HOW VIOLENCE IN MEXICO HAS PROPPED UP THE ADOLESCENT PREGNANCY NUMBERS

by
ANNA BYKADOROVA

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Approved by:

Asst. Prof. IVAN GUILLERMO LOPEZ CRUZ . . . .
(Thesis Supervisor)

Asst. Prof. ERDAL AYDIN . . . .

Asst. Prof. GUSTAVO TORRENS . . . .

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ABSTRACT

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ANNA BYKADOROVA

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Thesis Supervisor: Asst. Prof. IVAN GUILLERMO LOPEZ CRUZ

Keywords: adolescent fertility, cartel violence, Difference-in-Differences, Synthetic DiD, spatial analysis

This thesis investigates the causal impact of the Mexican War on Drugs on adolescent fertility across Mexican municipalities from 2000 to 2019. While national adolescent birth rates have declined, localized surges in fertility persist in areas affected by cartel violence and militarized state interventions. Using Difference-in-Differences and Synthetic Difference-in-Differences (SDID) methods, the study finds that municipalities with entrenched cartel presence or strategic value to drug trafficking networks experienced a significant increase in adolescent fertility following the onset of the drug war. The analysis highlights a two-wave fertility response: an initial rise in historically violent cartel strongholds and a delayed increase in regions later incorporated into DTO logistics corridors, particularly with the expansion of the Cártel de Jalisco Nueva Generación (CJNG). Spatial techniques, including Minimum Spanning Tree and DBSCAN clustering, reveal that these fertility shifts align with cartel infrastructure and geographic strategy. These findings underscore how criminal governance and state militarization reshape demographic behavior and may undermine human development in conflict-affected areas.

ÖZET

MEKSİKA'DAKİ ŞİDDET ERGEN GEBELİK ORANLARINI NASIL ARTIRDI

ANNA BYKADOROVA

Ekonomi, Yüksek Lisans Tezi, Temmuz 2025

Tez Danışmanı: Dr. Öğr. Üyesi IVAN GUILLERMO LOPEZ CRUZ

Anahtar Kelimeler: ergen doğurganlığı, kartel şiddeti, farkların farkı, sentetik farkların farkı, mekansal analiz

Bu tez, Meksika Uyuşturucu Savaşının 2000-2019 yılları arasında Meksika belediyelerinde ergen doğurganlığı üzerindeki nedensel etkisini araştırmaktadır. Ulusal ergen doğum oranları düşerken, kartel şiddetinden ve militarize devlet müdahalelerinden etkilenen bölgelerde doğurganlıktaki yerel artışlar devam etmektedir. Farkların Farkı (Difference-in-Differences) ve Sentetik Farkların Farkı (Synthetic Difference-in-Differences) - SDID yöntemlerini kullanan çalışma, kartellerin yerleşik olduğu veya uyuşturucu kaçakçılığı ağları için stratejik öneme sahip belediyelerin, uyuşturucu savaşının başlamasının ardından ergen doğurganlığında önemli bir artış yaşadığını ortaya koymaktadır. Analiz iki dalgalı bir doğurganlık tepkisini vurgulamaktadır: tarihsel olarak şiddet içeren kartel kalelerinde ilk artış ve daha sonra DTO lojistik koridorlarına dahil edilen bölgelerde, özellikle Cártel de Jalisco Nueva Generación'un (CJNG) genişlemesiyle gecikmeli bir artış. Minimum Kapsayan Ağaç (Spanning Tree) ve DBSCAN kümeleme gibi mekânsal teknikler, bu doğurganlık değişimlerinin kartel altyapısı ve coğrafi strateji ile uyumlu olduğunu ortaya koymaktadır. Bu bulgular, suç yönetiminin ve devlet militarizasyonunun demografik davranışı nasıl yeniden şekillendirdiğinin ve çatışmalardan etkilenen bölgelerde insani kalkınmayı nasıl baltalayabileceğinin altını çizmektedir.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my supervisor, Ivan Lopez Cruz, for his unwavering guidance, support, and encouragement throughout every stage of this thesis. His expertise and insightful feedback were invaluable in shaping the direction and depth of this research. I am also thankful to the faculty and staff for creating an intellectually stimulating and supportive academic environment. This thesis would not have been possible without the support of my family and friends. Their patience, understanding, and moral support sustained me through the most challenging periods of the research process. Finally, I wish to acknowledge the importance of open-access data and academic collaboration, which made it possible to explore a complex issue such as the intersection of violence and demographic behavior in Mexico. To all those who contributed directly or indirectly to this work, I am sincerely grateful.

