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ARTÍCULO

The War on Drugs, Military Interventions and Economic Activity in Mexican States from 2004 to 2015

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Abstract: We analyse the relationship between the military interventions within the so-called war on drugs and the economic activity at the subnational level in Mexico. During the early years of the war on drugs, federal forces were stationed in several Mexican states to ensure their security, known as Joint Interventions (Operativos Conjuntos). We focus on assessing the economic activity's impact on the nine Mexican states treated by the Federal Government's Joint Interventions. The empirical analysis comprises three econometric techniques: (i) a modified version of the interrupted time series approach; (ii) a univariate difference-in-differences method; and (iii) a time–effect panel regression. According to our findings, there is a negative association between Joint Interventions and subnational economic activity. Between 0.80 and 1.66 percentage points, the treated states experienced a considerable decline in the average rate of economic activity growth.

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Resumen: En este trabajo analizamos la relación entre las intervenciones policiaco-militar dentro de la llamada guerra contra las drogas y la actividad económica subestatal en México. Los Operativos Conjuntos implicaron el desplazamiento de la fuerza pública federal a algunos Estados mexicanos con el fin de garantizar la seguridad en esos territorios. El análisis empírico se compone de la aplicación de tres técnicas econométricas: (i) una versión modificada de las series de tiempo interrumpidas; (ii) un modelo univariante de diferencia-en-diferencias; y (iii) una regresión de panel con efectos fijos temporales. De acuerdo con nuestros resultados, existe una relación negativa entre las intervenciones policiaco-militar a través de los Operativos Conjuntos y la actividad económica subnacional en México. Los Estados mexicanos intervenidos presentaron una disminución en la tasa de crecimiento de la actividad económica estatal de entre 0.80 y 1.66 puntos porcentuales.

Palabras clave: Guerra contra las drogas, costo del conflicto, México, crecimiento económico

Códigos JEL: K42, H77, C21

1. Introduction

One of the first initiatives proposed by President Felipe Calderón's Mexican government was the so-called "war on drugs." On 11 December 2006, the Secretaries of the Government, Defense, Navy, and Public Security and the Republic's General Attorney jointly announced Operación Conjunta Michoacán (República, 2006) (Presidencia, 2006). As one of the Calderón Government's three priorities, the war on drugs sought to strengthen the security of the Mexican people throughout the country's regions. An essential part of the war on drugs was implemented through police/military interventions under *Operaciones Conjuntas* (from now on, Joint Interventions). In the words of the former Secretary of the Government (Poiré, 2011), Joint Interventions are:

Mechanisms implemented by the Federal Government to combat organised crime are based on the principle of subsidiarity of any federal system. When a governor considers that the support of the federal forces is required to guarantee security in the territory, it is designed such that elements of the different corporations of the Federal Government will be deployed to attend to this request.

Joint Interventions were carried out in nine Mexican states between 2006 and 2015 to combat drug trafficking (Presidency of the Republic as reported in El Universal, 2011). We aim to study and assess the effectiveness of such interventions on economic activity at the subnational level in Mexico. Accordingly, we analyse the effect of the interventions on the growth rate of the State Economic Activity Index (Índice de Actividad Económica Estatal, ITAEE). We compare the trend in the ITAEE between Mexican states that have received Joint Interventions and those that have not. There are several difficulties involved in estimating the economic effect of military interventions. For instance, in a critical Smith (2014) presents several issues that must be examined while evaluating a conflict, including why the impacts of a conflict are quantified and what should be quantified. What is the counterfactual, and how can it be generated? Where do the data come from, what data should be used and how accurate are the data? Furthermore, how can the direct and indirect costs be aggregated?

In our scenario, while measuring the economic impact of Joint Interventions, data availability constraints are crucial. As a result, we employ three distinct econometric methodologies to determine economic costs in the presence of conflict. (Gardeazabal, 2012). The implementation of three other methods allows us to contrast the results regarding the gains or losses suffered in terms of the ITAEE growth rate in the Mexican states treated by Joint Interventions.

These strategies were chosen for two primary reasons. These methodologies have been used previously to examine the economic consequences of conflict, and they complement one another. Second, data availability constraints place limitations on implementing alternative techniques, such as matching algorithms. The first approximation is performed with a modified version of the interrupted time series approach (Anderton & Carter, 2001; Gardeazabal, 2012). Interrupted time series permits the analysis of the effects of Joint Interventions at the individual level and – as in our proposed modification – at the group level. In addition, we implement the univariate difference-in-differences (DD) method proposed by Ball (2003), in which we use the states subject to Joint Interventions as members of the treated group and the remaining Mexican states as the control group. Finally, we implement a time fixed-effect panel regression. DD and time fixed-effect panel regression techniques analyse intervention effects, differentiating between treated and non-treated states.

The article is structured as follows. In section two, we analyse some critical features of the war on drugs in Mexico and review the recent literature on the relationship between drug trafficking-related crime and economic activity. In section three, we analyse the effects of the Joint Interventions on economic activity through the interrupted time series approach, the univariate DD and the time effect panel regression. Finally, in section four, we present some concluding remarks.

1.1 The War on Drugs and Economic Activity

In late 2006, the Mexican government announced the beginning of the so-called war on drugs as part of the three priorities of the Calderon presidency. One of those priorities was to strengthen the security of the Mexican people in all the country's regions. In this regard, an important part of the war against drug trafficking was carried out through so-called Joint Interventions (Operaciones Conjuntas), in which federal forces (federal police, army and navy) were deployed to different states, aiming to assure security (Poiré, 2011). The National Development Plan for the period 2007–2012 emphasised the desire to rebuild the state's power through a frontal and effective war against drug trafficking, including battling drug trade and money laundering and dismantling criminal organisations. (Plan Nacional de Desarrollo, 2007).

