The stick and carrot strategy: An empirical analysis of governmental intervention against illegal crops in front of the killings of social leaders.

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Abstract

Civil society participation is required to achieve strong peace agreements; however, these often fail to end conflicts and get durable peace when the physical security of the parties involved is not guaranteed. In Colombia, civil society has participated actively in peace agreements through the representation of social leaders. I study how the government eradication strategy is affected when the voluntary eradication program (PNIS) is implemented in municipalities where illegal criminal organizations threaten the security of social leaders; this paper estimates the effect of implementing the PNIS program in municipalities with potential exposure to violence for social leaders over the hectares of coca eradicated by government legitimate armed forces. I estimate the causal impact of treatment using micro-data at the municipal level and implement a difference-in-differences strategy with staggered adoption. I find that the rate of coca hectares manually forced eradicated (The stick strategy) increased by 6,5% after the PNIS program (The carrot strategy) began its implementation in municipalities with potential exposure to violence against social leaders and thus a deterioration of the PNIS program took place. The magnitude of this impact is intensified by other relevant variables such as the strength of legitimate armed forces (16,6%) and the contending of criminal organizations to take control of territories (14%). In contrast, I did not find effects on legal crop cultivation due to voluntary crop substitution.

Keywords: PNIS; Social leaders; Peacebuilding; Violence; Crops substitution; Coca; Colombia

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1 Introduction

Peace agreements are often failed to end conflicts and get durable peace. Arnault (2006) argues that although it is required to have a reasonable peace agreement from a constitutive[1] point of view, most of the success of a peace process relies on handling the implementation challenges. There are some case studies in which, during and after peace agreements were implemented; the violence increased mainly due to partial accords in conflicts that involved several armed groups[2]. Also, there is a general acknowledgment of the relevance of civil society participation in peace processes, thought in practice have proven extremely difficult to implement (Peace Direct, 2019).

In this line, Williams (2013) tracks nine initiatives worldwide in which civil society involves in the peace process in different roles. Therefore, civil society becomes peacebuilders by promoting social cohesion, reconciliation, and community-level mediation. The Colombian case is the recent case in which civil society played an essential role in the peace negotiations and the implementation of the peace agreement. Civil society participated in the Colombian peace process through the representation of regional social leaders in peace negotiation and implementation. The essential role of social leaders has been related to implementing a voluntary program of illegal crop substitution called PNIS, its Spanish acronym.

Arnault (2006) also highlights the main weaknesses that undermine the implementation of a peace process. The most severe flaw occurs when the physical security of the parties is not guaranteed. In Colombia, the Government has failed to provide security to the parties involved in the peace agreement, including social leaders. Killings of social leaders have been raised dramatically after the peace agreement. Since 2016, Colombia has the highest murder rate of human rights defenders in Latin America (International Crisis Group, 2020; Human Rights Watch, 2021).

This paper studies how the Government eradication strategy is affected when the voluntary eradication program (PNIS) is implemented in municipalities where illegal criminal organizations threaten the security of social leaders. Specifically, I study if the Government adopts the stick strategy of forced coca eradication when the carrot strategy of voluntary eradication program gets weak.

[1] This ex-ante approach stresses the stringent technical requirements that an agreement should meet: precision of terms, technical feasibility, international legitimacy, detailed implementation timetable, among others (Arnault, 2006).

[2] In Guatemala the violence increased severely after the Firm of the Acuerdo de Paz Firme y Duradera (By its name of Spanish) in 1996 according to (Aguirre, 2014). Similarly, the case of DR. Congo see: The Search for Elusive Peace in the Democratic Republic of Congo, Al Jazeera Centre for Studies. Available from: https://studies.aljazeera.net/en/reports/2015/12/201512301239519068 7.html. Some other cases are available in: https://www.ictj.org/sites/default/files/subsites/challenging-conventional-truth-commissions-peace/index.html05

In 2012, peace negotiations started with the FARC guerrilla. One of the critical points in the agenda related to rural reform was solving the problem of illicit drugs. The final agreement signed in late 2016 contained the National Program of Crop Substitution (PNIS, by its Spanish acronym). The PNIS program was designed to decrease the hectares of coca crops by voluntary substituting cultivations in exchange for conditional cash transfers and other benefits to farmers such as productive projects grants and technical assistance. The main cornerstone of this crop substitution program is the tripartite agreement between the Government, community, and FARC members to effectively reach the volunteer substitution of illegal crops. In this framework, the role of the community's social leaders encouraged farmers to eradicate voluntarily. The latter clarifies why social leaders represent a latent threat against criminal groups' political and economic interests.

Indeed, Prem et al. (2018) argues that local leaders constitute a threat to armed and illegal groups' interests due to several reasons. These include but are not limited to mobilizing people to claim the State's presence, represent national minorities, and lately support the implementation of the peace agreement. Indeed, as Llanes (2020) pointed out, social leaders have played an essential role in implementing the National Integrated Program for the Substitution of Illicit Crops (PNIS, by its Spanish acronym) due to the tripartite agreement between the Government, community, and FARC members.

Additionally, regarding the coca cultivation dynamics in Colombia, according to the United Nations Office on Drugs Crime (2020), even though the hectares cultivated with Coca have fallen in the last three years, the annual figures are located in the highest part of the historical series. Policies against illegal crops, particularly on Coca, have demonstrated not only to be ineffective in reducing the hectares of land cultivated with these crops but also have been proven to generate unintended consequences (Ladino et al., 2021; Mejia et al., 2019). With this in mind, the study of the strategy of illegal crop substitution is critical.

This work pretends to provide empirical evidence on the state response in its strategy of reducing illegal crops when the PNIS program takes place in municipalities where the social leaders are exposed to violence.[3]. I mainly focus on testing if the Government adopted the aggressive Coca forced manual eradication strategy when PNIS (voluntary substitution) program started in municipalities where illegal criminal organizations threaten the security of social leaders.

In this way, the theory of change on which this paper relies is the following: Given the critical role, social leaders have to ensure the proper functioning of PNIS (Carrot strategy); when a social leader is assassinated, a vacuum of leadership in voluntary illegal crops substitution is generated. In fact, Figure (B.1) depicts an increase in killings of social leaders while a fall in hectares was voluntarily eradicated by the PNIS program.

[3]My measure of exposure to targeted violence is a dummy variable called *high probability of killing social leaders*. It is a proxy of the potential weakness of PNIS implementation given the role of social leaders

Thus, the Government should react with the substitute strategy of forced manual eradication (Stick strategy) of illicit crops. Actually, as Nilsson & Marín (2021) recalls the eradication methodology[4] establishes: *those who refuse to be part of the program or do not follow the call for voluntary eradication will inevitably be subject to forced eradication by the Colombian unit for eradication*[5].

The empirical strategy used to estimate the causal effect of PNIS implementation in municipalities where the initiative of social leaders is affected by targeted violence over the rate of forced manual eradication considers the recent literature on the potential problems of using two-way fixed effects to obtain causal effects in difference-in-differences settings with staggered adoption and heterogeneous treatment effects (Chaisemartin & D'Haultfœuille, 2020)

Following Baker et al. (2021) after implementing the Bacon decomposition of the traditional TWFE estimator, I run some recent methodologies on staggered adoption of treatment. I evaluate how problematic it is to use a two-way fixed effect estimator to get the causal effect when there is a staggering treatment by the bacon decomposition recently proposed by Goodman-Bacon (2021)[6]. The identification strategy of this research relies on the parallel trend's assumption. I also test for potential mechanisms in which the treatment affects differently my main outcome variable; Strength of armed forces and the contending of criminal groups to take control of territories.

