fight against drugs", various crimes are being committed in Mexico which directly and indirectly affect civil population.

Two indicators to measure exposure to violent conflicts are used: (1) intentional homicide rates which are measured on the state level (macro indicator, continuous variable) and (2) the presence of armed groups in the neighbourhood (micro indicator, binary variable). Since severely dangerous municipalities are not in the MxFLS, the interviewed individuals are unlikely to have lost a household member or experienced injury due to the conflicts directly (which would directly affect labour supply). Rather, cases of homicides are read and heard about in the news, and the presence of armed groups in the neighbourhood spreads anxiety and may even lead to depression symptoms. To control for the fact that these measures could directly affect labour supply, various regional economic indicators are included in the regressions, additionally to personal and household characteristics.

The findings are based on IV-Probit and IV-Tobit models which are estimated for the dependent variables labour market participation and labour supply, respectively. The findings provide strong evidence for a negative effect of violent conflicts in Mexico on mental health for both men and women. For men, an increase in SDA by 1 standard deviation is associated with a significantly lower probability of 23 percentage points to be active in the labour market. Furthermore, an increase on the SDA scale by 1 standard deviation leads to 19 fewer weeks worked in the previous year and 19 fewer hours worked in the last week. The effects are large and statistically significant. The causal effects identified are valid for a subpopulation of compliers, i.e. those men who respond to changes in the conflict measures with higher SDA. Hence, the identified average treatment effects are not the average effects for the whole (sample) population, but they demonstrate that for a part of the population, the conflict directly affects mental health and consequently has detrimental impacts on labour market participation and labour supply. For women, a causal effect of SDA on labour supply cannot be identified, which may be due to weak instruments and the fact that women's mental health responds to other influences than

conflict intensity more strongly than men's.

With many families in Mexico still being poor, a reduction in labour supply may have considerable consequences for household income. Since men are usually the main contributors to household income, a decrease in labour supply reduces household expenditure which subsequently affects Mexico's economic growth. An increase in SDA and a reduction in labour supply also affect social development in the long run since children of mentally ill parents are likely to suffer not only from reduced income but also from hampered personal interaction. Hence, deterioration in mental health does not only incur monetary costs in terms of reduced labour income through a reduction in individual labour supply but also non-monetary costs on dependent children and other family members in the environment of the mentally ill person. From a policy perspective, apart from addressing drug-related crime more effectively, the provision of psychological counselling services for those suffering from anxiety or even depression seems to be an essential tool to counteract reduced labour supply due to mental illness. Furthermore, financial support should be provided for those families whose income is sufficiently low due to the problems associated with mental health.

Finally, it has to be kept in mind that the situation in some parts of Mexico has escalated since 2008, imposing higher levels of national insecurity, which may have even worse effects on mental health and labour supply than shown in this study. Furthermore, the identification strategy used in this paper may not be reasonable at other times when the conflict is more severe since then labour demand could directly be linked to the conflict measures.