To those who support the pursuit of research and knowledge

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AFR Adolescent Fertility Rate

CJNG Cártel de Jalisco Nueva Generación

DBSCAN Density-Based Clustering Non-Parametric Algorithm

DDD Triple Differences

DiD Difference-in-Differences

DTO Drug Trafficking Organization

EA Share of Adolescent Births in Total Births

IFRs Impulse Response Functions (IRFs)

MST Minimum Spanning Tree

MWD Mexican War on Drugs

SDID Synthetic Difference-in-Differences

1. INTRODUCTION

Over the past two decades, Mexico has transformed the geography of violence, primarily as a result of militarized campaigns against drug trafficking organizations (DTOs). These state-led interventions, aimed at dismantling organized crime, have generated not only security repercussions but also unintended demographic effects, most notably, the persistence and, in some regions, intensification of adolescent fertility despite a national decline in overall birth rates. This thesis investigates how state-induced violence interacts with entrenched criminal governance to shape adolescent reproductive outcomes. Focusing on the period from 2000 to 2019, the study estimates the causal impact of the Mexican War on Drugs on adolescent fertility at the municipal level, emphasizing how DTO territorial embeddedness and strategic geography, such as Pacific ports, border crossings, and poppy-growing regions, condition the fertility response. Rather than treating violence as a generic or evenly distributed shock, the analysis centers on how the spatial logic of conflict and the overlap of criminal and state power influence reproductive behavior in conflict-affected areas.

The thesis is organized around four topics:

1) Temporal Dynamics: Examining how adolescent fertility evolved before and after the onset of the Mexican War on Drugs.

2) Spatial Variation: Investigating how fertility responses differed across municipalities based on pre-existing cartel presence and strategic relevance to DTO operations.

3) Causal Identification: Using Difference-in-Differences (DiD) and Synthetic DiD (SDID) approaches to isolate treatment effects.

4) Structural Embeddedness: Analyzing how organized criminal governance and militarized state interventions jointly shape adolescent reproductive behavior.

Professional Significance. This research contributes to economic debates by providing novel empirical evidence on how militarized state interventions affect key demographic behaviors that influence long-term development outcomes. By focusing on adolescent fertility, which is a critical determinant of human capital accumulation and labor market participation, the study sheds light on the economic costs of organized violence. It highlights how conflict-driven disruptions interact with institutional fragility and criminal governance to shape reproductive decisions, with implications for intergenerational poverty, gender inequality, and regional economic divergence. The findings inform policy discussions on how security strategies may unintentionally undermine development goals in areas affected by violence.

Delimitations of the Study. This thesis focuses specifically on municipality-level fertility outcomes in Mexico between 2000 and 2019. The analysis is limited to female adolescents aged 15–19 and does not explore broader fertility behaviors among other age groups. The treatment is defined based on pre-war cartel embeddedness and strategic geography, without distinguishing between different cartel organizations. Additionally, while the study uses robust quasi-experimental designs, it does not investigate individual-level mechanisms due to data constraints. These questions are left for future research.

The remainder of this thesis is organized as follows. Section 2 provides the historical context and preliminary evidence, outlining the evolution of adolescent fertility alongside the rise of cartel-related violence in Mexico. Section 3 describes the data sources, key variables, and procedures for sample construction Section 4 outlines the empirical strategy, including the identification assumptions and econometric models used to estimate causal effects. Section 5 presents the main findings based on Difference-in-Differences and event study models, while Section 6 offers robustness checks using Synthetic Difference-in-Differences and trimmed donor analyses. Finally, Section 7 concludes with a discussion of the key implications, limitations, and directions for future research.

1.1 Related Literature

A central concern in the study of adolescent fertility is whether external interventions, whether policy-driven or contextually imposed, can significantly alter reproductive outcomes among teenagers. Existing research presents mixed evidence on whether various forms of social, institutional, or environmental disruption lead to behavioral shifts that increase adolescent fertility. These debates are relevant for understanding the impact of cartel-related violence in Mexico, where structural instability may act as a form of imposed disruption on adolescent life trajectories.