This paper finds that implementing the PNIS program in municipalities where illegal criminal organizations threaten the security of social leaders[7] increases the rate of coca forced manual eradication by 6,5%. The magnitude of the impact is intensified by other relevant variables such as the strength of legitimate armed forces (16,6%) and the contending of criminal organizations to take control of territories (14%). In addition to the former statement, complementing the results obtained, I included alternative outcome variables such as short-cycle crops to study the effects of the PNIS program in successful substitutions of coca crops.

To the best of my knowledge, mine is the first work that seeks to provide empirical evidence of the effects of implementing the PNIS program on the Colombian State's eradication strategy in front of the deterioration of the PNIS program via the killing of social leaders.

This research is related to the literature about the effectiveness of anti-drug policies in reducing hectares of illegal crops. This literature finds that drug eradication efforts are often ineffective in reducing coca cultivation and, in some cases, create unintended

[4]Proposed by the government into the national eradication methodology

[5]The special unit for eradication is composed of members of the national police department and the army.

[6]In this case, I did not find strong complaints against the TWFE Estimator based on Bacon decomposition results

[7]This should be understood as a proxy of a potential undermine of PNIS implementation

effects (Reyes, 2014; Ladino et al., 2021; Mejia et al., 2019). In terms of strategies for reducing coca cultivation, I find a switching effect from the carrot strategy of voluntary eradication to the stick strategy of forced eradication when the leadership of the carrot strategy is decaying due to exposure to targeted violence.

I also contribute to the literature that evaluates the relationship between the killing of social leaders and illegal crops. Regarding the empirical literature on the killing of social leaders, the paper of Prem et al. (2018) stands out. The authors address the killing of social leaders as an unintended consequence of the signing of the peace accords, more specifically, as a result of the struggle of other criminal groups for the territory. A couple of additional papers tackle the relationship between selective violence, the peace agreement, and illegal crops(Llanes, 2020; Rubio, 2020). In particular, Llanes (2020) concludes there is a causal effect of the substitution of illegal crops program increasing the killings of Social Leaders. I complement this literature showing that exposure to the killing of social leaders debilitated the PNIS implementation and increased the traditional forced manual eradication strategy.

The rest of the paper is organized as follows. The following section provides context on the Colombian conflict, illegal crops, and eradication strategy, and describes the PNIS program because of the current peace process. Section 3 describes the data sources, section 4 discusses the identification strategy and its primary identification assumption, section 5 reports the main results, robustness, and potential mechanisms, and finally, section 6 concludes.

2 Context

In late 2016, the final peace agreement between the oldest Latin American guerrilla, the Revolutionary Armed. Forces of Colombia (FARC, by its Spanish acronym) and the Government was signed. This political issue ended a long internal conflict that has been responsible for millions of victims and involved not only the FARC members and armed forces of the State but also other armed and criminal groups and rural communities. There is an increasing amount essays, publications, articles, etc., that study the unintended consequences of the peace agreement in several dimensions.

A key point related to the peace agreement was the strategy to face the increasing problem of illegal crops. In this way, the final document established the National Integrated Program for the Substitution of Illicit Crops (PNIS, by its Spanish acronym), which began its implementation in 2017.

First community agreements for being part of PNIS were signed in 2017, some others in 2018. These agreements offer several benefits to the farmer in exchange for the voluntary

eradication of their coca crops. According to Ladino et al. (2021), each cultivator can get up to 36 million COP (around 8.900 US dollars) in aid from PNIS by receiving benefits as follows: 1) Two million Colombian pesos (COP) in cash after signing the voluntary agreement (around 500 US dollars), 2) After eradication, five bi-monthly transfers of two million COP (around 500 US dollars), 3) In-kind transfers of 20,8 million COP for productive projects (around 5.100 US dollars), 4) Technical assistance for other crops 3,2 million COP (around 800 US dollars).

The central pillar the PNIS program relies on the tripartite agreement between the government, community, and FARC members to effectively reach the volunteer substitution of illegal crops. In this framework, the role of the community's social leaders[8] has been relevant due to these two things: first, the negotiation process, social leaders encourage farmers to eradicate voluntarily, Second, and equally important, they account for the compliance of the three actors in front of the pacts created by the peace agreement. The latter clarifies why social leaders represent a latent threat against criminal groups' political and economic interests. In fact, Llanes (2020) found a causal and positive effect of the implementation of the PNIS program on the killings of social leaders.

Killings of social leaders have been raised dramatically after the peace agreement. Between 2016 and early 2020, at least 515 leaders have been assassinated. Thus, since 2016, Colombia has the highest murder rate of human rights defenders in Latin America (Somos Defensores, 2020). The historical impunity rate against human rights defenders in Colombia has been around 95%.

Targeted killings is often a better strategy than indiscriminate violence to exercise control over territories. (Steele, 2017, 2009; Eck & Hultman, 2007; Ziemke, 2007). Moreover, since the Coca crops serve as a funding source for insurgent groups (**?**) and social leaders have played an essential role in implementing the PNIS program (Llanes, 2020) therefore implementing PNIS where killing of social leaders is high could not be completely effective.

Articles have brought evidence that forced eradication actions to generate unintended adverse effects, which direct or indirectly cause surprises such as an increase in the extension of coca crop cultivation in the territory; coca eradication is ineffective since producers compensate for supply controls by cultivating more extensively (Moreno-Sánchez et al., 2003). Additionally, (Ladino et al., 2021; Lopez et al., 2019), and (Mejia et al., 2019) have shown that the announcement of PNIS created an anticipation effect that implied unintended consequences in terms of the effectiveness of the PNIS program; Authors agree that the early announcement of benefits in exchange of voluntary coca eradication

[8]According to the Information System on Attacks on Human Rights Defenders in Colombia (SIADDHH, by its Spanish acronym), a social leader is someone that accomplishes two characteristics. First, it is recognized by a community or human group as a social leader. Second, following the UN definition, it is dedicated to the defense, promotion, respect, and protection of human rights nationally and internationally and works to eliminate human rights violations effectively.

led an increase in coca cultivation by generating perverse incentives.

The latter partially explains why despite several anti-drug programs such as PNIS and Plan Colombia[9], the amount of coca hectares cultivated has reached the highest numbers in Colombia History. Regarding the evolution of illegal crops in Colombia, the United Nations Office on Drugs Crime (2020) revealed that in 2018 the amount of coca cultivation was slightly lower than in 2017 (the highest level ever reported in Colombia). The document also highlights the rise and persistence of illegal crops.

3 Data

I combine data from different sources to study the effect of the PNIS implementation in municipalities with a high probability of killing social leaders over the government strategy of forced coca eradication. This section describes the different data sources used for this research and provides a short descriptive analysis of the data.

PNIS program: I obtained data on the PNIS program at the municipality level on hectares of coca voluntary eradicated by farmers as well as the timing of the signature of communitarian agreements around PNIS[10]. According to these data, 56 municipalities nationwide have farmers under the PNIS program; most PNIS agreements were signed in 2017 (45 municipalities out of 56), while PNIS started in 2018 for some other municipalities (11 municipalities, many of them located in the Putumayo state).

Killings of social leaders: To construct my measure of exposure to targeted violence prior to the start of the PNIS implementation, I use a database for the killing of social leaders in Colombia between 2009 and 2019 from the SIADDHH[11] promoted by the NGO Somos Defensores. It compiles information from a network of Human Rights organizations in the various municipalities affected by the conflict, along with their information. This database makes it possible to identify the typology of the social leader and the perpetrator of the murder[12]. Table (A.1) reports the states in which the killing of social leaders are concentrated. At the same time, Figure (B.2) show the dynamic of the three most common kind of leaders assassinated reported in Table (A.2). The measure of municipalities with a high probability of killing social leaders and potential weakness of the PNIS was constructed as a municipality dummy variable that takes a value of one if at least one killing of social leaders between 2009 and 2016 (Before the PNIS implementation) were registered.

