Breaking Sad: Drug-Related Homicides and Mental Well-Being in Mexico

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Abstract

This paper examines the effects of drug-related violence on depression among adults in Mexico, amid a conflict known as the "Mexican Drug War." The empirical strategy consists of first-differences in aggregate health outcomes at the municipality level before and after the beginning of the conflict. To account for potential migration biases, I use variation on net cocaine supply from Colombia and on federal-local enforcement cooperation. Results suggest an increase of 1.0% in depression among women, for every additional one-standard deviation expansion in drug-related homicide rates. In stark contrast, Mexican men are largely unaffected by drug-related violence.

The level of violence recently exerted by Mexican drug-trafficking organizations (DTOs) surpasses that of many international armed conflicts. Decapitations, mass executions, and hanging of bodies are now common events in many parts of Mexico (Bunker, Campbell, and Bunker, 2010). Beyond any rhetoric from national and international media, drug-related violence has become a visible phenomena in public spaces. Although expressions of drug-related violence have always occurred sporadically in Mexico, the frequency and brutality of the violence that prevailed between 2007 and 2012 are incomparable to previous periods.

Such rates of violence, usually generated by war, are known to have a negative impact on mental well-being. For instance, Scholte et al. (2004) find an immediate increase in depression among Afghans after the launching of Bush's "War on Terror." Similarly, de Jong et al. (2003) and Priebe et al. (2010) observe a long-lasting significant effect of war exposure on anxiety, depression, and post-traumatic stress disorders for individuals living in Algeria, Cambodia, Ethiopia, Palestine, and the former Yugoslavia.

This paper is a first attempt to estimate the effect of drug-related violence on depression among adults in Mexico, amid a conflict known as the "Mexican Drug War".[1] To infer causality, the empirical design consists mainly of first-differences in aggregate health outcomes at the municipality

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[1]A recent working paper by Michaelsen (2012) analyzes the effect of mental health on labor outcomes between 2002 and 2005, using changes in state-level homicide rates as instrumental variables. Although Michaelsen's approach

level before and after the beginning of the conflict. In addition, I employ two time-varying instrumental variables (e.g changes in net cocaine supply in municipalities with a drug-trafficking route and differences in federal-local enforcement cooperation) to account for potential endogeneity issues.

Preliminary results suggest a statistical significant increase in clinical and non-clinical depression among women as consequence of drug-related violence. In stark contrast, men in Mexico seem largely unaffected by drug-related violence as far as mental health outcomes concern. Future versions of this paper will expand on explanations for gender difference in the treatment effect.

The paper proceeds as follows. Section 1 describes the identification theory, and explains the relevant features of the Mexican Drug War. Section 2 provides the foundations for the empirical strategy to estimate the treatment effect. Section 3 presents preliminary results. Section 4 analyzes the robustness of the suggested findings. Finally, Section 5 discusses the economic implications of the preliminary results.

1 Identification Theory

1.1 Structural and Foreign Factors

Between 2004 and 2006, prior to the beginning of the conflict, Mexican DTOs expanded their activities significantly, even though homicide rates were at a historical low. This expansion in drug-trafficking activity was the result of several structural and foreign factors. Among the structural factors, there were three important events that fostered organized crime before the launching of Mexican Drug War.

First, U.S.-Mexico cooperation on law enforcement grew constantly after the murder of Enrique Camarena, an American drug-enforcement agent, in 1985. As a result of this multilateral cooperation, the Mexican government captured a few drug-lords. Even though these criminals continued to conduct business as usual from Mexican jails, the intensification of law enforcement began to change the industrial organization of drug-trafficking services towards more competition (Toro, 1995). Second, during the early 1990s, the U.S. government boosted crackdowns on cocaine shipments along the Caribbean-trafficking corridor (Toro, 1995), incentivizing cocaine-trafficking routes to shift towards Mexico (the "balloon effect"). Third and last, after the election of Vicente Fox in 2000, Mexico experienced a rapid democratization process, which left severe power vacuums as political decisions became increasingly decentralized (Osorio, 2012). The absence of a strong centralized State complicated a *pax narcotica*, the "explicit" coordination between DTOs and the State to maintain drug-related violence to a minimum (Osorio, 2012).

Additionally, there were two foreign events that developed simultaneously over the structural context. First, arguments on preserving the Second Amendment of the U.S. Constitution to its broadest interpretation led to the expiration of the U.S. Federal Assault Weapons Ban (AWB) in 2004. Lax gun regulations, just across the border, allowed Mexican DTOs to purchase semi-automatic weapons more easily (Chicoine, 2011; Dube et al., 2013). Second, after 2006, there was a dramatic shift in net cocaine supply from Colombia, provoked by increasing seizure efforts from

is novel, the first-stage in her analysis misses the spike in drug-related violence (2007-2012). In this paper, I focus exclusively on the effect of drug-related violence on depression during the Mexican Drug War, while accounting for potential endogeneity between drug-related violence and depression.

the Colombian government (Castillo et al., 2014). Less total output in a market with an inelastic demand translated into higher rents for DTOs. The absence of property rights over these additional rents induced DTOs to exert violence as means of appropriation (Castillo et al., 2014).

1.2 Joint Operations and Local Enforcement Coordination

In response to increasing drug-trafficking activity, President Felipe Calderon took the decision of combating DTOs, using the Mexican Army. Specifically, the main goal of the military policy was to capture the most-wanted drug-lords. In total, the Mexican Army killed or captured 26 of the 37 targets during the Mexican Drug War.

However, instead of discouraging criminal activity, the military strategy caused a "hydra effect," attributable to the organizational structure of DTOs. In stark contrast to Colombian cartels, Mexican DTOs organized internally within cells, rather than as a vertical hierarchy.[2] Once the Army removed the central management of DTOs, cells within and across DTOs fought for the control of assets. Consequently, the number of DTOs went from six to 16 in a matter of five years (Guerrero, 2011).