Empirical studies from diverse settings provide evidence of how instability influences reproductive behavior, especially among youth facing heightened uncertainty and limited life opportunities. On one hand, a large body of work emphasizes the negative behavioral consequences of instability. Studies by Celhay, Depetris-Chauvin, and Riquelme (2024) and Islam et al. (2016) show that disruptions to education and exposure to violence during formative years can provoke increases in early childbearing, whether through immediate responses to school closures in Chile or long-term fertility adaptations among women raised during Cambodia's civil conflict. Gaudie et al. (2010) and Aluga and Okolie (2021) further reveal how early psychosocial adversity and structural deprivation, such as family dysfunction, trauma, or poverty, can shape reproductive choices. These studies support the idea that when adolescents are exposed to instability or hardship, early motherhood may emerge as a coping strategy or rational response to constrained life options. Similarly, Heissel (2017) illustrates how adolescent fertility can have intergenerational effects by negatively affecting younger siblings' educational outcomes, reinforcing cycles of disadvantage within unstable households.

On the other hand, not all disruptions yield the same reproductive outcomes. Evidence from the UK by Paton (2002) and Paton and Wright (2017) shows that top-down institutional changes, such as restrictions on reproductive services or cuts to teen pregnancy programs, did not significantly affect adolescent pregnancy rates. These findings challenge the assumptions that policy levers alone are sufficient to influence teenage fertility, especially when they fail to account for the lived experiences or broader social conditions. However, Luca et al. (2021) provide a counterpoint: in a U.S.-based randomized controlled trial, a personalized, behaviorally oriented program offering psychosocial support significantly reduced repeat pregnancies among teenage mothers. This suggests that interventions are more effective when they directly engage with the emotional and behavioral dimensions of adolescent fertility rather than relying solely on access to services or institutional reforms.

A particularly relevant study for this thesis is Tsaneva and Gunes (2020), who investigate the effects of drug-related violence on adolescent fertility in Mexico using a triple-differences (DDD) design. By interacting with changes in homicide rates, periods, and cartel presence across a municipality-by-year panel, they estimate the causal impact of violence on teenage pregnancy rates. Their main finding is that an increase of 9 homicides per 100,000 people is associated with a 1.5 percentage point decline in the probability of teenage pregnancy. The authors interpret this as evidence that heightened violence may deter early fertility, possibly due to increased risk perception or constrained mobility. Although their DDD strategy uses variation at the municipal level, the resulting estimates capture only the average effects across all municipalities and years between 2005 and 2010.

This thesis builds on existing research by recognizing that adolescent fertility can be shaped by both structural disruption and behavioral adaptation while also extending the spatial scope of analysis. Rather than focusing solely on average treatment effects, it incorporates geographic heterogeneity to examine how fertility responses vary across municipalities with differing levels of cartel entrenchment and strategic importance to drug trafficking organizations. By doing so, it offers a more nuanced understanding of how organized criminal violence, particularly when confronted with militarized state interventions, can condition demographic outcomes. This study adds to previous research by showing that the combination of cartel control and government response creates uneven and localized effects on teenage fertility.