[9]It is a historical international joint strategy between Colombia and the U.S to combat illegal drug production and the illegal armed forces (Guerrilla and paramilitary groups)

[10]Through a formal petition to the Territorial Renewal Agency (ART, by its Spanish acronym).

[11]Information System on Attacks on Human Rights Defenders in Colombia (SIADDHH, by its Spanish acronym)

[12]In most of the cases the perpetrator of murders is not available.

From these data on the PNIS program and the killing of social leaders, I define the treatment as the interaction of i) the staggered PNIS implementation and ii) The measure of a high probability of killing social leaders (A proxy of potential weakness on PNIS implementation).

Forced Eradication of Coca: My primary outcome variable is the share of hectares of coca crops manually forced eradicated relative to the size of the municipality in hectares. This variable was constructed using the municipality hectares of coca manually eradicated by Colombian authorities obtained from the CEDE[13] panel, which extracts this information from the Colombia Drug Observatory (SIDCO, by its Spanish acronym).Table (1) reports that the rate of forced coca eradication is higher in municipalities where the PNIS was implemented and social leaders had exposure to violence.

Legal crops cultivation: I define as alternative outcome variables the rate of cultivation of some legal crops to identify changes in their dynamics due to illegal crop substitution. Based on the reports of the PNIS[14] program about the productive projects ex-coca producers focuses on the substitution strategy, I selected four legal crops short-cycle corn, rice, cotton, and potato. We use data on the area sown for each crop on hectares from the panel of agriculture from the CEDE municipal panel[15].

Coca cultivation: Data on coca cultivation is available for this research thanks to the Integrated System of Illicit Crops Monitoring (SIMCI, by its Spanish acronym) of the United Nations Office on Drugs and Crime. Thus, I obtain annually geo-referenced data on coca from 2009 to 2019 at the 1km x 1km grid-level through satellite images. I collapsed coca hectares of coca cultivation at municipality levels. Data reveals that 321 municipalities have registered hectares of coca in some years in the analysis period.

Potential Mechanisms: To study heterogeneous effects based on the strength of official armed forces, I built three different measures using several sources of data. The first approach captures the violent presence of Government forces at the municipality level with a dummy variable between 2011 and 2014, before the PNIS implementation. To do this, I use data on the violent presence of both illegal and legal armed actors obtained from the ViPAA[16] panel data produced by Osorio et al. (2019). Also, two alternative measures are constructed from a database on police effectiveness against illegal drugs provided by the police information system of crime (SIEDCO, by its Spanish acronym) for the 2011-2014 period. One of them is a dummy variable that takes the value of one at the municipality level if the amount of seizures of coca is above the national media, zero otherwise. Similarly, I define the last measure as a dummy variable; one if the cocaine

[13]Municipal panel of the Centro de Estudios sobre Desarrollo Económico (CEDE, by its Spanish acronym) at Universidad de los Andes

[14]Reports on PNIS implementation are periodically released by the United Nations Office on Drugs and Crime.

[15]I decided to use area sown in hectares above some other measures such as harvested area or production in tons because the latter are outcomes that depend on some other exogenous variables.

[16]Violent Presence of Armed Actors in Colombia. Available at: https://www.colombiaarmedactors.org/

trafficking arrests are above the national media, zero otherwise.

Data for testing potential mechanisms on the exposure to different criminal groups are also provided by ViPAA data[17]. In particular, I focus on the former joint presence of FARC and other illegal groups.

Control variables: The municipal panel of the Centro de Estudios Sobre Desarrollo Económico (CEDE, by its Spanish acronym) at Universidad de Los Andes consolidates yearly information at the municipal level from different sources and entities in a single database. The panel presents information on the general characteristics of the municipalities, fiscal and good governance variables, conflict and violence, education, the agricultural sector, health, and public services. There are three types of controls at the municipality level: geographical, socioeconomic, and fiscal characteristics.

Table 1: Summary statistics

	Non-treated municipalities				Treated municipalities			
	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max
Geographic								
Altitude	1,157.091	923.033	1	3,350	398.172	403.462	3	1,750
Distance to the capital of the department	82.640	59.530	0.00	493.084	101.790	74.301	0.00	360.770
Distance to the wholesale food market	129.751	111.453	4.524	926.467	192.531	94.145	31.575	343.508
Distance to Bogotá	318.215	195.000	11.920	1,270.850	396.512	105.360	204.262	546.584
Municipality area km²	94,314.090	317,227.800	1,500	6,567,400	343,810.300	434,623.500	21,200	1,787,300
Socioeconomic								
Ln (total population)	9.433	0.973	5.649	12.202	10.366	0.617	9.105	12.095
Multidimensional Poverty Index	69.944	15.857	14.272	100	78.770	10.516	52.583	94.485
Language test score	48.182	2.460	33.988	58.417	48.166	1.437	45.294	50.626
Math test score	48.123	2.996	34.388	63.681	48.360	1.752	44.791	52.062
Educational institutions	40.204	32.494	1.00	223.000	118.276	74.511	39	348
Number of teachers	214.948	274.639	1.00	2,410.000	427.276	401.570	112	2,297
Fiscal								
Ln (Tax income)	6.734	1.342	2.372	12.067	7.516	0.755	6.116	8.872
Good fiscal policy index	66.239	9.439	0.00	94.190	66.632	5.502	50.610	77.520
Rate of forced coca eradication	0.0189	0.148	0.000	0.197	0.245	0.328	0.000	0.597

Notes: Control variables are measured in 2010. Altitude above sea level of the urban center of each municipality. Distance to the wholesale food market is linear distance to the main food market of each municipality. Municipal area official in hectares. Total municipal population (in logs). Proportion of people in poverty according to multidimensional index. Percentage literate population. Math and language scores is the municipal average scores per area for high-school graduates in the official standardized test. Number of educational institutions and teachers.Tax income is municipal total amount collected taxes. Good fiscal policy index of efficiency, legal requirements and management of the fiscal resources.

Table (1) presents descriptive statistics for the covariates used in this study as control variables by the exposure to the treatment. There are three types of controls at the

[17]Even though this data reports the location of armed actors involved in violent attacks, it is a noisy measure of criminal groups presence since it does not necessarily reflect cases in which armed actors are present in a territory but refrain from exercising violence (Arjona & Otalora, 2011).

municipality level: geographical, socioeconomic, and fiscal characteristics. I account for invariable municipal features measured in 2010[18], previous the peace agreement. In particular, controlling for Geographic variables allows me to control, at least partially, for municipality characteristics that make cocoa production more or less suitable. Indeed, Mejía & Restrepo (2013) argues a coca suitability index produced by themselves using geographic variables predicts the location of coca crops across municipalities.

4 Empirical strategy

Since the conducted PNIS eradication program was not randomly assigned in municipalities; the impact evaluation of my treatment variable[19] requires addressing having unobserved confounding factors correlated with the hectares of coca forced eradicated. The current section describes the empirical strategy used to estimate the causal effect of implementing PNIS in municipalities where illegal criminal organizations threaten the security of social leaders on the hectares of coca forced eradicated.

The unit analysis defined for this research is the municipality. As previously pointed out, the PNIS program occurs at different times along the sample period. Hence, the empirical strategy is a Staggered Difference-in-Differences setting. Under this quasi-experimental strategy, municipalities can adopt the treatment (PNIS program in this case) at any time during the period.

Therefore, the following is the Staggered Diff-in-Diff representation of the relation of interest:

$$Y_{j,t} = \beta_0 + \beta_1 PNIS_{j,t} \times ExposureTKillings_j + \gamma \sum_{x \in X_{j,2010}} (x \times \theta_t) + \theta_t + \alpha_j + \epsilon_{j,t} \quad (1)$$

Where t indexes years, j indexes municipalities. The outcome variable of interest $Y_{j,t}$ represents the rate of hectares of Coca manually forced eradicated by Colombian authorities in time t relative to the hectares of the municipality j. Also, to reduce the skewness and narrow the ranges of this outcome that have heavily right-skewed and include zero values, I used the inverse hyperbolic sine (IHS) transformation [20]. Results on different specifications of the outcome are presented in the following sections.