Table 1 shows the intervention states in Mexico and the date of the interventions. From 2006 to 2015, nine states were subject to interventions with the primary objective of fighting drug trafficking. In addition to these states, interventions took place in two other regions but with mixed goals; that is, other purposes were considered in combating drug trafficking, such as fighting human trafficking in the southern region. As a consequence of the interventions, drug-related violence increased significantly, especially in those regions treated by Joint Interventions, with potentially adverse effects on economic performance. The confrontation strategy resulted in the multiplication of drug cartels and a fight for the control of local markets, increasing drug-related crime (Dickenson, 2014; Duran-Martinez, 2015; Guerrero, 2013)

Table 1. War on drug's Joint Interventions in Mexico

War on drug's Joint Interventions in Mexico		
Intervention date (MM/YYYY)	**Intervention region**	**The Mexican States involved in the intervention**
12/11/2006	Michoacán	Michoacán
01/02/2007	Tijuana	Baja California
01/15/2007	Guerrero I	Guerrero
01/22/2007	Triángulo Dorado	Chihuahua
		Sinaloa
		Durango
01/01/2008	Noreste	Nuevo León
		Tamaulipas
03/28/2008	Ciudad Juárez	Chihuahua
05/14/2008	Sinaloa	Sinaloa
10/04/2011	Veracruz	Veracruz
10/06/2011	Guerrero Seguro	Guerrero
Other interventions		
08/24/2009	Frontera Sur	Chiapas
05/09/2012	Morelos	Morelos

Source: Presidency of the Republic as reported in El Universal, 2011

The economic literature written since the pioneering work of Becker (1968) is mainly concerned with estimating the economic cost of crime, including the economic cost of different types of violent conflict (Brück & De Groot, 2013). In this regard, the consequences and functioning of transmission channels connecting criminality to economic activity – and the resulting violence – are contingent on various circumstances. . One such factor is related to the origin of the crime and the type of violence it generates. For instance, Collier (1999) studies the effects of civil war and points out the channels through which it affects economic performance: the destruction of resources, the disruption of infrastructure, the diversion of public expenditure from output-enhancing activities, dissaving and the change in portfolio preferences towards foreign assets. While the violence caused by the war on drugs is distinct from the violence generated by a civil war, some of the economic consequences may be comparable, given the presence of conflict within the country. Two factors must be considered when analysing the effects of the war on drugs.: 1) violence is generated by the confrontation between the government and private agents as a consequence of illegal activities related to organised crime; and 2) the conflict is mainly domestic, though triggered by external conditions (such as American consumers' increasing demand for drugs in a global context of drug prohibition). With these two ideas in mind, it is possible to analyse the actions that have been taken at the international level in conflicts of a similar nature Globally, Pinotti (2015b) finds that the presence of organised crime is associated with lower levels of output per capita. In addition, politicians are more corrupt and more exposed to the risk of violence in countries with a greater presence of criminal organisations.

At the country level, two cases stand out due to their potential similarities to the Mexican case. On the one hand, in the Colombian conflict (a mixture of drugs, organised crime and guerrilla warfare), Villa (2014) studied the linkages between violence generated by armed conflict, organised crime and economic growth. They discovered adverse effects on GDP at the regional level due to increased armed conflict and unlawful income appropriation activities using a panel of Colombian regions. Additionally, they noted that ending armed conflict would result in an average boost in regional GDP growth of 4.4 percent. Another relevant case is the Italian one, referring to an organised crime scheme run by the mafia. (Pinotti, 2015b) analyses the economic development of two regions in southern Italy (Apulia and Basilicata) with mafia activity after the 1970s. Their results indicate that the presence of the mafia decreases the GDP per capita by 16 per cent. Moreover, Barone (2013) highlight that criminal organisations reallocate public investment subsidies to those places where their influence is more substantial while increasing corruption in the public administration sector.

In the case of Mexico, there have been different attempts to analyse the socioeconomic effects of the war on drugs and drug trafficking-related crime (Ashby & Ramos, 2013; Balmori de la Miyar, 2020; Bel & Holst, 2018; BenYishay & Pearlman, 2014; Carrasco, 2018; Enamorado, López-Calva, Rodríguez-Castelán, & Winkler, 2016; Garduño-Rivera, 2014; Márquez-Padilla, 2015; Ríos, 2016; Robles, 2013; Sánchez-Juárez I., 2021; Verdugo-Yepes, 2015). The impact of the war on drugs can be assessed from different perspectives: the violence associated with the presence of cartels and their operations; drug production and trafficking in terms of volume and monetary value; the health problems related to addiction; and the effects on economic activity in states or regions with issues of violence related to drug trafficking. However, one of the main constraints on evaluating the impact of drug policies is the lack of data over a sufficiently long-time span to assess the change in the relevant variables at the state and local levels.

Additionally, Atuesta-Becerra (2014) identifies three explanations for the difficulty inherent in conducting a critical review of intervention programs: 1) there are no direct links between the strategies implemented and the objectives established; 2) no periodic modifications were made in response to negative findings; and 3) in the majority of cases, there were insufficient specific actions associated with the strategies and objectives' implementation. In this regard, Madrazo-Lajous (2018) highlight that military interventions were characterised by increased improvisation and growing lethality but no in-depth research was conducted before interventions. In our case, the army interventions within the war against drug trafficking are evaluated by analysing its effects on economic activity at the state level.

What mechanism connects the application of Joint Interventions in a region and an increase/decrease in economic activity? The war on drugs has led to a substantial increase in drug-related violence in intervention states. Such a spiral in violence could disincentivise economic growth in these regions in several ways. First, the increase in drug-related violence could be reflected in an increment in firms' costs, either related to hiring new staff to guarantee a more secure environment or the payment of extortion fees in the territories dominated by organised crime. If we add to the previous point the disincentives for new investments, massive amounts that require a stable and secure environment to foresee investment returns, the relocation of firms and unique assets to relatively safer places can be expected.

Second, in a context of increased violence, highly educated workers could decide to move their residence to safer places, and at the same time, the capacity to attract talent to regions with greater violence will diminish (Carrasco, 2018). In addition, the war on drugs could be seen as an opportunity for social mobility, implying the relocation of productive human resources to crime-related economic activities. To summarise, a hostile and insecure environment could limit economic growth by relocating resources from productive activities and promoting, in relative terms, economic activities with relatively low added value.

Recently, the economic literature on the effects of the war on drug trafficking and associated crime on the Mexican economy has expanded, although it is still relatively sparse. Robles (2013) point out a threshold of violence related to drug trafficking above which general economic activity contracts at the aggregate level. Therefore, in escalating violence, economic activity shrinks, as do labour participation and employment.Enamorado, López-Calva, and Rodríguez-Castelán (2014) studied the effect of crime on income growth in Mexico, separating the effects of corruption related to drug trafficking from those related to other types of crime. Their results indicate that drug-related crime harms income growth, while, for non-drug-related crime, the effect is not significant. In this regard, Bel and Holst (2018) analyse the impact on economic development of the increment in homicides and changes in the military budget within the war on drugs, finding that homicides are negatively associated with state GDP growth while military expenditure has positive effects on per capita economic growth.