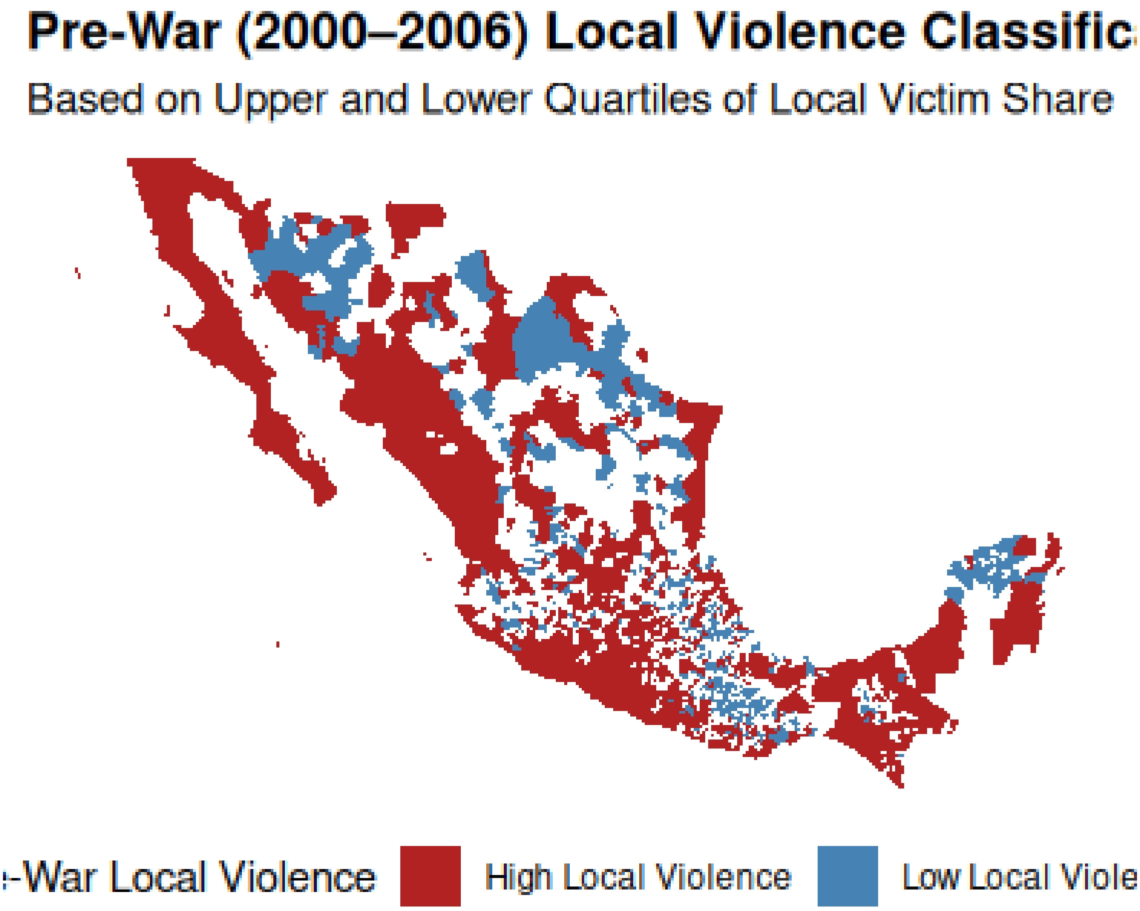
2. HISTORICAL BACKGROUND AND PRELIMINARY EVIDENCE

This section aims to explain how the rise and fall of adolescent fertility in Mexico relate to broader changes in violence and population trends. While teen pregnancy is often viewed as a behavioral or public health issue, in Mexico, it has unfolded during a period of significant social disruption, particularly with the growth and spread of drug-related violence. This chapter provides both the historical background and preliminary evidence needed to understand the drivers of these changes. It introduces the Mexican War on Drugs as a key turning point, outlines national trends in adolescent fertility, and presents initial signs that local violence may have influenced these patterns. These early observations on timing, location, and demographic response help lay the groundwork for the statistical analysis in the chapters that follow.

2.1 The Mexican War on Drugs and the Evolution of DTO Violence

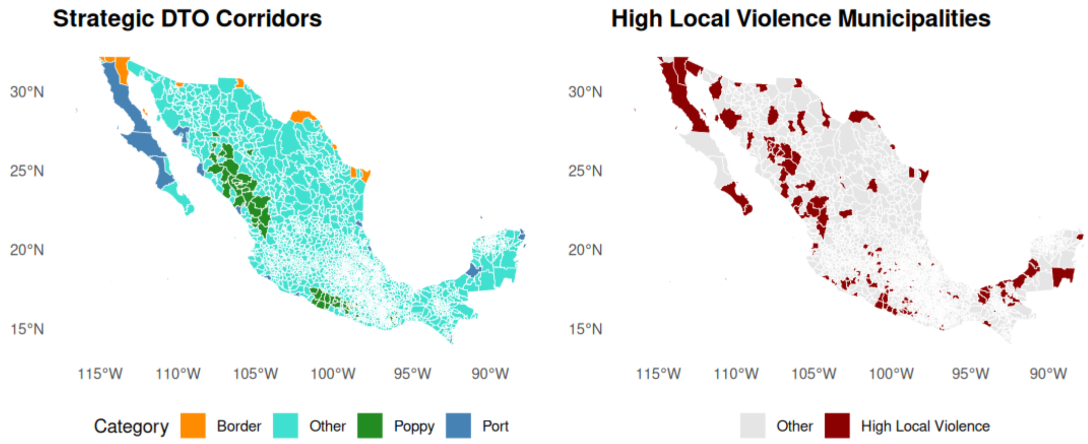
This subsection examines the two waves of organized violence in modern Mexico triggered by a military-led campaign against drug trafficking organizations (DTOs). The conflict began in 2007 when President Felipe Calderón launched the Mexican War on Drugs shortly after taking office. This marked a significant shift in national security policy, as the military was deployed domestically to confront organized crime. Figure 2.1 illustrates the distribution of local violence levels prior to the war (2000–2006), highlighting municipalities with high and low victimization rates.