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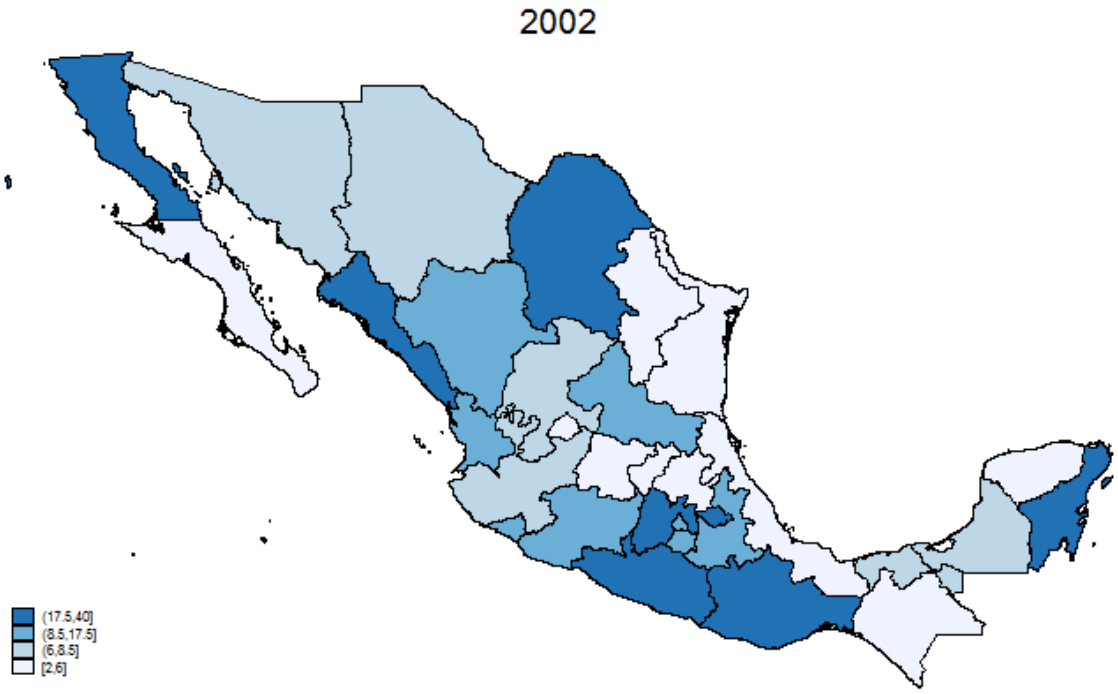
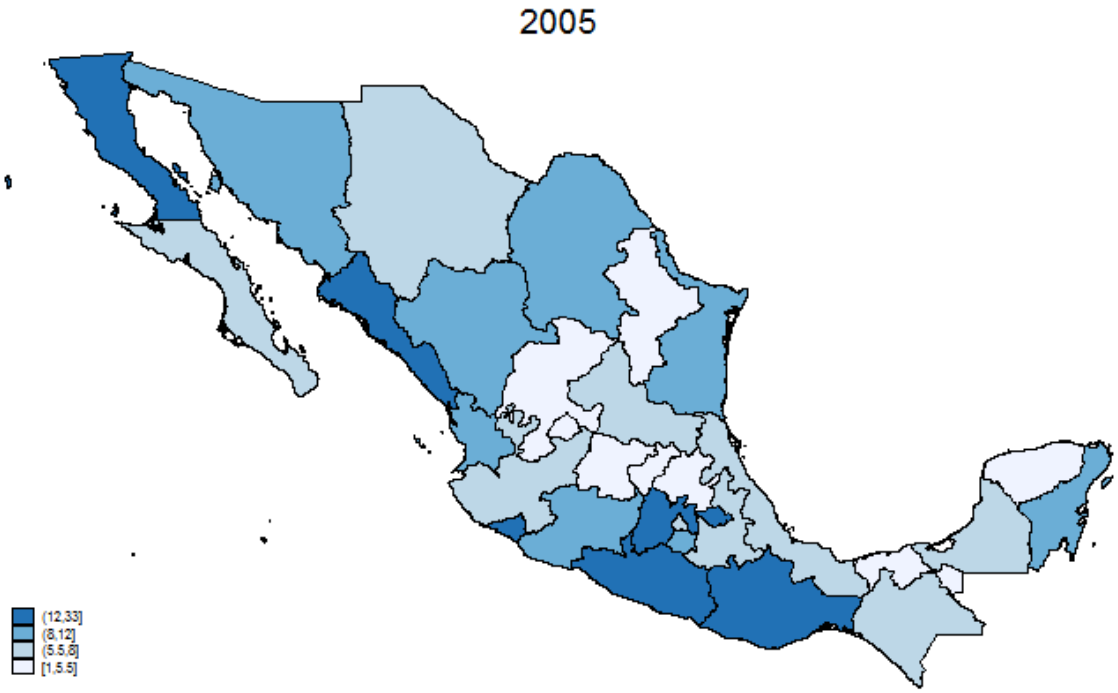
Figure 5: Intentional Homicide Rates 2002*