Verdugo-Yepes (2015) study the transmission of crime shocks to the economy in the 32 Mexican states at the regional level. Their analysis points to the complexity of the relationship at the state level, presenting a large range of responses to crime shocks among states with different magnitudes and signs. Garduo-Rivera (2014) examines the regional economic impact of illicit drugs on Mexico's population, economic units, and gross census added value in this regard. (VAB, which measures the size of the economy of each municipality) as well as the effect on the determinants of the gross domestic product (GDP) at the state level. Their results highlight the existence of migratory movements from the most violent municipalities to relatively quieter ones, as well as higher growth rates of economic units in less violent cities. In addition, in the more violent cities, the VAB is reduced, which is explained by the relocation of companies. Similarly, the states with the most significant decline in economic activity have the highest number of homicides related to drug trafficking.

Regarding the labour market, BenYishay and Pearlman (2014) study the impact of violent crime associated with the war against drug trafficking on the participation of the adult labour force in Mexico. Their results show a negative effect of the change in homicide rates on working hours, impacting self-employed workers more significantly. In this regard, Carrasco (2018) show that increases in drug-related violence in municipalities in intervention states are associated with increments in the share of low-income workers, whereby the more violent the city, the more significant the increase in the share of low-income workers is. Moreover, there is a negative relationship between drug-related violence and labour income, significantly negatively affecting inequality in more insecure areas (Velásquez, 2020).

Additionally, the study examined the consequences of the war on drugs and drug trafficking-related violence on human well-being. Enamorado et al. (2014) discuss how drug-related criminality affects inequality. Their findings indicate that a one-point increase in the Gini coefficient increases more than 36% of the number of drug-related homicides. Balmori de la Miyar (2020) demonstrates the distinct effects of violence and drug-related violence on mental well-being, whereas Márquez-Padilla (2015) indicate that the increase in violence in Mexico since 2006 has had a negligible effect on total enrolment of students and demonstrates that some students could be displaced from high-violence municipalities to low-violence municipalities without

Finally, at the sectoral level, Ríos (2016) points out that increases in the criminal presence and violent crime reduce economic diversification, increase sectoral concentration and reduce economic complexity. Likewise, Ashby and Ramos (2013) studied the responses of foreign direct investment (FDI) to organised crime for different industries in Mexico. Their results indicate that the presence of organised crime discourages foreign investment in financial services, commerce and agriculture. In the case of manufacturing, the effects are not significant, whereas, in oil extraction and mining, the results are positive.

The effects of the Joint Interventions on economic activity have not been widely studied. Balmori de la Miyar (2020) paper is, to our knowledge, pioneering in the study of the economic cost of conflict in the Mexican war on drugs, using the Joint Interventions as a benchmark. Balmori de la Miyar uses synthetic methods to create the counterfactual and points out that the war on drugs translated into a decrease of 0.5 per cent in the GDP per capita from 2007 to 2012. In addition, his results show that the magnitude of the GDP gap has a direct relationship with the expansion of drug-related violence. Considering the abovementioned points, we aim to contribute to the economic literature related to the effects of the war on drugs by analysing the relationship between Joint Interventions and subnational economic activity measured through the ITAEE. Before continuing with the empirical analysis, it is necessary to highlight some points about the ITAEE variable and its behaviour during the study period.

The ITAEE is a short-term economic indicator that measures the evolution of economic activity at the state level in Mexico. Unlike the state GDP, which is published annually, the ITAEE is published quarterly. We conduct an empirical examination of the evolution of the ITAEE, which encompasses all economic sectors. However, the ITAEE can be classified into three economic sectors: primary, secondary, and tertiary. Figure 1 shows the ITAEE growth rate for the primary, secondary, and tertiary sectors as the first approximation. In this case, the average ITAEE growth rate is estimated for treated and non-treated groups of states. The first part of Figure 1 presents the evolution of the primary sector, in which both groups of countries show diverging trends, especially after 2006. The tertiary industry has the closest behaviour between the two groups of states, diverging in 2007 and 2008 but following parallel trends. Finally, the secondary sector presents a particular behaviour. Thus, during the years of Joint Interventions, the volatility of the treated group was higher. Note that the Mexican economy was significantly adversely affected by the global financial crisis in 2009. In addition, in 2009, the spread of influenza forced a temporary closure of non-essential economic activity, reflected in a significant fall in the GDP.