At the beginning of the Mexican Drug War, the military strategy also sought to maintain cooperation with local enforcement institutions (e.g. state and municipal). Hence, military operations became known as *"joint operations"* (JOs). In total, President Calderon launched JOs in 11 different states.[3]

Ultimately, politics became a factor for cooperation, mainly because of trust issues. Municipalities governed by PAN, President's Calderon political party, experienced greater cooperation than municipalities governed by PRI (or PRD). Although at first this translated into higher rates of violence for PAN-governed municipalities, empirical evidence shows "a diversion of drug traffic" away from PAN-governed municipalities (Dell, 2011). Hence, shifting some of the violence towards non-PAN-governed municipalities.

Worse yet, President Calderon dismantled many local enforcement institutions, and did not maintain political operators in raided municipalities governed by non-PAN. As a result, violence and chaos remained in non-PAN-governed municipalities for longer periods of time. A comparison often drawn by President Calderon, himself, was between Tijuana and Juarez, two border urban municipalities. Whereas the former municipality was governed by PAN, the latter municipality maintained a PRI mayor in office. Not surprising, President Calderon claimed "success" for his military strategy in Tijuana, whereas Juarez became the most violent city in the world during the Mexican Drug War (Associate Press, 2010).[4]

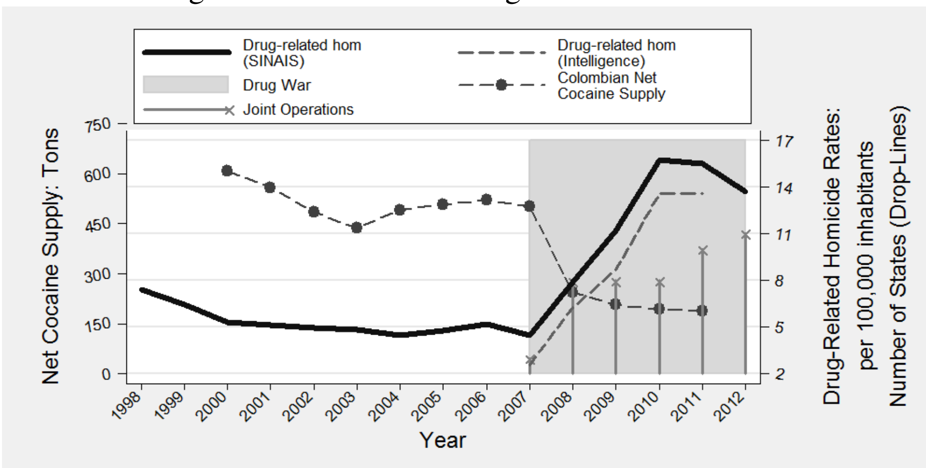
Provided the organizational structure of DTOs and the lack of political operators across the country, the military policy resulted in a counterproductive strategy. Figure 1 shows how drug-

[2]The main functions of the drug-lords were to coordinate all cells as franchises across trafficking-routes, and to maintain contracts with foreign supplier of cocaine and ephedrine.

[3]Some of these JOs occurred at the very beginning of the sexenium term, in 2007 (e.g. Baja California, Guerrero, and Michocan); some others in the middle of the administration, in 2008 (e.g. Chihuahua, Durango, Nuevo Leon, Sinaloa, and Tamaulipas); and the rest towards the very end of Calderon's presidency, in 2011 and 2012 (e.g. Coahuila, Morelos, and Veracruz).

[4]Specifically, Calderon said that "[i]n [...] Juarez, unfortunately, there has not been the same degree of collaboration and constructive attitude that we have found in other places, like Tijuana. [...] Instead of everyone working together, they [PRI] preferred the easy way out by blaming everything on the federal government [PAN] and the president" (Associate Press, 2010).

Figure 1: Evolution of Drug-Related Homicides



related homicide rates (solid and dashed lines) spiked tremendously after the launching of the Mexican Drug War (shaded area). Namely, rates rose from five drug-related homicides per 100,000 inhabitants, in 2006, to 16 drug-related homicides per 100,000 inhabitants, in 2012. Although foreign factors like net cocaine supply (lines with circles) also contributed to the spike in violence, empirical evidence suggest that the military strategy (droplines with crosses) was the main driver of the shock. Using a variety of methodologies (e.g. propensity score matching, regression discontinuity designs, and synthetic control methods), the existing literature finds a marginal effect of the Mexican Drug War on drug-related homicide rates between 46.9% and 52.4% (Dell, 2011; Merino, 2011; Calderon et al., 2012).

2 Empirical Strategy

2.1 Methodology

The primary objective of this paper is to assess whether drug-related violence had an impact on depression among adults during the Mexican Drug War. To achieve the goal of this paper, the empirical design consists in comparing aggregate mental health outcomes at the municipality level before and after the spike in drug-related homicide rates; hereinafter, pre-treatment and treatment period. Given the two-period empirical design of this paper, the central model is an equation in first-differences:[5]

$$\triangle Y_m = \alpha + \beta \triangle T_m^L + \gamma \triangle X_m + \triangle \varepsilon_m, \tag{1}$$

where $\triangle Y_m$ is the change in depression outcomes between the pre-treatment and treatment period, in municipality m; $\triangle T_m^L$ is the first difference in the lag values of yearly drug-related homicide rates between the pre-treatment and treatment period, for each municipality; $\triangle X_m$ are fluctuations in observable municipality characteristics; and $\triangle \varepsilon_m$ is the error term. The main parameter of interest, the average treatment effect (ATE) of drug-related homicide rates on depression, is β. I use

[5] The first-differences estimator is identical to the within-estimator in the two-period case of the fixed-effects model.

ordinary least squares (OLS) to compute the magnitude and standard errors of the ATE in equation (1).

Notwithstanding the advantages of first-differences regressions over cross-sectional analysis, equation (1) does not necessarily capture the true treatment effect because changes in depression and drug-related homicide rates could be caused by a third dynamic variable. For instance, recent literature contests a significant shift in migration patterns, motivated by drug-related violence. Specifically, Rios (2013) finds a gap of over 264,000 individuals, nationwide, between the population census and the demographic forecast by Mexico's Population Agency (CONAPO) for 2010. Based on records from the American Community Survey, Areceo-Gomez (2013) also suggests a new wave of wealthy well-educated Mexicans leaving the country as a consequence of drug-related violence. Using longitudinal survey data (MXFLS), Velasquez (2014) further predicts selective internal and international migration among self-employed men and single women living in troubled areas.