I include yearly fixed effects θ_t, and municipality fixed effects α_j. The inclusion of unit and time fixed effects accounts for both unit-specific (but time-invariant) and time-

[18] All variables are measured in 2010 except the Multidimensional Poverty Index measured in 2005

[19] PNIS interventions in municipalities with a high probability of killing social leaders

[20] $Y_{j,t}$ is the inverse of hyperbolic sine transformation $ln(x_{j,t} + \sqrt{x_{j,t}^2 + 1})$ where $x_{j,t}$ is the proportion of coca manually forced eradicated

specific (but unit-invariant) unobserved confounders in a flexible manner. $X_{j,2010}$ is a vector of control covariates fixed in a period before the implementation of PNIS (2010) which I interact by each year to get the differential effect over time of these covariates. The treatment is defined by the following interaction of $PNIS_{j,t} \times ExposureTKillings_j$ in which $PNIS_{j,t}$ is a dummy that takes value one in municipality j after the sing of PNIS agreement in a certain year. Similarly, $ExposureTKillings_j$ is a municipality-level variable that represents the measure of exposure to killings of social leaders, this variable takes value of one in municipalities with a high probability of killing of social leaders[21] and zero otherwise. Finally, the error term $\epsilon_{j,t}$ while the standard errors are clustered at the municipality level.

Several recent research has demonstrated that using the traditional two-way fixed effects (TWFE) statistical model to obtain the ATT under this scenario of staggered adoption of treatment is a bad idea since the estimator can suffer from a severe bias. However, Goodman-Bacon (2021) proposed a recursive method called bacon decomposition to evaluate how significant is the bias relative to the estimated ATT by analyzing the difference in difference estimators among the possible treatment-group pairs. Thus, I first ran the traditional difference in difference model through the TWFE. Table (1) contains this results. Following Baker et al. (2021), after doing that, I use the bacon decomposition to assess the validity of a TWFE estimator[22]. Table (2) reveals the weight of the *Forbidden comparison* (Use early treated as the comparison group of late treated) is less than one percent. In contrast, the comparison between treated vs. never treated has a higher weight (around 99.8%) and has a 2x2 difference in difference estimator close to the overall diff-in-diff estimation.

Although using the TWFE estimator seems not problematic in this context, in order to avoid potential bias and provide robustness exercises, I use some recent alternative estimators proposed in treatment heterogeneity and staggered adoption settings.

The methodology developed by Callaway & Sant'Anna (2021) considers an estimation procedure in which there is group-time ATT that is unique for all the units treated at a given point of time. That is to say, this procedure calculates the ATT for treatment units grouping by the timing of treatment adoption. However, this group-time ATT can also be understood as a dynamic term. The latter lets me track the dynamics of the ATT for a treated group in a particular year across the timeline.

As I previously explained, the PNIS program was adopted in different years for some municipalities. Among the 56 municipalities that adopted PNIS, 45 did it in 2017, and 11

[21] The measure of municipalities with a high probability of killing social leaders (A proxy of the deterioration of the PNIS) was constructed as a municipality dummy variable that takes a value of one if at least one killing of social leaders between 2009 and 2016 were registered

[22] According to Cunningham (2021) the weights and the 2×2 comparisons calculated in Bacon decomposition, can be a source of insight into why the twoway fixed effects estimator is finding what it finds. In other words, it is possible to know what explains the estimated δ_{TWFE} and also whether this is problematic or not.

in 2018. Thus, Callaway & Sant'Anna (2021) cluster municipalities in these two groups and never treated municipalities. This methodology allows me to 1) Calculate cohort-specific treatment effects in the function of the year of treatment adoption. 2) Identify the dynamics of the specific group ATT along the time. Finally, the authors proposed a simple way to aggregate the group-time ATT into an overall ATT that internalizes the treatment's staggered adoption and enables dynamic analysis of the ATT (Cunningham, 2021).

However, according to Borusyak et al. (2021), an important limitation of this robust estimator and other similar such as Chaisemartin & D'Haultfœuille (2020) is that their efficiency properties are not known. They proposed another practical solution for the potential bias generated by the TWFE estimator in staggered treatment adoption through an imputation procedure. They derive the efficient estimator when treatment-effect heterogeneity is unrestricted. I also included the results of Borusyak and author's methodology in this research, see Table (A.6).

My empirical strategy relies on the primary assumption that if the PNIS program had not taken place, the forced manual eradication of coca cultivation would have printed a similar dynamic in municipalities exposed to a high probability of killing social leaders and municipalities without targeted violence. The timing of PNIS implementation should be uncorrelated with the hectares of coca cultivation manually forced eradicated, controlling on covariates previously defined and the year and municipality fixed effects. This assumption is known as the no anticipation phenomenon. In other words, it means that before the PNIS implementation, a significant change in coca manually forced eradication could not occur; otherwise, the assumption would be violated.

More generally, the dynamic specification that allow me to provide evidence on the parallel trends assumption is the following event study or staggered design.

$$Y_{j,t} = \beta_0 + \sum_{t=-K}^{-2} \omega_t d_{j,t} + \sum_{t=0}^{L} \delta_t d_{j,t} + \theta_t + \alpha_j + \epsilon_{j,t} \tag{2}$$

where $d_{j,t}$ is a dummy variable that takes the value of 1 from period t in which the PNIS program started in municipality j with high exposure to killing of social leaders. While K is defined as the number of periods prior to the treatment and L is the number of periods after the treatment, relative to the treatment period (Adoption of PNIS program).

In addition, to account for potential mechanisms in which the PNIS implementation in municipalities with exposure to the killing of social leaders affects the government's coca eradication strategy, I use a variation of the main specification represented in Equation (1). As Equation (3) shows, I use triple interactions to test for heterogeneous effects using the historical presence of FARC and a measure of state capacity at the municipality level.

Formally, I estimate the heterogeneous effects of any variable Z as follows:

$$Y_{j,t} = \lambda_0 + \lambda_1 PNIS_{j,t} \times ExposureTKillings_j \times Z_{j,T} + \lambda_2 ExposureTKillings_j \times Z_{j,T} + \lambda_3 PNIS_{j,t} \times Z_{j,T} + \gamma \sum_{x \in X_{j,2010}} (x \times \theta_t) + \theta_t + \alpha_j + \epsilon_{j,t} \quad (3)$$

Notice $Z_{j,T}$ could be any variable at the municipality level I want to focus on. However, to avoid any source of endogeneity, this variable should be measured in any time T before PNIS implementation. In addition, λ_1 is the parameter of interest though his interpretation should be careful since it not necessarily represents a causal effect.

5 Results

5.1 Main results

Following the empirical strategy proposed in previous section, β_1 in Equation (1), captures the average differential change in hectares of coca cultivation manually force eradicated before and after the implementation of PNIS program in municipalities with and without prior killing of social leaders. Table (2) presents the results for the difference-in-differences specification for the traditional TWFE of equation (1). Columns 1 and 2 show the estimation results when the municipalities in the sample are restricted to municipalities with less than 200 thousand population. While columns 3 and 4 print the results when I restrict the analysis to coca producer municipalities.

Thus, PNIS implementation in municipalities with high exposure to targeting violence against social leaders increases the proportion of coca hectares manually forced eradicated. After PNIS implementation, the proportion of coca cultivation manually forced eradicated increased by around 6,5% in areas with a high probability of killing social leaders with respect to the rest of the municipalities. This result is robust to focus the analysis on coca producer municipalities.