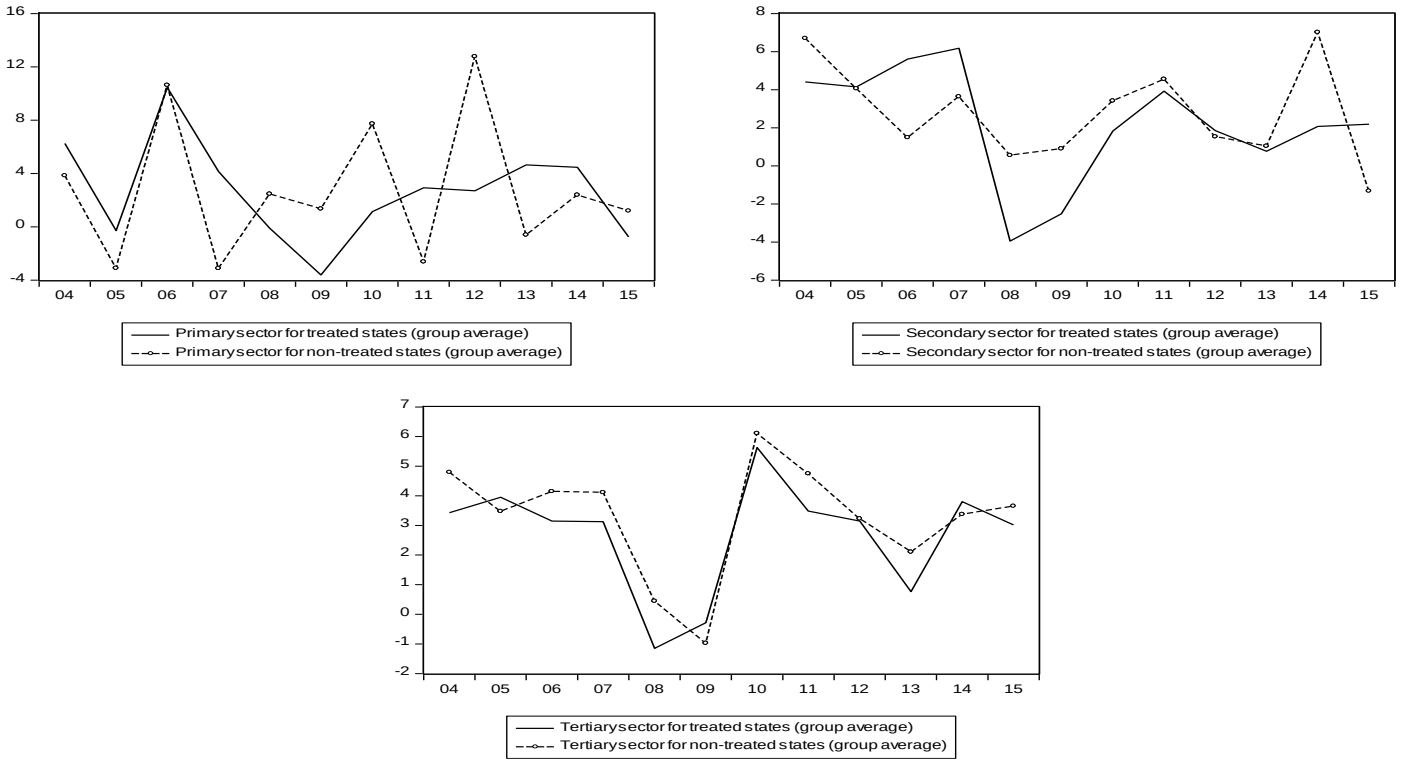

Figure 1. ITAEE trends in treated and untreated states by economic sector.

Source: INEGI

1.2 The Impact of The War On Drugs On Subnational Economic Activity

We formally analyse the relationship between the military interventions within the war on drugs and the economic activity at the subnational level measured using the ITAEE (see Appendix A for source details). We focus on the Mexican states that have undergone a police/military intervention through the Joint Interventions: Baja California, Chihuahua, Durango, Guerrero, Michoacán, Nuevo León, Sinaloa, Tamaulipas and Veracruz.

1.3 The Interrupted Time Series Approach

The interrupted time series approach is used to analyse the effect of an intervention on a relevant variable (Gardeazabal, 2012). Anderton and Carter (2001) adopt this approach to investigate the impact of conflicts on trade between countries, estimating an equation that considers the periods before, during and after armed conflict, as shown in Eq. (1):

$$y_t = \beta_1 + \beta_2 Trend_t + \beta_3 WarLevel_t + \beta_4 WarTrend_t + \beta_5 PeaceLevel_t + \beta_6 PeaceTrend_t + u_t \quad (1)$$

where y_t is the relevant variable with which the effect of war is analysed; $Trend_t$ is the trend for each year in the series; $WarLevel_t$ is a dummy variable that takes the value 0 before the war and 1 for the remaining years; $WarTrend_t$ takes the value 0 before the war and 1, 2, 3, ... from the beginning of the war to the end of the series; $PeaceLevel_t$ takes the value 1 after the war and 0 otherwise; and $PeaceTrend_t$ takes the value 0 before and during the war and the values 1, 2, 3, ... following the end of the war. We consider two relevant factors to specify the regression for the interrupted time series approach. First, as the years of intervention coincide with the outbreak of the global financial crisis, we introduce the quarterly annualised growth rate of industrial production in the United States (US) as an independent variable; accordingly, we control for the effect that the crisis could have on the growth rates of state economic activity. Second, in our case, it is difficult to define the end date of the intervention, that is, the end of the increased violence associated with the intervention. One possible way of identifying the end of the conflict related to the implementation of Joint Interventions is to determine the period in which homicide deaths return to and remain at or below the average number of homicide deaths recorded by each state before the intervention. Using this criterion in none of the ' states is evidence of the end of the escalation in violence associated with implementing the Joint Interventions. Therefore, after considering both factors, we specify the first approximation of the interrupted time series approach as follows:

$$y_t = \beta_1 + \beta_2 USA_t + \beta_3 Trend_t + \beta_4 InterventionLevel_t + \beta_5 InterventionTrend_t + u_t \quad (2)$$

where y_t is the ITAEE; USA_t is the quarterly annualised growth rate of industrial production in the US, which controls for the international financial crisis; $Trend_t$ takes the values 1, 2, 3, ... for each year in the series; $InterventionLevel_t$ takes the value 0 before the implementation of the Joint Interventions and 1 in the remaining years; and $InterventionTrend_t$ takes the value 0 before the Joint Interventions and 1, 2, 3, ... otherwise. However, there is a crucial restriction when estimating Eq. (2): the number of available periods is relatively small. To address this restriction, we construct an interrupted time series panel framework that allows us to analyse the effects of Joint Interventions for the group of treated states. Our proposed model is stated in Eq. (3):

$$y_{it} = \beta_1 + \beta_2 USA_{it} + \beta_3 Trend_{it} + \beta_4 InterventionLevel_{it} + \beta_5 InterventionTrend_{it} + u_{it} \quad (3)$$

In Eq. (3), the results should be interpreted the same way as in Eq. (2), with two exceptions. First, the subscripts i and t

indicate the state and period data, respectively. Second, including the variable USA_{it} is similar to including time fixed effects in the panel regression, the only difference being how the variable should be interpreted. Finally, it should be noted that our proposed model for an interrupted time series panel approach only includes the nine intervention states; that is, there is no comparison with untreated states.

Table 2. Interrupted Time Series Panel Approach

Interrupted Time Series Panel Approach		
Dependent variable: Annualized Economics Activity by State (quarterly data; period 2004/1-2015/4)		
	Model 1 (Eq. 3)	**Model 1 (Eq. 4)**
Constant	3.640*** (0.434)	3.821*** (0.466)
USA	0.455*** (0.046)	0.465*** (0.042)
Trend	-0.043* (0.0.25)	-0.067** (0.029)
Intervention Level	-1.358*** (0.609)	-0.801* (0.602)
Intervention Trend	0.049* (0.031)	0.021 (0.033)
Peace Level		0.052 (0.929)
Peace Trend		0.106* (0.078)
R-squared	0.41	0.42
Obs.	432(9x48)	432(9x48)
White cross-section standard errors & covariance. Significance level: *** at 1%, ** at 5%, * at 10%. Im-Pesaran-Shin W-stat, ADF-Fisher and PP-Fisher unit root tests indicate ITAEE is I(1).		