Insofar as migration occurs more frequently among those individuals with mental health distress, equation (1) provides a lower-bound of the ATE because $Cov\left(\triangle T_m^L, \triangle \varepsilon_m\right) \leq 0$. Conversely, if depressed individuals are less likely to migrate because of their mental health condition, then equation (1) provides an upper-bound of the ATE because $Cov\left(\triangle T_m^L, \triangle \varepsilon_m\right) \geq 0$. I address this migration endogeneity problem by introducing two instrumental variables: 1) the interaction of net cocaine supply from Colombia and the presence of a drug trafficking route (DTR) in a municipality, and 2) the interaction of a non-PAN-governed municipality dummy and the launching of a JO in any given state. As discussed in Section 1, the first instrument is inversely correlated to drug-related homicide rates (more net cocaine supply leads to less violence,) whereas the latter instrument is positively correlated with drug-related homicide rates (less enforcement coordination and the hydra effect lead to more violence.) Although hardly testable, it is unlike for both of these instruments to affect depression, other than through more drug-related violence.

Therefore, so long as the aforementioned instrumental variables are strong and exogenous, I am able to estimate the true effect of drug-related homicide rates on depression by conducting two-stage least squares (2SLS) in the first-differences model above:

$$
\begin{aligned}
\triangle Y_m &= \alpha + \beta \triangle T_m^L + \gamma \triangle X_m + \triangle \varepsilon_m \\
\triangle T_m^L &= \alpha^F + \pi \triangle Z_m^L + \gamma^F \triangle X_m + \triangle \varepsilon_m^F,
\end{aligned}
\tag{2}
$$

where the first stage (F) incorporates the vector $\triangle Z_m^L$, which contains the first difference in the lag values of both instrumental variables under standard exclusion restrictions: $Cov\left(\triangle Z_m^L, \triangle \varepsilon_m \mid \triangle X_m\right) = 0$. To control for non-linearity, I include a second-order polynomial of drug-related homicide rates in equation (1) and (2), for some of the specifications. Finally, following the medical and economics literature, I present estimations by gender (Piccinelli and Wilkinson, 2000).

2.2 Data

To measure aggregate depression among adults, I use the National Health and Nutrition Survey (ENSANUT) for 2006 and 2012, the only available waves.[6] This repeated cross-sectional survey

[6]Mexico's Ministry of Health began collecting ENSANUT in October of the preceding year (2005 and 2011), and concluded all survey gathering in May of the base year.

provides a timely framework to estimate the full effect of drug-related homicide rates on depression at the municipality level. Namely, I consider the 2006-wave as the pre-treatment period, whereas the 2012-wave serves as the treatment period (see Figure 1.)

ENSANUT contains four variables to capture the prevalence of depression among individuals older than 19 years of age. The first variable is a dummy for clinical depression (ever in lifetime);[7] the second variable is measure for "having felt sad for several days in the last week"; the third variable is an indicator for "currently feeling depressed"; and the fourth variable captures whether an individual is "currently taking antidepressants". Additionally, ENSANUT provides several socio-economic indicators like crime victimization, ethnicity, education, health insured status, and labor outcomes.

The size of the cross-sectional samples are 45,240 and 46,277 adults for 2006 and 2012, respectively. To avoid mortality selection biases, I exclude adults older than 65 years of age.[8] What is more, given the aggregate level of the empirical analysis, I only keep observations for individuals living in municipalities that appear in both waves. The previous selection reduces the sample to 29,990 adults for 2006, and to 33,103 adults for 2012. After collapsing mental health outcomes and socio-economic information by municipality, the sample becomes a panel of 368 municipalities.[9] Although the number of municipalities in the sample represents a tiny fraction for the more than 2,450 municipalities in Mexico, these 368 municipalities amasses over two-thirds of the total Mexican population.

To determine drug-related homicide rates at the municipality level, I utilize Mexico's Mortality Databases from the Bureau of Health Statistics (SINAIS). These databases contain the universe of homicides for the period 1998-2012, along with detail information about the method of killing and the crime scene. I employ murders caused by gunshots, decapitations, and hangings as proxies for drug-related homicides. As shown in Figure 1, records from SINAIS move parallel to the officially identified drug-related homicide rates from the Mexican Intelligence Agencies. One disadvantage of official data for drug-related homicides is that these are only available from December, 2006 to September, 2011; thus missing the pre-treatment period. Consequently, I conduct my analysis using SINAIS data, exclusively.

To build cocain net supply data, as part of the identified instrumental variables, I gather information for cocaine production and cocaine confiscation in Colombia from the United Nations World Drug Report and Colombia's Ministry of Defense, accordingly. Net cocain supply data is available from 2000 to 2011. To assign DTR dummies across municipalities, I employ records of drug-shipment confiscations from Mexico's Ministry of Defense, for the period 2007-2011. Last, CIDAC's electoral database distinguishes municipalities where non-PAN mayors hold office, for the immediate electoral year that precedes the implementation of JOs.

2.3 Descriptive Statistics and Sources of Exogeneity

Table 1 contains the average values of the treatment indicator, mental health outcomes, socio-economic covariates, and instrumental variables by gender and time period. Immediately notice-

[7] Diagnosis by a medical professional.

[8] Older population accounts for 11% of the surveyed adult population.

[9] On average, the number of surveyed adults per municipality, by gender is 37.21 observations for males and 48.51 observations for females, for each of the survey waves. Consequently, there is more precision in municipality estimations for females than for males.