Results reported in Table (2) came from the simple TWFE estimator. Since literature has proven the TWFE estimator to be biased when heterogeneous treatment and staggering adoption, Table (A.3) presents the performed Bacon decomposition to assess the validity of TWFE results.

Table (A.3) reveals the weight of the *Forbidden comparison* (Use early treated as the comparison group of late treated) is less than one percent. In contrast, the comparison between treated vs. never treated has a higher weight (around 99.8%) and has a 2x2

Table 2: Government coca eradication strategy

	Dependent variable: % of Hectares manually forced eradicated			
	(1)	(2)	(3)	(4)
$PNIS \times ExposureTKillings$	0.0656***	0.0644***	0.0672***	0.0641***
	(0.0250)	(0.0249)	(0.0258)	(0.0252)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
Clustered errors	Yes	Yes	Yes	Yes
Observations	12,034	11,682	3,531	3,311
R-squared	0.327	0.337	0.347	0.369
Mean of dependent variable	0.028	0.028	0.090	0.090
Number of municipalities	1094	1094	321	321

Notes:*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level. This table presents the traditional TWFE estimator for the parametric Diff-in-Diff. Errors are clustered at the municipality level and are shown in parentheses. In columns 1-2, I restrict the sample to municipalities with total population below 200 thousand. In columns 3-4 I restrict the sample to coca producers municipalities. Columns 2 and 4 includes all the control variables as in Equation (1).

difference in difference estimator close to the overall diff-in-diff estimation. Figure (B.3) shows the magnitude of calculating diff-in-diff estimators by pairs of comparison.

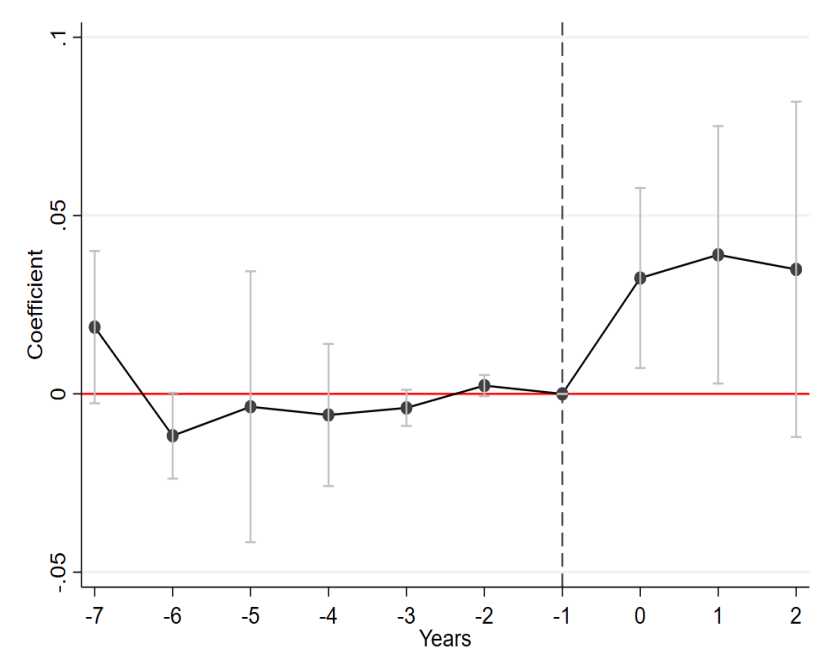
As a robustness check, I ran alternative estimators recently proposed by literature to obtain the ATT successfully. Table (A.4) suggests Callaway & Sant'Anna (2021) estimator in a staggered treatment design shows the same effect of PNIS adoption in municipalities with exposure to the killing of social leaders over the proportion of hectares of coca manually eradicated (increasing of 6,5%). Similarly, following Borusyak et al. (2021),I find the magnitude of the treatment effect is around 5%, a little bit below the printed in (Callaway & Sant'Anna, 2021). Table (A.6) reports the results for this estimator which is based on a imputation strategy.

Regarding the main identification assumption of no anticipation effect, There should not be differential trends in the pre-treatment period between treated and control municipalities. In other words, it means the point estimates given by ω in Equation (2) should not be statistically different from zero.

Indeed, Figure (1) displays the result of the dynamic difference-in-differences defined in equation (2). Since all the point estimates before PNIS implementation are statistically equal to zero, the identification assumption of no anticipation effect is empirically satisfied. Then post-treatment coefficients could be understood as dynamic causal effects of PNIS implementation under exposure to the killing of social leaders on the govern-

mental eradication strategy. That is to say, parameter δ in equation (2) turns to causal interpretation.

Figure 1: Event study differential coca manually forced eradicated in KSL/No KSL areas before and after PNIS



Notes: This figure illustrates the event study for the forced coca eradication comparing municipalities with a high probability of killing social leaders and others.

This illustration makes it possible to identify the positive effect of PNIS when implemented in municipalities with high exposure to the killing of social leaders (KSL areas) on the coca eradication strategy adopted by the government. It is clear that after implementing PNIS, treated and control units do not follow the same path. Even having a big noise in the standard errors, it is possible to identify significant effects in two periods ahead. Figure (B.4) shows the event study for the main specification when the sample is reduced to coca producer municipalities.

I also demonstrated results are robust to different specifications for the outcome variable. Table (A.5) reports the estimator of ATT for different specifications of the outcome variable that is the proportion of hectares of coca cultivation manually forced eradicated relative to the area of municipality in hectares. In particular, I account for three different specifications: 1) Simple manually forced eradication rate, 2) Log transformation of the eradication rate, and 3) Inverse Hyperbolic Sine of the eradication rate[23]. Results for

[23]Log transformation is defined as follows: $Ln(x+1)$ in my case x where x is the proportion of coca manually forced eradicated. Similarly, Inverse Hyperbolic Sine (IHS) transformation is given by: $ln(x+\sqrt{x^2+1})$ where x is the proportion of coca manually forced eradicated

different specifications are similar in direction, magnitude, and significance.

5.2 Potential mechanisms

To account for potential mechanisms in which our treatment affects the government strategy for coca eradication differentially, I study the relevance of heterogeneous effects of some municipal characteristics empirically. I consider two kinds of potential mechanisms: i) the strength of the legitimate armed forces measured in three different ways. ii) the exposure to different criminal groups at municipal level[24].

According to the Ministry of Justice, the forced manual eradication strategy of coca crops oversees the unit for eradication called Mobile Eradication Groups (GME, by its Spanish acronym), composed of members of the national police department and the army. This group is trained in different skills, within highlights to be capable of dealing with landmines and improvised explosive devices. This special unit for eradication requires supporting security from the official armed forces to conduct their eradication tasks.

In this line, I test if the increase of forced manual eradication due to implementing the PNIS program in municipalities with a high probability of killing social leaders is intensified by the strength of the legitimate armed forces at municipality levels. To do this formally, I estimate Equation (3), in which, using a triple interaction, I include different measures of strength of armed forces as the variable Z.

I find an incremental effect (16.6%) on the strength of armed forces over the rate of forced coca eradication after the beginning of PNIS implementations in municipalities influenced by the killing of social leaders (Column 1 of Table (A.7)). Results for other measures of the strength of armed forces are reported in Columns 2 and 3; these results are equally statistically significant but show moderate results compared to Column 1. In line with the initial hypothesis, when the PNIS program is implemented in municipalities where illegal criminal organizations threaten the security of social leaders, the increase in the rate of hectares of coca manually forced eradicated is higher when it occurs in municipalities with strong armed forces since it helps to provide security in eradication procedure.