Source: own calculations

The estimation results for Eq. (3) are presented in Table 2. As can be seen, the interrupted time series panel approach indicates a common average decrease in the ITAEE rate of growth after the intervention of 1.36 percentage points. In addition, as the second model, we estimate a specification including the $PeaceLevel$ and $PeaceTrend$ variables, assuming an end of conflict date in 2012 when the parallel trends in the ITAEE average between treated and non-treated states seem to converge (see Figure 2).

$$y_{it} = \beta_1 + \beta_2 USA_{it} + \beta_3 Trend_{it} + \beta_4 InterventionLevel_{it} + \beta_5 InterventionTrend_{it} + \beta_4 PeaceLevel_{it} + \beta_5 PeaceTrend_{it} + u_{it} \quad (4)$$

where $PeaceLevel_t$ takes the value 0 before the implementation and during the interventions and 1 in the remaining years of peace; and $PeaceTrend_t$ takes the value 0 before and during the Joint Interventions and 1, 2, 3, … otherwise. Thus, the second column model includes those peace variables. In this case, the intervention level is statistically significant at the 10 per cent level, with a coefficient of -0.80 (see Table 2). The constant coefficients, the USA variable and the trend, are similar in magnitude and sign to the estimates in column one. Thus, the interrupted time series panel technique indicates that the intervention is connected with a decline in the ITAEE's growth rate. It is also possible to identify the effects of the intervention by controlling for states that were not subject to Joint Interventions. In the following, we incorporate information on the untreated states.

1.4 The Univariate Difference-In-Differences (DD) Approach

In theoretical terms, the primary causal estimation problem resulting from an intervention can be stated as Eq. (5):

$$\varphi = y_T - y_N \quad (5)$$

where φ is the causal impact of the joint intervention treatment on the state economic activity in the intervention states in Mexico, y_T is the output (the rate of growth of state economic activity) when there is an intervention in the states (that is, $y_T = [y|P = 1]$) and y_N is the output obtained without an intervention (that is, $y_N = [y|P = 0]$). In the latter term, y_N, represents what would have happened to the intervention group of states if they had not received the intervention. However, as the intervention states have received the treatment, it is not possible to observe directly what would have happened to them without the treatment.

To solve this estimate difficulty, the DD technique allows estimating a counterfactual by comparing the intervention group to a control (untreated) group and examining the variation in the relevant variable before and after the intervention. Comparisons before and after and between the treated and untreated groups are false counterfactuals. However, when they are combined, we can estimate a relatively robust counterfactual and thus analyse the impact of the intervention (Gertler, 2017). For this to hold, two assumptions are made: parallel trends are presented before the intervention and the unobserved characteristics for both groups, treated and untreated states, remain unchanged.

DD models aim to analyse the differences between two individuals when one of these groups has received a public policy intervention. DD models consider two periods. None of the groups received a public policy intervention in the first period, whereas, in the second period, intervention took place in a group. The DD method makes it possible to identify the effects of the treatment. In addition, DD models allow the removal of bias in the second period in comparisons between the two groups resulting from permanent differences between them and the prejudice resulting from existing trends (Imbens, 2007).

A general approximation for the DD method (Gertler, 2017) is presented in Eq. (6):

$$\varphi_{DD} = (y_{T,A} - y_{T,B}) - (y_{N,A} - y_{N,B}) \quad (6)$$

where φ_{DD} is the impact of the intervention obtained by applying the DD method, and y is the relevant variable. In Eq. (6), the subscripts T and N denote whether the state has been treated with Joint Interventions (T) or not (N), while the subscripts B and A denote whether the output was measured before (B) or following (A) the intervention. Therefore, when estimating φ_{DD}, the two false counterfactuals are considered.

Besides the basic DD estimation (Eq. 6), which we use to analyse the effects of Joint Interventions on the ITAEE, we employ the univariate DD method proposed by Ball (2003). In a two-way fixed-effect panel model, the ITAEE of the state *i* at time *t* is given by:

$$y_{i,t} = a_1 + a_2 E_{i,t} + \theta_i + \varphi_t + \varepsilon_{i,t} \quad (7)$$

where θ_i is the individual effect, φ_t is the time effect, $\varepsilon_{i,t}$ is an error term for country *i* at time *t* and $E_{i,t}$ is a dummy variable

taking the value 1 if country i received intervention at t and 0 otherwise. There are only two periods, the pre-intervention and post-intervention periods. Differentiating Eq. (7), we obtain:

$$y_{i,Post} - y_{i,Pre} = (\varphi_{Post} - \varphi_{Pre}) + \alpha_2(E_{i,Post} - E_{i,Pre}) + (\varepsilon_{i,Post} - \varepsilon_{i,Pre}) \quad (8)$$

Given $D_i = (E_{i,Post} - E_{i,Pre})$, we have:

$$y_{i,Post} - y_{i,Pre} = (\varphi_{Post} - \varphi_{Pre}) + \alpha_2 D_i + (\varepsilon_{i,Post} - \varepsilon_{i,Pre}) \quad (9)$$

Following Ball (2003), we can interpret Eq. (10) as the cross-country estimator of Eq. (9) plus the added $y_{i,Pre}$ regressor to avoid regression to the mean problem:

$$y_{i,Post} - y_{i,Pre} = \alpha_1 + \alpha_2 D_i + \alpha_3 y_{i,Pre} + \mu_i \quad (10)$$