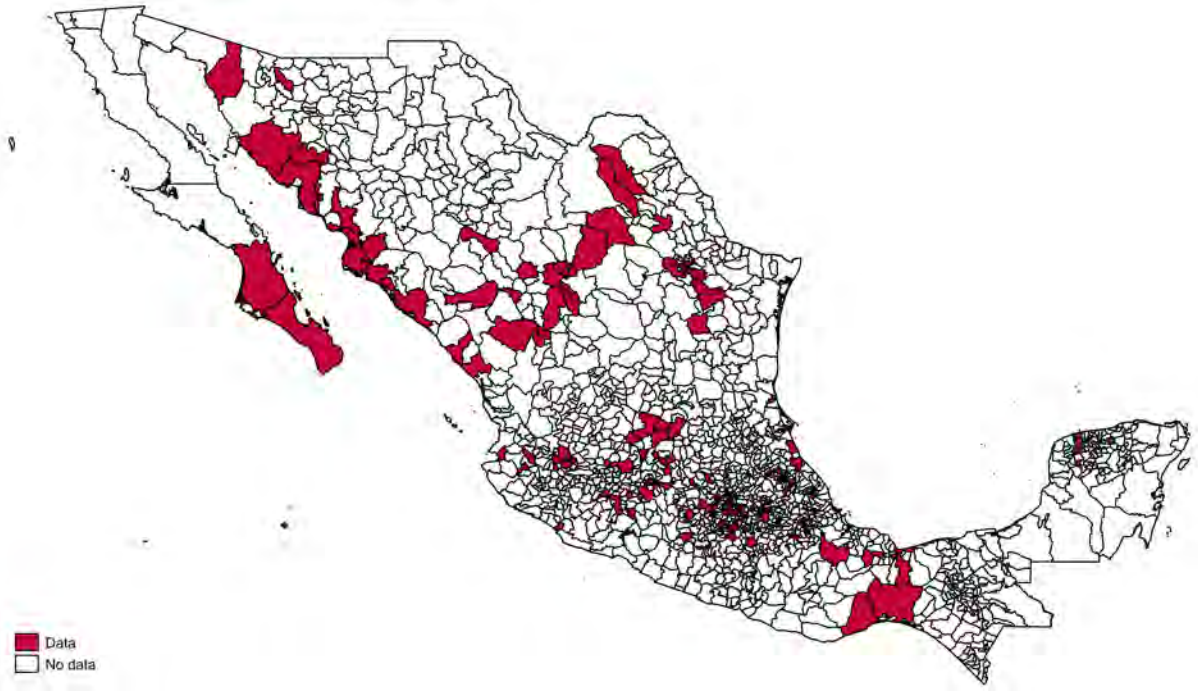

* per 1,000 inhabitants. Author's construction using data from ICESI.

Figure 6: Intentional Homicide Rates 2005*




* per 1,000 inhabitants. Author's construction using data from ICESI.

Figure 7: Municipalities in which interviews have been conducted




Author's construction based on MxFLS.

# Appendix

Table A1: Correlation between Regional Economic Indicators and Armed Conflict

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| (1) Unemployment rate, registred | 1.000 | | | | | | |
| (2) Unemployment rate, unregistered | -0.078 | 1.000 | | | | | |
| | (0.000) | | | | | | |
| (3) HDI health | 0.152 | 0.042 | 1.000 | | | | |
| | (0.000) | (0.000) | | | | | |
| (4) HDI education | 0.380 | -0.061 | 0.745 | 1.000 | | | |
| | (0.000) | (0.000) | (0.000) | | | | |
| (5) HDI income | 0.282 | -0.022 | 0.831 | 0.825 | 1.000 | | |
| | (0.000) | (0.001) | (0.000) | (0.000) | | | |
| (6) Homicides/100,000 inhabitants | -0.326 | 0.247 | -0.072 | -0.134 | -0.164 | 1.000 | |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | | |
| (7) Armed groups neighborhood | 0.009 | 0.032 | 0.042 | 0.050 | 0.051 | 0.035 | 1.000 |
| | (0.142) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | |

Table A2: Effect of SDA on Participation – Men

| | Probit | IV Probit | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.002*** | -0.046*** | -0.028 | -0.039*** |
| | (0.000) | (0.013) | (0.019) | (0.012) |
| Age | 0.012*** | 0.011*** | 0.013*** | 0.012*** |
| | (0.001) | (0.003) | (0.002) | (0.002) |
| Age sqrd | -0.000*** | -0.000** | -0.000*** | -0.000*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Indigenous | 0.009 | 0.027** | 0.019 | 0.024** |
| | (0.008) | (0.013) | (0.013) | (0.012) |
| High school | -0.009 | -0.036** | -0.026 | -0.032** |
| | (0.010) | (0.016) | (0.017) | (0.016) |
| College | -0.002 | -0.039** | -0.023 | -0.034* |
| | (0.010) | (0.018) | (0.021) | (0.017) |
| House owner | -0.018*** | -0.022** | -0.023** | -0.023** |
| | (0.006) | (0.011) | (0.009) | (0.010) |
| Savings | 0.009 | 0.001 | 0.005 | 0.003 |
| | (0.006) | (0.011) | (0.009) | (0.010) |
| HH size | 0.000 | -0.000 | 0.000 | 0.000 |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Rural | -0.005 | -0.022** | -0.015 | -0.019* |
| | (0.007) | (0.011) | (0.012) | (0.011) |
| Death of HH member | -0.020** | 0.004 | -0.008 | -0.001 |
| | (0.010) | (0.017) | (0.016) | (0.016) |
| HDI health | 0.062 | 0.253* | 0.183 | 0.226* |
| | (0.090) | (0.142) | (0.146) | (0.136) |
| HDI education | -0.094 | -0.275* | -0.212 | -0.250* |
| | (0.091) | (0.147) | (0.147) | (0.142) |
| HDI income | 0.143** | 0.023 | 0.090 | 0.052 |
| | (0.061) | (0.109) | (0.094) | (0.098) |
| Unemployment rate, registred | 0.000 | -0.004 | -0.002 | -0.004 |
| | (0.003) | (0.004) | (0.004) | (0.004) |
| Unemployment rate, unregistered | 0.000 | -0.001 | -0.001 | -0.001 |
| | (0.000) | (0.001) | (0.001) | (0.001) |
| Year 2005 | -0.022*** | -0.052*** | -0.042*** | -0.049*** |
| | (0.006) | (0.011) | (0.016) | (0.011) |
| Regional dummies | Yes | Yes | Yes | Yes |
| N | 10279 | 10279 | 10279 | 10279 |
| $\chi^2$ | 199 | 1246 | 478 | 885 |
| p | 0.000 | 0.000 | 0.000 | 0.000 |

Note: The coefficients are marginal effects. Standard errors are clustered on individuals. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood.