On the other hand, I explore the exposure to different criminal groups that ultimately translate into exposure to violence as a potential mechanism. Prem et al. (2018) argues that after the FARC demobilization, a vacuum of power was generated, and other criminal groups with a presence in municipalities had incentives to take control of these territories. However, social leaders represent a threat to that end. In this regard, municipalities with several organized criminal groups, including FARC, before the peace

[24]As exposed in section 3, the municipal characteristics used to test potential mechanisms were measured before the treatment to avoid any font of endogeneity.

agreement should be territories where the killing of social leaders was a territorial gain strategy. Thus, the PNIS program as an eradication strategy deteriorates, obliging the government to adopt the stick eradication strategy (forced manual eradication).

To test this hypothesis, I constructed two different measures of exposure to criminal groups using the ViPAA[25] database on violent acts between 2011 and 2015. Similar to previous research on conflict in Colombia (Acemoglu et al., 2009; Fergusson et al., 2013; Prem et al., 2018), I create two dummy variables at the municipality level; the first one accounts for the presence of FARC guerrilla and ELN[26] and other paramilitary groups, and the second accounts for the former FARC presence.

The estimation of Equation (3) for the heterogeneous effect of these variables is reported in Table (A.8). Overall, positive and significant coefficients were found for the exposure to different criminal groups. In particular, Column 1 of Table (A.8) reveals that the coefficient for the triple interaction of PNIS implementation, high probability of killing social leaders, and the exposure to FARC, ELN, and other paramilitary groups is 0.14 and significant at the 95%. Similarly, in Column 2, I find an effect of the triple interaction of 9%[27] which is slightly above the baseline effect (6.5%).

5.3 Alternative outcome variables

I include as alternative outcome variables the rate of cultivation of some legal crops to identify changes in their dynamics due to illegal crop substitution. As previously pointed out, the PNIS program includes complimentary aids to support the effectiveness of voluntary eradication and substitution, such as in-kind transfers for productive projects and assistance in cultivating other crops. According to the Territorial Renewal Agency (ART, by its Spanish acronym), productive projects and the technical assistant focus on short-cycle projects.

Therefore this research studies what happened with the cultivation of legal short-cycle crops after PNIS implementation in municipalities with a high probability of killing social leaders. To do this, I re-estimate Equation (1), replacing the outcome variable with the rate of area cultivated with several short-cycle crops relative to the municipality's total area[28]. I selected four legal crops with short-cycle based on the crops in which productive projects were focused in different regions according to the reports of the PNIS program released periodically by the United Nations Office on Drugs and Crime. These crops are corn, rice, cotton, and potato.

[25] Violent Presence of Armed Actors in Colombia

[26] National Liberation Army, ELN by its Spanish acronym

[27] A possible explanation of the magnitude of this interaction is close to the baseline effect reported in Table 1; Both specifications exploit the same variability, given that the PNIS program was implemented in municipalities with a former FARC presence.

[28] This outcome variable also was transformed with the inverse hyperbolic sine.

Table (A.9) shows neither statistical nor economic significant effects on Columns 1,2 and 4, which correspond to corn, rice, and potato. Figure (B.5) plots the treatment effect on the rate of hectares cultivated across the years and confirms there is no statistically significant effect. Regarding the cotton crop cultivation results, (Table (A.9) , Column 3) reports an adverse effect of 12% with 10% of significance. However, Figure (B.5C) also reveals that the identification assumption was violated since no anticipation assumption is broken in several periods. In general, there is not evidence that implementing the PNIS program in municipalities with exposure to targeted violence against social leaders increases or decreases hectares of legal short-cycle crops. The latter could be due to two main reasons: first, the policy of productive projects and technical assistance has a local effect that a municipality-level study can not capture. Second, the farmers that adopted the program of voluntary eradication PNIS can accede to neither technical assistance to cultivate legal crops nor to funding for productive projects. Indeed, according to Blanco et al. (2019), by the 2018 year-end, only 32% of farmers in the PNIS program had received technical assistance.

6 Conclusions

In this paper, I studied the impacts of implementing the PNIS program in municipalities with exposure to targeted violence against social leaders on the government strategy for eradicating coca cultivations and areas cultivated with legal crops within a short cycle. I found that implementing the PNIS program in municipalities exposed to killing of social leaders, leads to an increase of 6,5 % in the rate of hectares manually forced eradicated. On the other hand, I do not find any differential dynamic for the cultivation of legal crops with a short cycle after PNIS implementation in municipalities where social leaders had exposure to violence.

I investigate two mechanisms that potentially drive the result for the forced manual eradication. First, I found an incremental effect (16.6%) on the strength of armed forces over the rate of forced coca eradication after the beginning of PNIS implementations in municipalities influenced by the killing of social leaders.This result is consistent with the idea of the requirement of security to successfully implementing the forced eradication by army and police. Second, I conclude that in municipalities with multiple illegal organizations before the peace agreement, the forced manual eradication also increases. This is in line with Prem et al. (2018) that argues the violence generated by a vacuum of power in order to take control over territories increases the killing of social leaders. The PNIS program deteriorates, and the government increases efforts to force coca cultivations eradication manually.

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Appendix A Additional tables

Table A.1: Top 5 Departments with killing of social leaders

Department	Number of killings of social leaders
Cauca	163
Antioquia	133
Valle del Cauca	55
Nariño	54
Norte de santander	43

Notes: This table reports the top 5 Departments that focus the distribution of the killing of social leaders during our period of analysis, 2009 to 2019

Table A.2: Top 5 Kind of leadership with the higher killing of social leaders numbers

Kind of leadership	Number of killings of social leaders
Community leader	380
Indigenous leader	217
Peasant leader	147
Victims of conflict leader	64
Afro-Colombian community leader	48

Notes: This table shows the top 5 type of leaders assassinated during our period of analysis, 2009 to 2019.

Table A.3: Bacon decomposition

Overall Diff-in-Diff estimate: 0.066		
DD Comparison	Weight	Av. DD Est
Early treated (T) vs Late treated (C)	0.002	0.049
Late treated (T) vs Early treated (C)	0.001	0.145
Treated (T) vs Never treated (C)	0.997	0.066

Notes: This table presents the decomposition of the two-way fixed effects (TWFE) model from the equation (1).

Table A.4: Alternative estimators: Callaway & Sant'Anna (2021)

	Dependent variable: % of Hectares manually forced eradicated			
	(1)	(2)	(3)	(4)
$PNIS \times ExposureTKillings$	0.0727***	0.0668***	0.0729***	0.0641***
	(0.0293)	(0.0282)	(0.0276)	(0.0252)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
Clustered errors	Yes	Yes	Yes	Yes
Observations	12,034	11,682	3,531	3,311
Mean of dependent variable	0.028	0.028	0.090	0.090
Number of municipalities	1094	1094	321	321

Notes:*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level. This table presents the e overall ATT estimator proposed by Callaway & Sant'Anna (2021). Errors are clustered at the municipality level and are shown in parentheses. In columns 1-2, I restrict the sample to municipalities with total population below 200 thousand. In columns 3-4 I restrict the sample to coca producers municipalities. Columns 2 and 4 includes all the control variables as in Equation (1).

Table A.5: Transformation of the outcome variable

	Dependent variable: Hectares coca manually forced eradicated		
	(1)	(2)	(3)
	Share of coca	Log(Share of coca)	IHS Share of coca
$PNIS \times ExposureTKillings$	0.0645***	0.0513***	0.0644***
	(0.0249)	(0.0185)	(0.0249)
Year FE	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Clustered errors	Yes	Yes	Yes
Observations	11,682	11,682	11,682
Mean of dependent variable	0.02846	0.0258	0.02845
S.D. of dependent variable	0.02678	0.02130	0.02675
Number of municipalities	1094	1094	1094

Notes:*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level. This table presents the overall ATT estimator proposed by Callaway & Sant'Anna (2021) for three different especificactions of outcome variable. Errors are clustered at the municipality level and are shown in parentheses. Column 1 shows results when outcome variable is defined as the simple manually forced eradication rate. Column 2 applies the Log transformation for the eradication rate. Column 3 three applies Inverse Hyperbolic Sine transformation for the eradication rate.