Table 3. Economic activity by the state for Difference-in-Difference estimation

Economic activity by the state for Difference-in-Difference estimation					
Intervened States					
	Periods		**Period Average**		
	Before Intervention	**After Intervention**	**Before**	**After**	**Change**
Baja California	2004/1-2006/4	2007/1-2009/4	5.357	-1.297	-6.654
Chihuahua 1	2004/1-2006/4	2007/1-2009/4	5.999	-0.757	-6.756
Chihuahua 2	2005/1-2007/4	2008/1-2010/4	5.349	-1.125	-6.474
Durango	2004/1-2006/4	2007/1-2009/4	2.899	-0.116	-3.015
Guerrero 1	2004/1-2006/4	2007/1-2009/4	4.089	0.549	-3.540
Guerrero 2	2008/4-2011/3	2011/4-2014/3	1.607	1.873	0.266
Michoacan	2004/1-2006/3	2006/4-2009/3	2.712	0.638	-2.074
Nuevo Leon	2005/1-2007/4	2008/1-2010/4	6.844	1.249	-5.594
Sinaloa 1	2004/1-2006/4	2007/1-2009/4	4.436	1.223	-3.213
Sinaloa 2	2005/2-2008/1	2008/2-2011/1	4.027	-0.184	-4.211
Tamaulipas	2005/1-2007/4	2008/1-2010/4	4.103	0.457	-3.646
Veracruz	2008/4-2011/3	2011/4-2014/3	1.439	1.622	0.183
Average			4.072	0.344	-3.727
Non-intervened States					
	Periods		**Period Average**		
	Before Intervention	**After Intervention**	**Before**	**After**	**Change**
Aguascalientes	2005/2-2008/1	2008/2-2011/1	6.148	1.648	-4.500
Baja California Sur	2005/2-2008/1	2008/2-2011/1	7.574	1.011	-6.563
Campeche	2005/2-2008/1	2008/2-2011/1	-3.829	-6.159	-2.330
Coahuila	2005/2-2008/1	2008/2-2011/1	4.148	1.573	-2.575
Colima	2005/2-2008/1	2008/2-2011/1	4.370	1.260	-3.110
Chiapas	2005/2-2008/1	2008/2-2011/1	0.829	4.458	3.629
Ciudad de Mexico	2005/2-2008/1	2008/2-2011/1	3.802	0.820	-2.983
Guanajuato	2005/2-2008/1	2008/2-2011/1	2.871	1.879	-0.992
Hidalgo	2005/2-2008/1	2008/2-2011/1	3.057	1.155	-1.902
Jalisco	2005/2-2008/1	2008/2-2011/1	4.969	0.279	-4.689
México	2005/2-2008/1	2008/2-2011/1	4.639	2.019	-2.619
Morelos	2005/2-2008/1	2008/2-2011/1	3.469	1.272	-2.198
Nayarit	2005/2-2008/1	2008/2-2011/1	3.117	2.134	-0.983
Oaxaca	2005/2-2008/1	2008/2-2011/1	1.514	1.038	-0.476
Puebla	2005/2-2008/1	2008/2-2011/1	4.511	1.574	-2.937
Querétaro	2005/2-2008/1	2008/2-2011/1	6.192	3.020	-3.171
Quintana Roo	2005/2-2008/1	2008/2-2011/1	7.048	1.018	-6.030
San Luis Potosi	2005/2-2008/1	2008/2-2011/1	3.726	2.047	-1.679
Sonora	2005/2-2008/1	2008/2-2011/1	5.405	1.407	-3.998
Tabasco	2005/2-2008/1	2008/2-2011/1	5.903	4.538	-1.364
Tlaxcala	2005/2-2008/1	2008/2-2011/1	1.507	1.638	0.131
Yucatán	2005/2-2008/1	2008/2-2011/1	5.344	1.138	-4.207
Zacatecas	2005/2-2008/1	2008/2-2011/1	3.188	7.030	3.842
Average			3.891	1.643	-2.248
Three-year period average before and after the intervention. The only exception is Michoacan, where no data is available for 12 quarters before the intervention but 11 quarters.					

Source: own calculations

Table 3 shows the data used for estimating Eq. (6) and Eq. (10). As shown in Table 3, we use the three years average for our estimations for the pre- and post-intervention periods. We select three years average due to the data availability

restrictions. This maximises the number of cross-country terms included in our estimations. For non-intervention Mexican states, period averages are selected according to the average intervention period, following Ball (2003); for non-intervention states, the pre-intervention period is 2/2005-1/2008, the post-intervention period is 2/2008-1/2011.

Table 4. Difference-in-Difference estimations

Table 4. Difference-in-Differences Estimations					
Part A. Univariate models					
4a. Basic Difference-in Differences Estimation (Eq. 6)				**4b. Ball and Sheridan's Difference-in-Differences (Eq. 10)**	
Relevant variable: Annualized Three Years-Average Rate of Growth of the State Economic Activity Index				Dependent variable: Change in Economic Activity by State (Period Average)	
	After intervention	Before intervention	Difference		Benchmark Model
Intervened States	0.344	4.072	-3.727	Constant	0.637 (1.544)
Non-intervened States	1.643	3.891	-2.248	Before Intervention Average	-0.741** (0.316)
Difference	-1.299	0.18	-1.479	Intervention Dummy	-1.346** (0.565)
				R-squared	0.48
				Obs.	35
				White heteroskedasticity-consistent standard errors in parentheses. Significance level: *** at 1%, ** at 5%, * at 10%	

Part B. Multivariate models (Eq. 11)			
	Model 1	**Model 2**	**Model 3**
Constant	-1.438 (9.894)	1.171 (10.148)	0.433 (1.708)
Before Intervention ITAEE Average	-0.967*** (0.225)	-0.864*** (0.225)	-0.731** (0.316)
Intervention Dummy	-1.661** (0.729)	-1.623*** (0.567)	-1.349* (0.728)
Before Intervention Prod	0.624 (0.338)	0.364 (0.263)	
Before Intervention l_FDI	-0.458 (0.397)	-0.277 (0.295)	
Before Intervention l_PubInv	0.281 (0.517)	0.080 (0.505)	
Prod change	0.464 (0.279)		0.202 (0.223)
l_FDI change	0.327 (0.856)		0.751 (0.860)
l_PubInv change	-0.224 (0.812)		0.354 (0.775)
R-squared	0.61	0.53	0.51
Obs.	35	35	35
White heteroskedasticity-consistent standard errors in parentheses. Significance level: *** at 1%, ** at 5%, * at 10%			

Source: own calculations

Part A of Table 4 presents the results of our DD models (Eq. (6) and Eq. (10)). Our results show that intervention states exhibit a significant decrease in the average rate of growth of the ITAEE of between 1.48 percentage points in the basic model and 1.35 percentage points in Ball and Sheridan's approach. In addition, a 1% higher average rate of growth in the pre-intervention period implies a decrease of 0.74 percentage points. To summarise, according to our models, the growth rate for the second period declines by between 1.35 and 1.48 percentage points for the Mexican states receiving the intervention. While the DD approach enables us to estimate a relatively robust counterfactual by combining two false counterfactuals, it assumes that parallel trends are provided before the intervention and that the unobserved attributes for both treated and untreated states remain unchanged. (Gertler, 2017). If these assumptions are not met, an estimation bias will occur if the unobserved behaviour of the states diverges between those that receive an intervention and those that do not. Figure 2 shows the four-period moving-average ITAEE growth rate for treated and untreated states. According to Figure 2, treated and untreated states seem to follow similar trends in the ITAEE growth rate before the intervention and after 2012. However, during the implementation of Joint Interventions, and coinciding with the global financial crisis and its aftermath, the ITAEE growth rate for treated states was lower than the ITAEE growth rate for untreated states. To improve the difference-in-differences estimations of Eq. (10), we estimate Eq. (11) to account for the different characteristics of treated and untreated states:

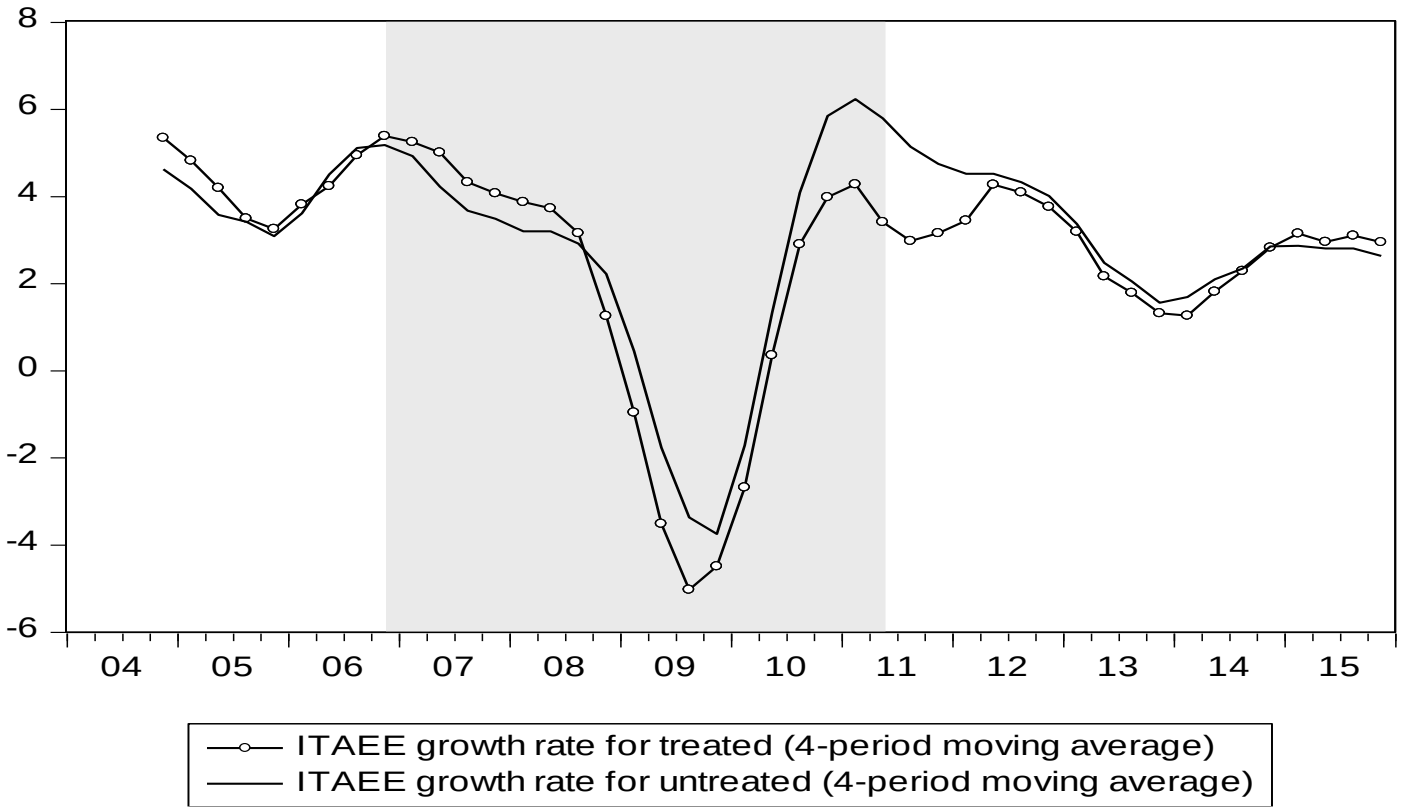

Figure 2. ITAEE trends in treated and untreated states.
Source: INEGI

$$y_{i,Post} - y_{i,Pre} = \theta_1 + \theta_2 D_i + \theta_3 y_{i,Pre} + \theta_4 Prod_{i,Pre} + \theta_5 l_{FDI\,i,Pre} + \theta_6 l_{PubInv\,i,Pre} + \theta_7 (Prod_{i,Post} - Prod_{i,Pre}) + \theta_8 (l_{FDI\,i,Post} - l_{FDI\,i,Pre}) + \theta_9 (l_{PubInv\,i,Post} - l_{PubInv\,i,Pre}) + \omega_i \quad (11)$$

where $Prod$ accounts for productivity, l_{FDI} is the logarithm of net foreign direct investment and l_{PubInv} is the logarithm of public investment. All of these regressors are expected to impact the rate of growth of the ITAEE positively. In addition, the subscripts *Pre* and *Post* indicate the average before and after the intervention, respectively. Therefore, Eq. (11) includes the variation in those variables during treatment as regressors. A limitation in estimating Eq. (11) is the difference in the frequencies of the variables. Thus, we calculate the pre- and post-treatment averagewe calculate the pre- and post-treatment average for the independent variables with yearly data for the independent variables. Part B of Table 4 contains the results of different specifications derived from Eq. 11. In Models 1 to 3, the intervention dummy remains statistically significant with a negative sign. However, the difference-in-differences technique presents limitations regarding the two basic assumptions (parallel trends before intervention and unobserved characteristics remaining). A possibility for addressing these problems is to match intervention states with some other state, the characteristics of which on average, coincide (Abadie, 2005). Not surprisingly, in this case, the implied restriction on the number of individuals (states) renders such a strategy impossible.

As an alternative, in the following section, we estimate a panel model considering covariates that could influence the behaviour of the relevant variable after the intervention.

1.5 Time fixed-effects panel regression

Finally, we implement a time fixed-effect panel regression as an alternative robustness check. In this case, the panel specifications include time fixed effects as both intervention and non-intervention states received a common shock from the global financial crisis. Thus, our baseline model is as stated in Eq. (12):

$$y_{it} = \gamma_1 + \gamma_2 Prod_{it} + \gamma_3 l\_FDI_{it} + \gamma_4 l\_PubInv_{it}\gamma_6 + Population_{it} + \gamma_6 Homicides_{it} + \gamma_7 Intervention_{it} + \tau_t + \varepsilon_{it} \quad (12)$$

where y_{it} is the annual rate of growth of the ITAEE series in state *i* at time *t*; $Prod_{it}$ is the ratio of the GDP per affiliated worker to the social security system in state *i* at time *t*; l_FDI_{it} is the logarithm of the net FDI in state *i* at time *t*; l_PubInv_{it} is the logarithm of public investment in state *i* at time *t*; $Population_{it}$ is the growth rate of the population; $Homicides_{it}$ is the number of homicides per 100,000 inhabitants in state *i* at time *t*; and, finally, $Intervention_{it}$ is a dummy variable that takes the value 1 for an intervention state and 0 otherwise. In this case, we aim to measure two kinds of effects. On the one hand, we investigate whether the intervention effects are transitory using a dummy variable ($Dummy\_transitory_{it}$), which takes the value 1 uniquely in the intervention state in the year of the intervention and 0 otherwise. On the other hand, we determine whether the intervention effects are permanent using a dummy variable ($Dummy\_level_{it}$) taking the value 1 from the year of the intervention up to the end of the period in the intervention states and 0 otherwise. To estimate the panel regression, we use annual data from 2004 to 2015.