Table 1: Descriptive Statistics (Means) of Municipalities by Gender

		Means at the Municipality Level†			
		Females		Males	
		Pre-Treat (2006)	Treat (2012)	Pre-Treat (2006)	Treat (2012)
Treatment	Lag Drug-Related Homicide Rates‡	4.51	17.60	4.51	17.60
Outcomes	Clinical Depression (Ever in Lifetime)	16.90	16.53	5.12	5.80
	Sad for Several Days (Last Week)	40.78	46.69	22.33	28.20
	Currently Feeling Depressed	14.31	17.38	8.29	6.50
	Currently Taking Antidepressants	2.54	2.83	0.76	0.87
Covariates	Victim of Crime (Last 12 Months)	1.29	2.91	2.29	3.66
	Population Growth⋆	1.36	1.27	1.36	1.27
	Average Age	38.45	39.97	38.74	39.71
	Indigenous (Speaking) Population	4.27	4.03	4.08	3.85
	Health Insured	54.51	78.46	53.63	71.38
Instruments	Lag Cocaine Supply x DTR‡	374.93	139.90	374.93	139.90
	Joint Operations x Non-PAN-Governed‡	0	0.23	0	0.23

† Means are weighted by inverse population weights. N=368. ‡Pooled average at the municipality level.

able is the differences in mental health outcomes across gender groups. In conformity with the existing literature, females report higher rates of depression than males for both time periods (Piccinelli and Wilkinson, 2000).

Across treatment periods, depression seems to increase for almost all proxies of depression. Similarly, crime victimization rates expand during the treatment period, although not nearly as much as drug-related homicide rates. The previous implies that, during the peak of the conflict, DTOs internalized the bulk of drug-related violence, directly.

Demographic covariates show a declining growth in population size, an aging adult population, and less indigenous (speaking) Mexicans across time, for both genders. Also, health insured rates rise dramatically after the 2007 expansion of "Seguro Popular," an universal health care program for disadvantaged households. This expansion in health insured rates is much greater for females than for males.

Finally, both instrumental variables move in accordance with the identification theory. In particular, during the treatment period, there is less net cocaine supply from Colombia and less enforcement coordination through the implementation of JOs in non-PAN-governed municipalities. Still, Table 1 does not test for instrumental exogeneity.

To verify the validity of the instrumental variables, Table 2 reproduces the previous statistics for the pre-treatment period, by instrument's complaince groups. The top panel presents statistics by the presence of a DTR across municipalities; while the bottom panel shows statistics by non-PAN-governed municipalities with a JO. The columns of interest in Table 2 contain the t-test difference in means between complaince groups.

Table 2: Pre-Treatment Statistics by Instrument's Compliance Groups

Panel A. Pre-Treatment (2006) Difference in Means by Presence of a DTR: T-Tests

	Females			Males		
	DTR	No DTR	Difference	DTR	No DTR	Difference
Lag Drug-Rel. Homicide Rates‡	**4.58**	**4.33**	**0.24**	**4.58**	**4.33**	**0.24**
Clinical Depression (Ever in Life)	16.11	19.10	-2.99	5.11	5.13	-0.02
Sad for Several Days (Last Week)	41.28	39.37	1.91	23.11	20.16	2.95
Currently Feeling Depressed	14.55	13.66	0.89	8.71	7.10	1.61
Currently Taking Antidepressants	2.90	1.54	1.36***	0.79	0.69	0.10
Victim of Crime (Last Year)	1.37	1.09	0.28	2.13	2.75	-0.61
Population Growth	1.57	0.76	0.81***	1.57	0.76	0.81***
Average Age	38.56	38.17	0.39	38.65	38.98	-0.33
Indigenous (Speaking) Population	4.06	4.87	-0.81	3.87	4.68	-0.81
Health Insured	56.17	49.83	6.34**	54.99	49.80	5.19**
Lag Cocaine Supply x DTR‡	508.45	0.00	508.45***	508.45	0.00	508.45***

Panel B. Pre-Treatment (2006) Difference in Means by Non-PAN-Governed with a JO: T-Tests

	Females			Males		
	Non-PAN x JO	PAN or no JO	Difference	Non-PAN x JO	PAN or no JO	Difference
Lag Drug-Rel. Homicide Rates‡	**6.03**	**4.05**	**1.98**	**6.03**	**4.05**	**1.98**
Clinical Depression (Ever in Life)	12.90	18.12	-5.22***	4.47	5.32	-0.85
Sad for Several Days (Last Week)	38.80	41.39	-2.59	22.06	22.41	-0.35
Currently Feeling Depressed	12.84	14.77	-1.93	8.75	8.15	0.60
Currently Taking Antidepressants	2.25	2.63	-0.38	0.57	0.82	-0.25
Victim of Crime (Last Year)	1.06	1.37	-0.31	1.85	2.43	-0.58
Population Growth	1.48	1.32	0.16	1.48	1.32	0.16
Average Age	38.47	38.45	0.02	38.93	38.68	0.25
Indigenous (Speaking) Population	1.89	5.00	-3.11***	2.01	4.72	-2.71***
Health Insured	58.28	53.35	49.94*	57.35	52.48	4.87*
Lag Cocaine Supply x DTR‡	488.47	340.08	148.39***	488.47	340.08	148.39***

†Means are weighted by inverse population weights. Difference in means contain robust standard errors. N=368.
‡Pooled average at the municipality level. Connotations *, **, and *** mean significantly different from zero at the 90p, 95p, and 99p confidence level.

Table 2 presents three crucial results for the identification strategy. First and most important, pre-treatment drug-related homicide rates (in-bold) are statistically indistinguishable between compliance groups, for both instruments. This result is the main source of exogeneity. Second, prior to treatment, mental health outcomes are practically the same, even though there might be a possible trend for females taking antidepressants in municipalities with a DTR. Third and last, compliers for both instruments have a smaller indigenous population (usually poor), and a bigger formal economy, approximated by health insured rates before the expansion of "Seguro Popular."

3 Preliminary Results

3.1 Clinical Depression

In Table 3, I present the main results for the effect of drug-related homicide rates on clinical depression (ever in lifetime) among adults. Columns 1 to 4 show estimations for females, while columns 4 to 8 present effects for males. The first two columns for each gender group correspond to linear estimations, whereas the last two columns for each gender group incorporate a second-order polynomial of drug-related homicide rates.