## Table A3: Effect of SDA on Participation – Women

| | Probit | IV Probit | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | 0.000 | 0.023* | 0.020 | 0.021** |
| | (0.001) | (0.012) | (0.014) | (0.010) |
| Age | 0.021*** | 0.018*** | 0.019*** | 0.018*** |
| | (0.003) | (0.004) | (0.004) | (0.003) |
| Age sqrd | -0.000*** | -0.000*** | -0.000*** | -0.000*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Indigenous | 0.004 | -0.002 | -0.001 | -0.001 |
| | (0.015) | (0.015) | (0.015) | (0.015) |
| High school | 0.184*** | 0.198*** | 0.198*** | 0.198*** |
| | (0.017) | (0.016) | (0.016) | (0.016) |
| College | 0.309*** | 0.327*** | 0.329*** | 0.328*** |
| | (0.019) | (0.020) | (0.018) | (0.018) |
| House owner | 0.001 | 0.013 | 0.011 | 0.012 |
| | (0.012) | (0.013) | (0.014) | (0.013) |
| Savings | 0.022* | 0.028** | 0.028** | 0.028** |
| | (0.011) | (0.011) | (0.011) | (0.011) |
| HH size | -0.002* | -0.002* | -0.002* | -0.002* |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Death of HH member | 0.072*** | 0.043* | 0.047* | 0.045** |
| | (0.015) | (0.024) | (0.026) | (0.021) |
| Rural | -0.080*** | -0.060*** | -0.063*** | -0.061*** |
| | (0.012) | (0.019) | (0.020) | (0.016) |
| Unemployment rate, registred | 0.001 | 0.005 | 0.005 | 0.005 |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| Unemployment rate, unregistered | 0.003*** | 0.003*** | 0.003*** | 0.003*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| HDI health | 0.167 | -0.048 | -0.015 | -0.034 |
| | (0.174) | (0.203) | (0.219) | (0.190) |
| HDI education | -0.180 | -0.110 | -0.122 | -0.116 |
| | (0.160) | (0.161) | (0.164) | (0.159) |
| HDI income | 0.546*** | 0.673*** | 0.662*** | 0.669*** |
| | (0.101) | (0.104) | (0.113) | (0.103) |
| Year 2005 | -0.065*** | -0.021 | -0.027 | -0.024 |
| | (0.011) | (0.029) | (0.032) | (0.023) |
| Regional dummies | Yes | Yes | Yes | Yes |
| N | 14780 | 14780 | 14780 | 14780 |
| p | 0.000 | 0.000 | 0.000 | 0.000 |

Note: The coefficients are marginal effects. Standard errors are clustered on individuals. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood.

## Table A4: Effect of SDA on Participation – Women

| | Probit | IV Probit | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | 0.000 | 0.023* | 0.020 | $0.021^{**A}$ |
| | (0.001) | (0.012) | (0.014) | (0.010) |
| SDA (perc) | 0.000 | 0.006* | 0.005 | $0.005^{**A}$ |
| | (0.000) | (0.003) | (0.004) | (0.002) |
| SDA (pcm) | 0.001 | 0.172* | 0.150 | $0.162^{**A}$ |
| | (0.004) | (0.093) | (0.109) | (0.073) |
| N | 14780 | | | |

Note: Each coefficient is obtained from a different regression. The numbers are marginal effects. Standard errors are clustered on the individual level. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood. When two instruments are included, a test for overidentification is pursued. The test statistic is the Amemiya-Lee-Newey minimum $\chi^2$-statistic (obtained from the two-step rather than the MLE method) and $^A$ indicates that $p > 0.1$, i.e. instruments are valid.