Table 5. Panel estimations

Table 5. Panel estimations					
Dependent variable: ITAEE					
Panel specification: Period fixed effects | Annual data | 2004-2015					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Constant	4.082 (3.899)	3.856 (3.907)	3.947 (3.862)	3.730 (3.926)	3.693 (3.855)
Prod	0.552*** (0.069)	0.555*** (0.069)	0.555*** (0.069)	0.556*** (0.070)	0.555*** (0.072)
l_FDI	0.405** (0.127)	0.413*** (0.124)	0.405*** (0.127)	0.410*** (0.125)	0.391*** (0.134)
l_PubInv	-0.213 (0.183)	-0.203 (0.186)	-0.205 (0.183)	-0.201 (0.188)	-0.204 (0.185)
Population	0.807* (0.448)	0.781* (0.449)	0.790* (0.451)	0.799* (0.432)	0.858* (0.420)
Homicides	-0.014 (0.009)	-0.006 (0.011)	-0.013 (0.009)		
Dummy_level		-0.677 (0.414)		-0.825** (0.353)	
Dummy_transitory			-0.848 (0.676)		-0.991 (0.707)
R-squared	0.42	0.42	0.42	0.42	0.42
Obs.	381(32X12)	381(32X12)	381(32X12)	381(32X12)	381(32X12)
White cross-section standard errors & covariance. Significance level: *** at 1%, ** at 5%, * at 10%					

Source: own calculations

Table 5 shows the results of the estimation of Eq. (12) and the other specifications. The variable $Prod_{it}$ is statistically significant, and the estimated parameter is consistent in all specifications. A similar case is found for the variable l_FDI_{it}, which is statistically significant at the 5 per cent level in the five models. For their part, l_PubInv_{it} and $Homicides_{it}$ are not statistically significant.

When analysing the effects of the intervention, *Homicides* and the *dummy_level* variables present a relatively high correlation (0.58). The two variables are related to the impact of the Joint Interventions on violence. Including both variables simultaneously in the model could translate into a multicollinearity problem. Therefore, in models 4 and 5, we do not include the *Homicides* variable but instead the dummy variables for transitory and permanent effects. Our results show that the impact of the interventions on state economic activity was harmful. As a result of the Joint Interventions, the number of homicides per 100,000 inhabitants increased in intervention states, negatively affecting the rate of growth of economic activity. Violence works as an inhibitor of economic activity by disincentivising long-term investment. When the *dummy level variable* is included, the intervention results in a decline in economic activity of around 0.825 percentage points in the intervention states' ITAEE growth rate. To summarise, the interrupted times series panel approach, the DD models and the panel regression estimation show that the Joint Interventions imply a decrease in economic activity for the intervention states of around 0.80 and 1.66 percentage points. The increase in violence associated with the Joint Interventions leads to business closures, discourages new investments, and promotes migratory movements and the relocation of firms to safer places (Carrasco, 2018; Garduño-Rivera, 2014). In addition, the presence of violence disincentivises labour participation (BenYishay & Pearlman, 2014) and decreases the economic complexity (Ríos, 2016) that would allow for specialisation in higher value-added activities.

2. Conclusions

In December 2006, Mexican President Felipe Calderon announced the beginning of the so-called war against illegal drug trafficking. An important part of the war on drugs has been implemented through Joint Interventions, in which some Mexican states were treated with the main aim of reducing illegal drug trafficking-related violence.

In the last years, there have been many different attempts to evaluate the effects of the war on drugs (Ashby & Ramos, 2013; BenYishay & Pearlman, 2014; Carrasco, 2018; Enamorado et al., 2016; Márquez-Padilla, 2015; Miyar, 2016; Ríos, 2016; Robles, 2013; Verdugo-Yepes, 2015). However, the lack of clarity in its objectives (Atuesta-Becerra, 2014; Madrazo-Lajous, 2018) and the lack of available data make the evaluation difficult. Thus, the economic literature focuses on assessing the relationship between the war on drugs and the behaviour of relevant socioeconomic variables.

We examine the association between Joint Interventions and subnational economic activity in Mexico. Three econometric techniques were used to conduct the empirical analysis: a modified version of the interrupted time series methodology, a univariate difference-in-differences technique, and time fixed-effect panel regression. According to our findings, Mexican states treated by Joint Interventions presented a significant decrease in the ITAEE growth rate. Our results show that the interventions are associated with a substantial reduction in the average growth rate for the ITAEE of around 0.80 and 1.66 percentage points.

The decline in economic activities in the intervention states can be explained in terms of different channels. For instance, the increase in violence associated with the Joint Interventions not only leads to business closures and discourages new investment but also promotes migratory movements (Carrasco, 2018) and the relocation of firms to safer places (Garduño-Rivera, 2014) disincentivising labour participation (BenYishay & Pearlman, 2014) and decreasing economic complexity (Ríos, 2016). Therefore, in addition to crime prevention policies, the strategy to fight drug trafficking should be accompanied by regional development plans to avoid the adverse effects on economic activity associated with the increased violence of military interventions.

Numerous empirical studies consistently demonstrate a detrimental association between military involvement in the war on drugs and subnational economic activity. However,

providing evidence of a causal relationship is beyond the scope of this article since the techniques implemented require strict assumptions to conjecture the existence of causality. Our empirical strategy is based on different techniques that complement each other to address the problem of data unavailability. Therefore, future research should address these limitations.

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Appendix A

Appendix A - Data sources and details of estimations				
Approach	**Variables**	**Source**	**Period**	**Data frequency**
Interrupted time series	ITAEE	INEGI	2004Q1-2015Q4	Quarterly
	USA	Federal Reserve Bank of St. Louis	2004Q1-2015Q4	Quarterly
Difference-in-differences	ITAEE	INEGI	Three-year average pre- and post-intervention	Average from quarterly data
Time-effects panel regression	ITAEE	INEGI	2004-2015	Annual
	GDP per State	INEGI	2004-2015	Annual
	GDP per worker	Own calculations based on INEGI	2004-2015	Annual
	Worker affiliated to social security	INEGI	2004-2015	Annual
	Net Foreign Direct Investment	Secretaria de Economía (Mexico)	2004-2015	Annual
	Public Investment	INEGI	2004-2015	Annual
	Homicides	INEGI	2004-2015	Annual
	Population	CONAPO	2004-2015	Annual
	Homicides per 100,000 inhabitants	Own calculations based on INEGI	2004-2015	Annual