A rapid inspection of the main results suggests a significant linear effect of drug-related violence on clinical depression among females. In stark contrast, Mexican men are largely unaffected by drug-related violence as far as clinical depression concerns. Hence, I describe the different specifications of Table 3 for females, exclusively.

Table 3: Average Effect of Drug-Related Violence on Clinical Depression (Ever in Lifetime)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
D Homicide	0.032*	0.097*	0.065	0.485	0.009	-0.035	0.062	-0.741
	(0.017)	(0.057)	(0.066)	(0.834)	(0.015)	(0.036)	(0.050)	(0.628)
D Homicide Sqr.			-0.000	-0.004			-0.000	0.007
			(0.000)	(0.008)			(0.000)	(0.007)
Joint Significance			[1.61]	[1.75]			[0.89]	[1.88]
Joint P-Value			0.201	0.417			0.412	0.391
FIRST-STAGE								
D Cocaine x DTR		-0.023***		-1.426**		-0.022***		-1.453***
		(0.006)		(0.545)		(0.006)		(0.532)
D non-PAN x JO		27.221***		2920.781*		27.253***		2919.909*
		(9.455)		(1519.394)		(9.243)		(1489.024)
Gender	Female	Female	Female	Female	Male	Male	Male	Male
R-squared	0.092	0.068	0.093	-0.038	0.039	0.012	0.044	-1.493
Municipalities	368	368	368	368	368	368	368	368
F-Stat Excluded		13.9		0.9		13.6		0.8
Chi-p: OLS-2SLS		0.145		0.320		0.227		0.096

Notes: All regressions contain robust standard errors in parentheses. Estimations factored by population weights. Joint test for non-linear models correspond to F-stats (OLS) and Chi-square stast (2SLS). Controls include first-differences in victimization, population growth, average age, indigenous population, and health insured rates by municipality. Connotations *, **, and *** mean significant at the 90p, 95p and 99p confidence level.

According to the OLS model in column 1, an one-standard deviation in the difference of yearly lagged drug-related homicide rates between pre-treatment and treatment period —or 34.9 drug-related homicides per 100,000 inhabitants— causes an enlargement of 1.0% on the proportion of females who report clinical depression. Relative to the pre-treatment mean of clinical depression for women, the ATE is equal to 5.9%. Said effect is statistically significant at the 90% level of confidence.

On the other hand, the 2SLS model in column 2 shows an effect three-times the size of the OLS model. This implies an absolute impact on clinical depression equal to 3.3% for every additional one-standard deviation expansion of yearly lagged drug-related homicide rates between treatment periods. Provided that the effect for the 2SLS model is also statistically distinguishable from zero, the lower-bound bias hypothesis on migration among clinically depressed women appears to be true.[10] However, statistically speaking, the p-value of the difference in magnitudes between the OLS model and 2SLS model is not different from zero. Therefore, the results for the OLS model are preferable to the 2SLS model.

Regarding a non-linear relationship between drug-related violence and clinical depression among women, the joint significance test indicates a null effect. This is true across estimators. As a caveat, in columns 4 and 8, I only present the first stage for the squared value of drug-related homicide rates because the first stage for the linear value of drug-related homicide rates is exactly the same as in columns 2 and 6.[11]

3.2 Current Depression by Severity

Notwithstanding the relevance of the results for clinical depression, these estimations could miss the bigger picture for two reasons. First and foremost, the indicator for clinical depression does not inform whether the depression diagnosis by a medical professional occurred in the recent past. Second, not every person considers depression to be a serious or curable health problem, particularly in a developing country like Mexico. In fact, data suggest that a large portion of depressed Mexicans do not have a medical assessment of their mental health condition (Belló et al., 2005).[12]

Fortunately, both waves of ENSANUT contain proxies for current depression at various levels of severity. Specifically, the indicator for "having felt sad for several days in the last week" serves as a proxy for current mild depression; the measure for "currently feeling depressed" approximates current moderate depression; while the dummy variable for "currently taking antidepressants" represents current severe depression. As a caveat, the following results for current depression should be considered as mere approximations, because these findings are not based on a medically approved method of assessment like the Center for Epidemiologic Studies Depression Scale.

Table 4 conducts the same regressions as before, but for current depression among adults, and by severity. In particular, Table 4 contains three panels: the dependent variable in the top panel is mild depression; the outcome in the middle panel is moderate depression; while the results in the bottom panel are for severe depression. For the sake of brevity, I omit the first-stage of the 2SLS estimator, which is identical to one presented in Table 3. Yet, the layout in Table 4 corresponds exactly to the same specifications as in Table 3.

In line with the results for clinical depression, males do not indicate any significant effect of drug-related homicide rates on current depression. What is more, females continue to report a significant enlargement in current depression as a consequence of drug-related violence. Thus, once again, I limit the subsequent discussion to current depression among females.

According the top panel of Table 4, the ATE of an additional one-standard deviation expansion in yearly lagged drug-related homicide rates on mild depression is equal to 1.8%. Moreover, there is little change in the treatment effect between the OLS and 2SLS models, implying no migration among mildly depressed women. Nonetheless, in contrast to the OLS model, the 2SLS model is not statistically different from zero. Based on the p-value of the joint significance test in the

[10] I present coefficients and F-statistics for the first-stage of the 2SLS estimator. Based on a large F-statistic for excluded variables, I can say that the instrumental variables are strong predictors of drug-related homicide rates.

[11] The F-statistic for excluded variables drops significantly when the model is exactly identified.

[12] In Mexico, the percentage of depressed women without a medical diagnosis is 72.8%, while the proportion of undiagnosed depressed males is 81.0% (Belló et al., 2005).

OLS model, in column 3, these results on mild depression hold after introducing a second-order polynomial of drug-related homicide rates, even though the coefficient for this latter term is equal to zero.