## Table A5: Effect of SDA on Weeks Worked – Men

| | OLS | IV | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.110*** | -2.381** | -1.412* | -1.881*** |
| | (0.022) | (1.011) | (0.775) | (0.619) |
| Age | 0.599*** | 0.431*** | 0.503*** | 0.467*** |
| | (0.075) | (0.128) | (0.103) | (0.105) |
| Age sqrd | -0.007*** | -0.003 | -0.005*** | -0.004*** |
| | (0.001) | (0.002) | (0.002) | (0.001) |
| Indigenous | 0.060 | 0.700 | 0.427 | 0.557 |
| | (0.433) | (0.683) | (0.545) | (0.583) |
| High school | 0.513 | -0.655 | -0.157 | -0.401 |
| | (0.419) | (0.799) | (0.636) | (0.629) |
| College | 0.219 | -1.292 | -0.648 | -0.975 |
| | (0.378) | (0.845) | (0.679) | (0.628) |
| House owner | -0.585* | -0.509 | -0.541 | -0.521 |
| | (0.306) | (0.463) | (0.366) | (0.409) |
| Savings | 0.487* | 0.023 | 0.221 | 0.121 |
| | (0.289) | (0.483) | (0.381) | (0.406) |
| HH size | -0.003 | -0.011 | -0.008 | -0.008 |
| | (0.032) | (0.047) | (0.038) | (0.042) |
| Death of HH member | -1.568*** | -0.230 | -0.801 | -0.552 |
| | (0.509) | (0.937) | (0.715) | (0.725) |
| Rural | -1.675*** | -2.525*** | -2.162*** | -2.341*** |
| | (0.335) | (0.608) | (0.487) | (0.488) |
| Year 2005 | -0.198 | -1.738** | -1.081 | -1.417** |
| | (0.360) | (0.836) | (0.676) | (0.614) |
| Constant | Yes | Yes | Yes | Yes |
| Regional characteristics | Yes | Yes | Yes | Yes |
| Regional dummies | Yes | Yes | Yes | Yes |
| N | 9700 | 9700 | 9700 | 9700 |
| $R^2$ centered | 0.039 | -1.046 | -0.318 | -0.621 |
| $R^2$ uncentered | 0.941 | 0.875 | 0.920 | 0.901 |
| F | 14 | 7 | 10 | 9 |
| p | 0.000 | 0.000 | 0.000 | 0.000 |
| Kleibergen-Paap rk Wald-F | – | 9.129 | 9.475 | 8.781 |
| Shea's $r^2$ | – | 0.001 | 0.001 | 0.003 |
| Hansen's J | – | – | – | 0.598 |
| H's J-p | – | – | – | 0.440 |

Note: Standard errors are two-way clustered on individual and household level in the OLS, Tobit and IV models and obtained from asymtotic theory (twostep) in the IV-Tobit models. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood.

## Table A6: Effect of SDA on Weeks Worked – Women

| *Linear Regression* | OLS | IV | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.104*** | 1.108 | -0.261 | 0.237 |
| | (0.028) | (1.349) | (0.854) | (0.717) |
| *A-P First stage* $\chi^2$ | – | 2.618 | 3.884 | 3.252 |
| SDA (perc) | -0.028*** | 0.267 | -0.053 | 0.037 |
| | (0.006) | (0.330) | (0.172) | (0.152) |
| *A-P First stage* $\chi^2$ | – | 2.528 | 5.537 | 3.832 |
| SDA (pcm) | -0.776*** | 8.205 | -2.048 | 1.985 |
| | (0.213) | (9.904) | (6.699) | (5.519) |
| *A-P First stage* $\chi^2$ | – | 2.776 | 3.652 | 3.229 |
| N | | 5262 | | |
| *Tobit Regression* | Tobit | IV Tobit | | |
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.008 | 1.040** | 0.716 | 0.886** |
| | (0.022) | (0.521) | (0.535) | (0.375) |
| SDA (perc) | 0.004 | 0.258** | 0.186 | 0.225** |
| | (0.005) | (0.129) | (0.139) | (0.095) |
| SDA (pcm) | -0.071 | 7.881** | 5.435 | 6.720** |
| | (0.165) | (3.948) | (4.059) | (2.845) |
| N | | 14780 | | |

Note: Each coefficient is obtained from a different regression. In Tobit and IV-Tobit results marginal effects are presented. Standard errors are clustered on individuals in the OLS and Tobit models and bootstrapped with 400 replications in the IV and IV-Tobit models. Standard errors in parentheses. $^{*}$,$^{**}$ and $^{***}$ denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood. When two instruments are included, the Hansen's J test for overidentification is pursued. $^{A}$ indicates that the critical value $p > 0.1$, i.e. instruments are valid. $^{+}$ denotes strong instruments (not tested in Tobit models): $\chi^2 >$ Stock/Yogo's (2005) critical value (25% maximal IV size).