Table A.6: Borusyak estimator

	% of Hectares manually forced eradicated
$PNIS \times ExposureTKillings$	0.04857***
	(0.01835)
Year FE	Yes
Municipality FE	Yes
Controls	Yes
Observations	11,682
R-squared	0.3621
Number of municipalities	1094

Notes:*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level. This table presents the overall ATT estimator proposed by Borusyak et al. (2021) for three different especificactions of outcome variable. Errors are clustered at the municipality level and are shown in parentheses.

Table A.7: Heterogeneous effects: The strength of the legitimate armed forces

	Dependent variable: Hectares coca manually forced eradicated		
	(1)	(2)	(3)
$PNIS \times ExposureTKillings \times S.ArmedForces_1$	0.166**		
	(0.0809)		
$PNIS \times ExposureTKillings \times S.ArmedForces_2$		0.0716**	
		(0.0319)	
$PNIS \times ExposureTKillings \times S.ArmedForces_3$			0.0863**
			(0.0357)
Year FE	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Clustered errors	Yes	Yes	Yes
Observations	11,682	11,682	11,682
Mean of dependent variable	0.02845	0.02845	0.02845
S.D. of dependent variable	0.02675	0.02675	0.02675
Number of municipalities	1094	1094	1094

Notes:*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level. This table presents the TWFE estimator for the triple interaction of equation (3). Errors are clustered at the municipality level and are shown in parentheses. In column 1, the strength of armed forces is capture by violent presence of Government forces at the municipality level with a dummy variable between 2011 and 2014, before the PNIS implementation. In column 2 I define the strength of armed forces as a dummy variable that takes value of one if the amount of seizures of coca is above the national media, zero otherwise. Similarly, In column 3 I define the last measure as a dummy variable; one if the cocaine trafficking arrests are above the national media, zero otherwise. All specifications include the interactions terms defined in equation (3).

Table A.8: Heterogeneous effects: The exposure to different criminal groups before peace agreement

Dependent variable: Hectares coca manually forced eradicated		
	(1)	(2)
$PNIS \times ExposureTKillings \times OtherGroups_1$	0.141**	
	(0.0721)	
$PNIS \times ExposureTKillings \times OtherGroups_2$		0.0901*
		(0.0474)
Year FE	Yes	Yes
Municipality FE	Yes	Yes
Controls	Yes	Yes
Clustered errors	Yes	Yes
Observations	11,682	11,682
Mean of dependent variable	0.02845	0.02845
S.D. of dependent variable	0.02675	0.02675
Number of municipalities	1094	1094

Notes:*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level. This table presents the TWFE estimator for the triple interaction of equation (3). Errors are clustered at the municipality level and are shown in parentheses. In column 1, the *OtherGroups* is a dummy variable accounts for the presence of FARC guerrilla and ELN[a] and other paramilitary groups, and in column 2 account for the FARC presence, between 2011 and 2014. All specifications include the interactions terms defined in equation (3).

[a]National Liberation Army, ELN by its Spanish acronym

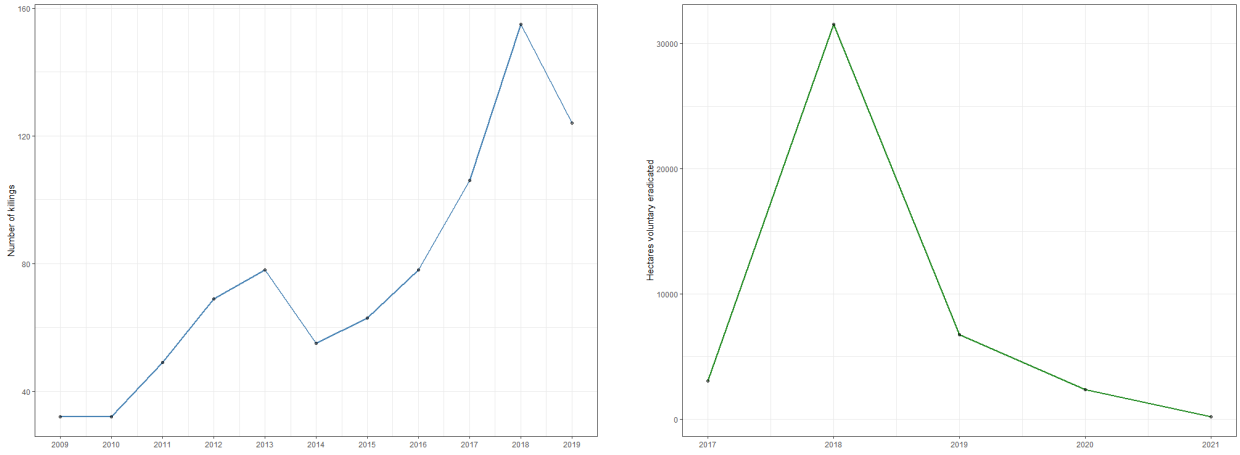
Table A.9: Alternative outcome variables

	Dependent variable: cultivation of legal crops short-cycle			
	(1)	(2)	(3)	(4)
	Corn	Rice	Cotton	Potato
$PNIS \times ExposureTKillings$	0.0065	-0.00351	-0.1221*	-0.00440
	(0.0094)	(0.0033)	(0.0676)	(0.0685)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Clustered errors	Yes	Yes	Yes	Yes
Observations	11,682	11,682	11,682	11,682
Number of municipalities	1094	1094	1094	1094

Notes:*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level. This table presents the TWFE estimator for the equation (1) changing the outcome variable for the cultivation rate of legal crops. Errors are clustered at the municipality level and are shown in parentheses. In columns 1-4, presents the results for 4 legal crops cultivation.

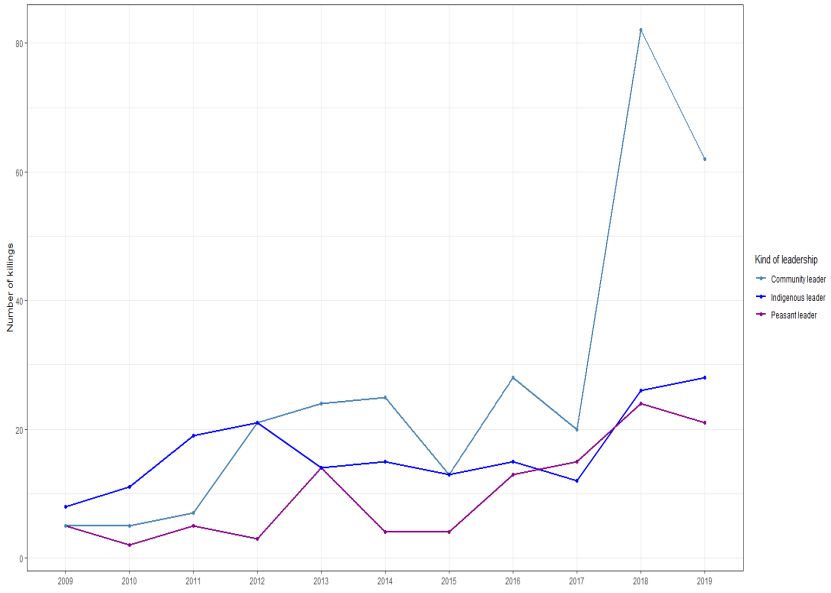
Appendix B Other Figures

Figure B.1: Evolution of killings of social leaders and the effectiveness of PNIS program



(A) Dynamics of killings of social leaders (B) Hectares voluntary eradicated by PNIS

Figure B.2: Evolution of killings of social leaders by kind of leadership



Notes: This figure illustrates the evolution of the killing of social leaders by type of leader.