Table 4: Average Effect of Drug-Related Violence on Current Depression

Panel A. Dependent Variable: Sad for Several Days (Last Week).

	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) OLS	(8) 2SLS
D Homicide	0.048**	0.030	0.021	-1.112	0.001	-0.056	-0.111	-1.630
	(0.020)	(0.063)	(0.086)	(0.855)	(0.027)	(0.075)	(0.092)	(1.149)
D Homicide Sqr.			0.000	0.011			0.001	0.015
			(0.001)	(0.009)			(0.001)	(0.013)
Joint Significance			[6.57]	[1.83]			[2.28]	[2.68]
Joint P-Value			0.002	0.400			0.104	0.262
Gender	Female	Female	Female	Female	Male	Male	Male	Male
R-squared	0.262	0.261	0.262	-0.506	0.166	0.157	0.255	-0.995
Municipalities	368	368	368	368	368	368	368	368
Chi-p: OLS-2SLS		0.895		0.282		0.544		0.309

Panel B. Dependent Variable: Currently Feeling Depressed.

	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) OLS	(8) 2SLS
D Homicide	0.035**	0.090*	0.128**	-0.127	0.002	-0.021	-0.020	-0.275
	(0.017)	(0.052)	(0.060)	(0.532)	(0.012)	(0.038)	(0.043)	(0.519)
D Homicide Sqr.			-0.001*	0.002			0.000	0.002
			(0.000)	(0.005)			(0.000)	(0.005)
Joint Significance			[2.62]	[1.28]			[.6]	[.37]
Joint P-Value			0.074	0.526			0.552	0.832
Gender	Female	Female	Female	Female	Male	Male	Male	Male
R-squared	0.143	0.124	0.150	-0.012	0.093	0.086	0.093	-0.040
Municipalities	368	368	368	368	368	368	368	368
Chi-p: OLS-2SLS		0.143		0.441		0.519		0.750

Panel C. Dependent Variable: Currently Taking Antidepressants.

	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) OLS	(8) 2SLS
D Homicide	0.009	-0.006	0.027	-0.297	0.004	-0.010	0.023	-0.296
	(0.007)	(0.017)	(0.023)	(0.242)	(0.005)	(0.013)	(0.016)	(0.239)
D Homicide Sqr.			-0.000	0.003			-0.000	0.003
			(0.000)	(0.003)			(0.000)	(0.003)
Joint Significance			[.98]	[1.76]			[1.02]	[1.89]
Joint P-Value			0.375	0.415			0.360	0.389
Gender	Female	Female	Female	Female	Male	Male	Male	Male
R-squared	0.067	0.058	0.069	-0.734	0.022	-0.001	0.028	-2.137
Municipalities	368	368	368	368	368	368	368	368
Chi-p: OLS-2SLS		0.380		0.176		0.496		0.124

Notes: All regressions contain robust standard errors in parentheses. Estimations factored by population weights. Joint test for non-linear models correspond to F-stats (OLS) and Chi-square stast (2SLS). Controls include first-differences in mean victimization, population growth, average age, indigenous population, and health insured rates by municipality. Connotations *, **, and *** mean significant at the 90p, 95p and 99p confidence level.

The middle panel of Table 4 shows a very similar enlargement in the proportion of moderately depressed women vis-à-vis clinical depression. Specifically, the OLS model in column 1 predicts a 1.2% increase in moderate depression among females for every additional one-standard deviation expansion in drug-related homicide rates. Most remarkable, the 2SLS model threefolds the effect for the OLS estimator, just as in the case of clinical depression. However, once again, there is no statistically significant difference between the magnitudes of the OLS model and the 2SLS model. Both linear specifications for moderate current depression among women are statistically significant at the 90% and 95% level of confidence. These findings remain constant in the non-linear specification for the OLS model.

Finally, the bottom panel of Table 3 reveals zero changes in the proportion of women who currently take antidepressants during the treatment period. These results on severe current depression for women are somehow contradictory to the linear results for clinical depression and mild-to-moderate current depression. However, this could be an indication for a limited effect of drug-related violence on current depression among women.

Table 5: Average Effect of Drug-Related Violence on Suicide

	(1) OLS	(2) OLS	(3) 2SLS	(4) OLS	(5) OLS	(6) 2SLS
L Drug Homicide Rate	-0.001	-0.001	0.003	-0.002	-0.001	-0.007
	(0.000)	(0.000)	(0.004)	(0.001)	(0.001)	(0.011)
Gender	Female	Female	Female	Male	Male	Male
Linear Time Trends	No	Yes	Yes	No	Yes	Yes
R-squared	0.010	0.014	0.010	0.009	0.019	0.017
Municipalities	2453	2453	2453	2453	2453	2453
Observations	34342	34342	29436	34342	34342	29436
1stg: L Cocaine x DTR			-0.011***			-0.011***
			(.002)			(.002)
1stg: L Non-Pan Mayor x JO			12.267*			12.267*
			(6.831)			(6.831)
F-Stat for Excluded Var.			13.2			13.2

Notes: All regressions contain robust standard errors, clustered by municipality, in parentheses. Estimations factored by population weights. Pre-treatment mean suicide rates are 0.30 per 100,000 inhabitans for women and 2.05 per 100,000 inhabitants for men. Connotations *, **, and *** mean significant at the 90p, 95p and 99p confidence level.

To verify that this is the case, I use suicide rates as an alternative proxy for severe depression. SINAIS provides the universe of suicides from 1998 to 2012. As mentioned previously, SINAIS also contains information for all drug-related homicides, for the same time period. Therefore, the number of time periods available for this proxy is much greater than in the previous analysis, which only allows for first-differences. Consequently, I run a t-period fixed-effects regression of suicide rates on drug-related homicide rates.[13] For consistency purposes, I also conduct the following

[13] Specifically, the t-period fixed-effects model is as follows:

$$Y_{mt} = \beta T^L_{mt} + \gamma X_{mt} + \delta_m + \alpha_t + \varepsilon_{mt},$$

where Y is yearly suicide rates at the municipality level, in period t;, T^L is the lag value of drug-related homicides at the municipality level, in period t; X is a vector of municipality time-varying observables, δ is a full set of municipality dummies that controls for time-invariant unobservables, α is a matrix of year dummies that captures common shocks analysis using OLS and 2SLS models; however, for brevity, I limit my results to linear effects, exclusively.