Table A7: Effect of SDA on Hours Worked – Men

| | OLS | IV | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.090*** | -3.101** | -0.968 | -2.036** |
| | (0.031) | (1.434) | (1.029) | (0.854) |
| Age | 0.540*** | 0.316* | 0.475*** | 0.389*** |
| | (0.097) | (0.172) | (0.127) | (0.130) |
| Age sqrd | -0.007*** | -0.003 | -0.006*** | -0.004** |
| | (0.001) | (0.003) | (0.002) | (0.002) |
| Indigenous | -0.986* | -0.331 | -0.795 | -0.544 |
| | (0.575) | (0.851) | (0.635) | (0.697) |
| High school | -1.116* | -2.488** | -1.516* | -2.016** |
| | (0.605) | (1.064) | (0.784) | (0.808) |
| College | -4.066*** | -5.928*** | -4.609*** | -5.291*** |
| | (0.583) | (1.170) | (0.885) | (0.852) |
| House owner | -1.373*** | -1.388** | -1.377*** | -1.368*** |
| | (0.438) | (0.635) | (0.459) | (0.528) |
| Savings | 1.023** | 0.078 | 0.747 | 0.430 |
| | (0.424) | (0.764) | (0.546) | (0.576) |
| HH size | -0.081* | -0.094 | -0.085* | -0.090* |
| | (0.042) | (0.063) | (0.045) | (0.052) |
| Death of HH member | 0.093 | 1.768 | 0.581 | 1.169 |
| | (0.625) | (1.210) | (0.861) | (0.884) |
| Rural | -1.898*** | -2.987*** | -2.216*** | -2.555*** |
| | (0.453) | (0.850) | (0.590) | (0.629) |
| Year 2005 | -0.473 | -2.816** | -1.156 | -2.018** |
| | (0.437) | (1.255) | (0.925) | (0.834) |
| Constant | Yes | Yes | Yes | Yes |
| Regional characteristics | Yes | Yes | Yes | Yes |
| Regional dummies | Yes | Yes | Yes | Yes |
| N | 9541 | 9541 | 9541 | 9541 |
| $R^2$ centered | 0.034 | -1.038 | -0.057 | -0.414 |
| $R^2$ uncentered | 0.898 | 0.784 | 0.888 | 0.850 |
| F | 14 | 6 | 12 | 9 |
| p | 0.000 | 0.000 | 0.000 | 0.000 |
| Kleibergen-Paap rk Wald-F | – | 8.423 | 8.530 | 7.943 |
| Shea's $r^2$ | – | 0.001 | 0.001 | 0.002 |
| Hansen's J | – | – | – | 1.651 |
| H's J-p | – | – | – | 0.199 |