Figure B.3: Bacon decomposition: 2x2 Diff-in-Diff estimate

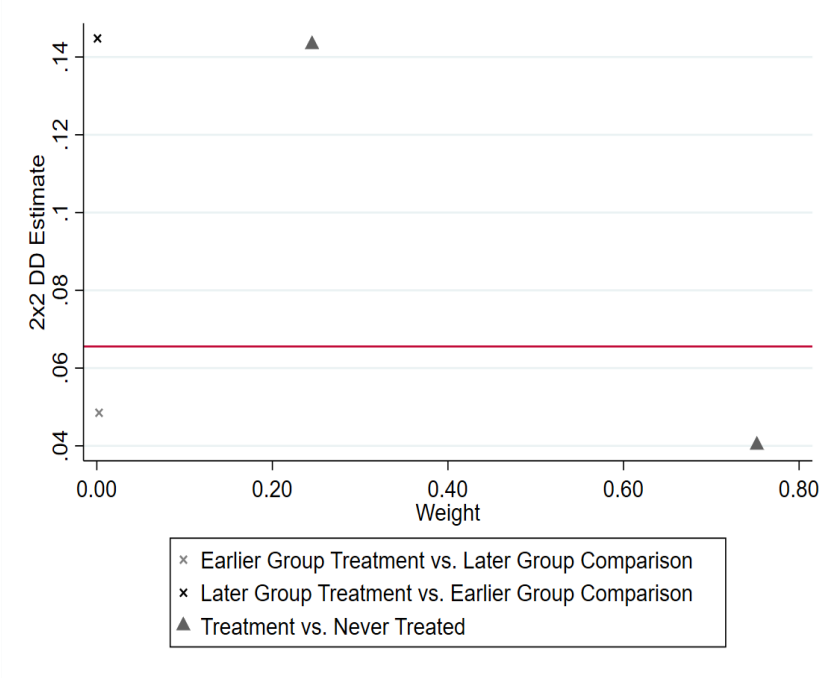
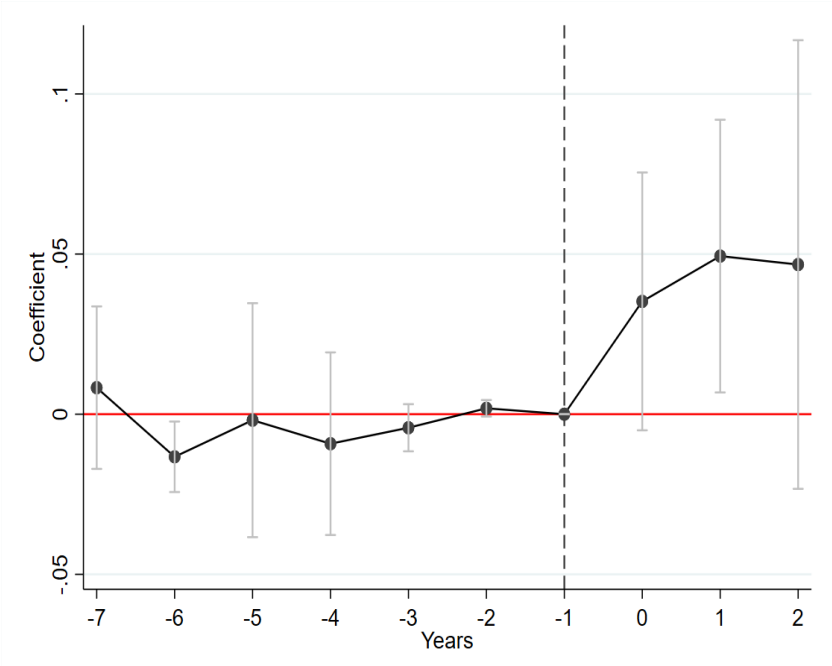
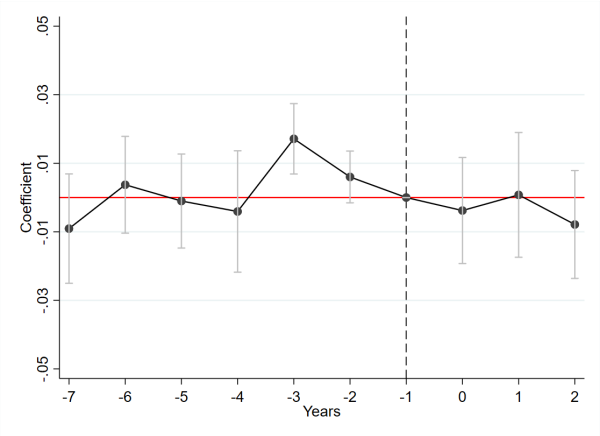


Figure B.4: Event study differential coca manually forced eradicated in KSL/No KSL areas before/after PNIS implementation. Only for coca producer municipalities.

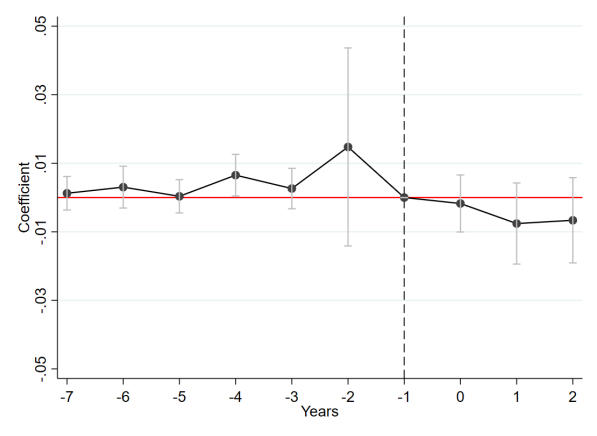


Notes: This figure illustrates the event study for the forced coca eradication comparing municipalities. I restrict the sample to 321 coca producer municipalities.

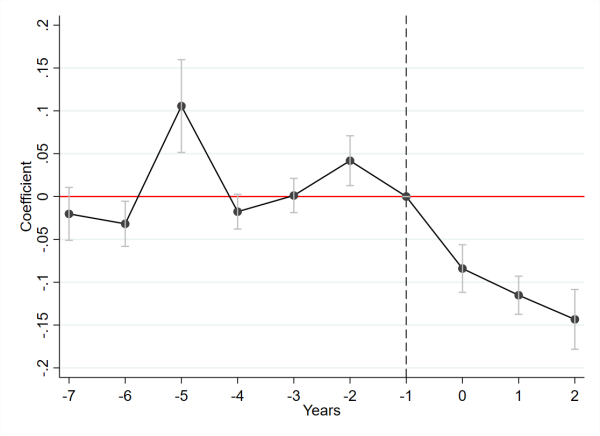
Figure B.5: Event study for cultivation of legal crops short-cycle



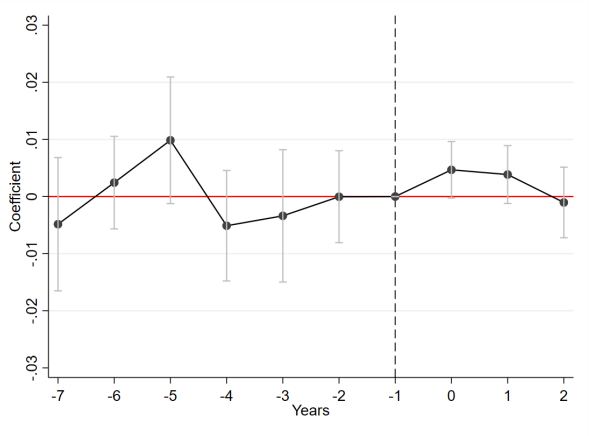
(A) Corn



(B) Rice



(C) Cotton



(D) Potato

Notes: Panel A,B,C,and D, illustrates the event study for the cultivation rate of four different legal crops.