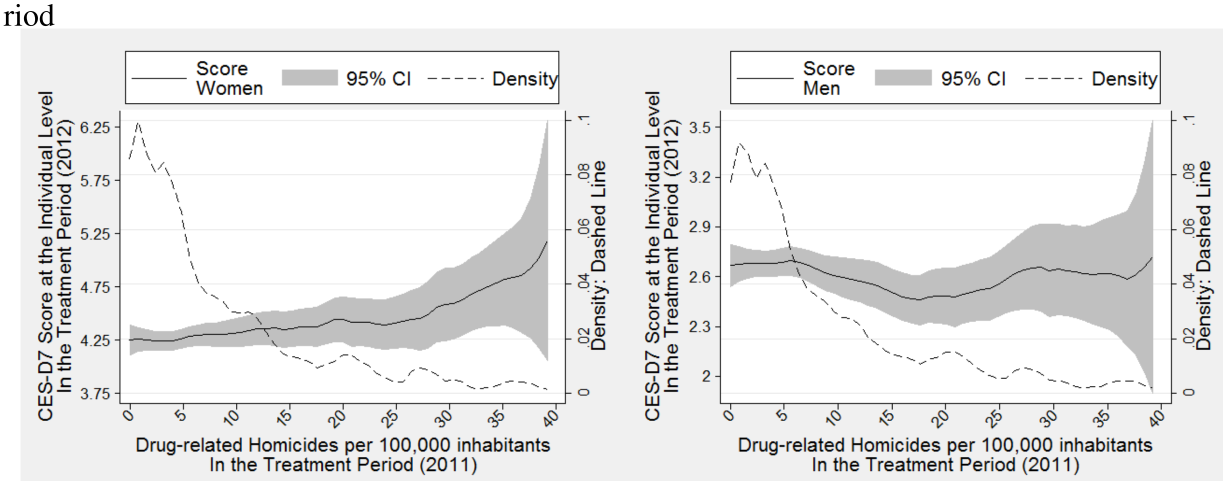
Table 5 indicates a null effect of drug-related homicides on suicide rates across gender groups. These results imply that, indeed, the spike in violence had a limited effect on current depression, bringing confidence to the proxies for current depression and all of the results above. Finally, as the number of time periods increases, the F-statistic for excluded variables remains practically unchanged.

4 Robustness Test

To evaluate the sensitivity and validity of the findings above, I conduct five robustness tests. First, I perform a non-parametric analysis, using the Center for Epidemiologic Studies Depression Scale (CES-D), available only for the 2012-wave of ENSANUT. Based on a host of medically approved questions, CES-D computes a depression score that runs from zero to 21, in which higher values indicate more severe depression. In particular, I run a first-order local polynomial smoothing regression of individual CES-D scores on municipality lagged drug-related homicide rates, by gender.[14]

Figure 2 presents graphically the non-parametric results for individuals that live in municipalities with drug-related homicide rates below an one-standard deviation expansion over the pre-treatment mean (e.g. 39.41 drug-related homicides per 100,000 inhabitants).[15] The left-hand side panel contains results for females, whereas the right-hand side panel shows findings for males. In line with the results above, females report higher CES-D scores than males.

Figure 2: Relationship between Drug-Related Homicide Rates and CES-D for the Treatment Period



For females, the CES-D score line increases constantly all throughout the horizontal axis, be-

across municipalities, and ε are all other time-varying unobservables that influence suicide rates. For this regression, I use the within-estimator of the fixed-effects model.

[14]This locally weighted OLS contains an Epanechnikov kernel and optimized bandwidths.

[15]Over 90% of the surveyed adult population live in municipalities with a drug-related homicide rates below the aforementioned threshold.

coming slightly steeper around extreme values of drug-related homicide rates. Conversely, the CES-D score line for males is basically flat along the x-axis, corroborating the results in Tables 3 and 4. This check presumes a robust linear causal relationship of drug-related homicides on depression among females, in its rawest sense.

Second, I verify the robustness of the linear 2SLS model by dropping one of the instruments, for each of the outcomes in Table 3 and 4. Table A.1 in the Appendix section include the results of this robustness check. The top panel tests the instrumental validity for the interaction of net cocaine supply from Colombia and the presence of a DTR in a municipality, while the bottom panel does so for the interaction of a non-PAN governed municipality and the launching of a JO in a given state.

In the case of clinical depression among women, the linear 2SLS model continues to be much higher than the OLS estimator, after dropping one of the instrumental variables. Similarly, moderate current depression for females also shows the same behavior. Conversely, the linear 2SLS model for mild and severe current depression among females are not robust to the exclusion of one of the instrumental variables. However, the linear 2SLS model for both of these outcomes, in females, are not statistically significant. Most important, both instrumental variables continue to report a large F-statistic value, separately.

The last three robustness tests consists of including additional covariates, applying a fake out-of-synch treatment, and using official records of drug-related homicides from the Mexican Intelligence Agencies, instead of SINAIS data. To conduct this last robustness test, I assume official drug-related homicides to be zero during the pre-treatment period, which is missing. Table A.2 in the Appendix section contains the results for all three robustness checks. Each of the panels in Table A.2 contains one robustness test for the linear OLS model.

The top panel reports coefficients that are robust to the inclusion of a host of covariates (e.g. education levels, prevalence of chronic diseases, labor outcomes, and recent accidents,) even though some statistical power is lost for clinical depression among females. The middle panel confirms the nature of this natural experiment by regressing drug-related homicides that are out-of-synch, and which do not correspond to the spike in drug-related violence (e.g. five years earlier). Finally, the bottom panel indicates very similar results when using official records of drug-related homicides from the Mexican Intelligence Agencies, instead of SINAIS data.