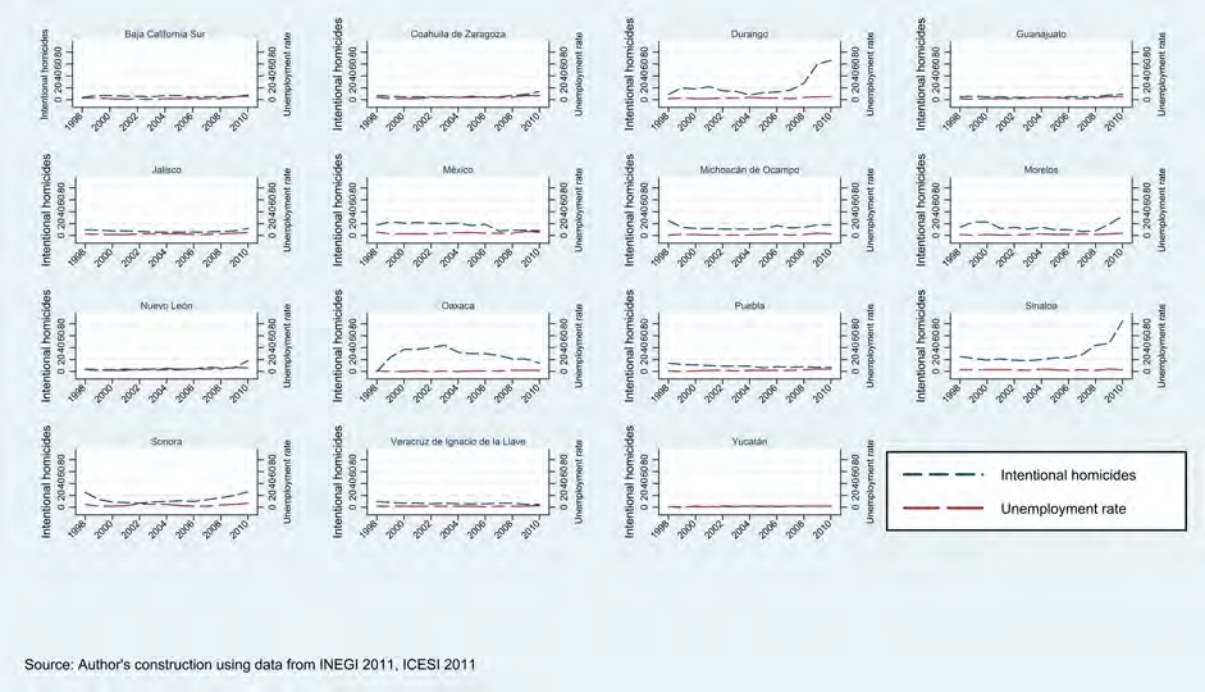
Note: Standard errors are two-way clustered on individual and household level in the OLS, Tobit and IV models and obtained from asymtotic theory (twostep) in the IV-Tobit models. Standard errors in parentheses. *,** and *** denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood.

## Table A8: Effect of SDA on Hours Worked – Women

| *Linear Regression* | OLS | IV | | |
|---|---|---|---|---|
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.115*** | -3.134 | -0.886 | -1.851 |
| | (0.038) | (2.245) | (1.265) | (1.164) |
| *A-P First stage* $\chi^2$ | – | 3.190 | 3.577 | 3.384 |
| SDA (perc) | -0.034*** | -0.803 | -0.178 | -0.369 |
| | (0.009) | (0.588) | (0.247) | (0.240) |
| *A-P First stage* $\chi^2$ | – | 2.768 | 5.314 | 3.876 |
| SDA (pcm) | -0.863*** | -23.375 | -6.983 | -14.485 |
| | (0.294) | (16.528) | (10.013) | (9.024) |
| *A-P First stage* $\chi^2$ | – | 3.334 | 3.335 | 3.349 |
| N | 5192 | | | |
| *Tobit Regression* | Tobit | IV Tobit | | |
| | – | IV (1) | IV (2) | IV (1+2) |
| SDA (linear) | -0.015 | 0.391 | 0.546 | 0.463 |
| | (0.019) | (0.453) | (0.471) | (0.329) |
| SDA (perc) | 0.001 | 0.097 | 0.142 | 0.117 |
| | (0.005) | (0.112) | (0.122) | (0.083) |
| SDA (pcm) | -0.118 | 2.964 | 4.142 | 3.507 |
| | (0.145) | (3.431) | (3.576) | (2.493) |
| N | 14780 | | | |

Note: Each coefficient is obtained from a different regression. In Tobit and IV-Tobit results marginal effects are presented. Standard errors are clustered on individuals in the OLS and Tobit models and bootstrapped with 400 replications in the IV and IV-Tobit models. Standard errors in parentheses. $^{*}$,$^{**}$ and $^{***}$ denote significance level of 10%, 5% and 1%, respectively. IV (1) = homicide rates on state level, IV (2) = armed groups in neighbourhood. When two instruments are included, the Hansen's J test for overidentification is pursued. $^{A}$ indicates that the critical value $p > 0.1$, i.e. instruments are valid. $^{+}$ denotes strong instruments (not tested in Tobit models): $\chi^2 >$ Stock/Yogo's (2005) critical value (25% maximal IV size).

Figure A1: Unemployment Rates and Homicide Rates over time by state




Source: Author's construction using data from INEGI 2011, ICESI 2011