5 Conclusion

Preliminary findings in this paper suggest a statistically significant increase of 1.0% in clinical depression among women for every one-standard deviation expansion in yearly lagged drug-related homicide rates, after the beginning of the Mexican Drug War. Also, drug-related homicides seem to have a very similar impact on self-assessed mild-to-moderate depression among women vis-à-vis clinical depression. In stark contrast, Mexican men appear largely unaffected by drug-related violence. These results are robust to a variety of specifications, falsification tests, and data sources of drug-related homicides. However, additional research into the mechanisms that create differential effects for females and males is needed. Future versions of this paper will seek to find these gender differential mechanisms.

The economics consequences of a higher depression prevalence in the adult population are numerous. For instance, there are immediate effects on labor supply (Michaelsen, 2012). Moreover, depression can lead to a series of intrafamily problems, ultimately being reflected back into the social fabric. Hence, an extrapolation to all possible economic consequences could easily indicate slower economic development in Mexico because of the absence of the rule of law, and the social conditions to maintain citizens free of fear.

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Table A.1: Robustness Test for Instrumental Variables

Panel A. Instrumental Variable: Interaction of Net Cocaine Supply from Colombia and DTR

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Diff L Drug Homicide Rate	0.166	-0.144	-0.173	-0.300	0.051	-0.060	-0.057	-0.054
	(0.168)	(0.096)	(0.161)	(0.185)	(0.105)	(0.096)	(0.042)	(0.038)
Dependent Variable	Clinical	Clinical	Mild	Mild	Moderate	Moderate	Severe	Severe
Gender	Female	Male	Female	Male	Female	Male	Female	Male
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	-0.008	-0.290	0.124	-0.084	0.141	0.044	-0.122	-0.383
Municipalities	368	368	368	368	368	368	368	368
1stg: Diff L Cocaine x DTR	-0.0460***	-0.045***	-0.0460***	-0.045***	-0.0460***	-0.045***	-0.0460***	-0.045***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
F-Stat for Excluded Var.	17.6	17.1	17.6	17.1	17.6	17.1	17.6	17.1

Panel B. Instrumental Variable: Interaction of a Statewide Joint Operation and non-PAN Mayor

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Diff L Drug Homicide Rate	0.088*	-0.021	0.059	-0.024	0.095*	-0.016	0.002	-0.004
	(0.052)	(0.034)	(0.063)	(0.070)	(0.054)	(0.036)	(0.017)	(0.011)
Dependent Variable	Clinical	Clinical	Mild	Mild	Moderate	Moderate	Severe	Severe
Gender	Female	Male	Female	Male	Female	Male	Female	Male
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.075	0.027	0.262	0.165	0.120	0.089	0.065	0.015
Municipalities	368	368	368	368	368	368	368	368
1stg: Diff L non-PAN x JO	29.206***	29.218***	29.206***	29.218***	29.206***	29.218***	29.206***	29.218***
	(9.398)	(9.201)	(9.398)	(9.201)	(9.398)	(9.201)	(9.398)	(9.201)
F-Stat for Excluded Var.	9.6	10.0	9.6	10.0	9.6	10.0	9.6	10.0

Notes: All regressions contain robust standard errors in parentheses. Estimations factored by population weights. Controls include first-differences in mean victimization, population growth, average age, indigenous population, and health insured rates by municipality. Connotations *, **, and *** mean significant at the 90p, 95p and 99p confidence level.

A Appendix

Table A.2: Robustness and Falisication Checks

Panel A. Additional Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Diff L Drug Homicide Rate	0.026	0.012	0.043**	0.009	0.034*	0.007	0.008	0.005
	(0.018)	(0.013)	(0.019)	(0.025)	(0.020)	(0.012)	(0.008)	(0.004)
Dependent Variable	Clinical	Clinical	Mild	Mild	Moderate	Moderate	Severe	Severe
Gender	Female	Male	Female	Male	Female	Male	Female	Male
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.170	0.150	0.356	0.296	0.214	0.183	0.168	0.092
Municipalities	368	368	368	368	368	368	368	368

Notes: All regressions contain robust standard errors in parentheses. Estimations factored by population weights. Controls include first-difference in mean victimization, population growth, average age, indigenous population, health insured rates, education levels, chronic diseases, labor participation, and recent accidents by municipality. Connotations *, **, and *** mean significant at the 90p, 95p and 99p confidence level.

Panel B. Fake Treatment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Diff L Drug Homicide Rate	0.123	0.033	0.048	0.080	0.074	0.087	0.013	-0.006
	(0.145)	(0.106)	(0.219)	(0.192)	(0.116)	(0.122)	(0.053)	(0.031)
Dependent Variable	Clinical	Clinical	Mild	Mild	Moderate	Moderate	Severe	Severe
Gender	Female	Male	Female	Male	Female	Male	Female	Male
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.085	0.038	0.258	0.167	0.139	0.092	0.064	0.022
Municipalities	368	368	368	368	368	368	368	368

Notes: All regressions contain robust standard errors in parentheses. Estimations factored by population weights. Controls include first-differences in mean victimization, population growth, average age, indigenous population, and health insured rates by municipality. Signs *, **, and *** mean significant at the 90p, 95p and 99p confidence level.

Panel C. Official Records of Drug-Related Homicide Rates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Diff L Of Drug Hom Rate	0.026*	-0.001	0.043**	-0.004	0.037**	-0.000	0.004	0.001
	(0.016)	(0.012)	(0.017)	(0.026)	(0.018)	(0.012)	(0.006)	(0.003)
Dependent Variable	Clinical	Clinical	Mild	Mild	Moderate	Moderate	Severe	Severe
Gender	Female	Male	Female	Male	Female	Male	Female	Male
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0	0	0	0	0	0	0	0
Municipalities	368	368	368	368	368	368	368	368

Notes: All regressions contain robust standard errors in parentheses. Estimations factored by population weights. Controls include first-differences in mean victimization, population growth, average age, indigenous population, and health insured rates by municipality. Signs *, **, and *** mean significant at the 90p, 95p and 99p confidence level.