Figure 2.1 Pre-War (2000–2006) local violence classification



To further contextualize early violence, Figure 2.2 compares these pre-war victimization patterns to the geographic footprint of strategic DTO infrastructure, including major ports, border crossings, and poppy cultivation zones. This overlay helps explain not only where violence initially concentrated but also why specific municipalities later became battlegrounds as DTOs fought for control of critical trafficking routes.

Figure 2.2 Strategic DTO corridors vs. high local violence municipalities



A central tactic of the Mexican government's anti-cartel campaign under President Calderón was the so-called "decapitation" strategy, which involved targeting the leadership of drug trafficking organizations (DTOs) through arrests or killings. Between 2007 and 2012, 25 of the 37 most-wanted cartel leaders were captured or killed (Beittel 2013). However, this approach often produced unintended consequences. Rather than weakening DTOs, the removal of top leaders frequently triggered organizational fragmentation and violent power struggles as rival factions and successor groups competed for dominance. These dynamics fueled surges in homicides, kidnappings, and instability (Jones 2013; Phillips 2015).

The spatial distribution of this violence was far from uniform. The first wave was heavily concentrated in the northern border states, particularly Chihuahua and Tamaulipas, as well as in traditional cartel strongholds such as Sinaloa and parts of Michoacán (Beittel 2013). These regions were strategically important due to their proximity to U.S. border crossings, trafficking corridors, and production zones (Jones 2013). Between 2007 and 2010, they became epicenters of conflict as federal forces clashed with criminal organizations and rival cartels fought to fill emerging power vacuums. The resulting violence was especially acute in municipalities where competition for key trafficking routes and local markets intensified (Calderón et al. 2015).

According to Beittel (2019), a second wave of violence emerged several years after the initial crackdown, driven by the rise of synthetic drugs, especially fentanyl, and the territorial expansion of the Cártel de Jalisco Nueva Generación (CJNG). Starting around 2013, CJNG pursued a militarized and business-oriented strategy to seize control of key fentanyl trafficking routes connecting Pacific ports like Veracruz, Manzanillo, and Lázaro Cárdenas to the U.S. border. The group expanded rapidly by absorbing local criminal cells, consolidating logistics corridors, and operating autonomously across multiple states. This transformation led to a dramatic spread of violence into central and southern Mexico, reshaping the geography of organized crime and pulling previously unaffected municipalities into the conflict (López Cruz and Torrens 2024). Many of these municipalities were not historically violent but, as Figure 2.2 shows, were strategically located within DTO corridors, highlighting the long-term influence of geography on cartel behavior. The shift toward synthetic drugs not only altered DTO incentives but also introduced new forms of organized violence, turning once-peripheral regions into vital nodes in the transnational fentanyl supply chain.

2.2 The Evolution of Adolescent Fertility in Mexico

Adolescent pregnancy rates in Mexico rose during the early 2000s, as reflected in the increasing share of births to mothers aged 15–19. At first glance, this could suggest that adolescent fertility was becoming more prevalent. However, this pattern may stem from two distinct forces: demographic composition (i.e., a larger adolescent cohort) and behavioral change (i.e., a higher likelihood of pregnancy among adolescents). These mechanisms have vastly different implications and should be disentangled to interpret fertility trends accurately.

A purely demographic explanation would imply that a growing adolescent population naturally led to more adolescent births. However, this is not supported by the data. As shown in Figure 2.3, the share of adolescents aged 15–19 in the total population steadily declined from over 11.5 percent in 1990 to below 9 percent by 2019, with only a brief plateau in the early 2000s. Similarly, Figure 2.4 illustrates the declining adolescent-to-adult population ratio, further indicating demographic contraction in the adolescent cohort relative to the working-age population (ages 20–64).

Figure 2.3 Demographic boost in Mexico (1990–2019)

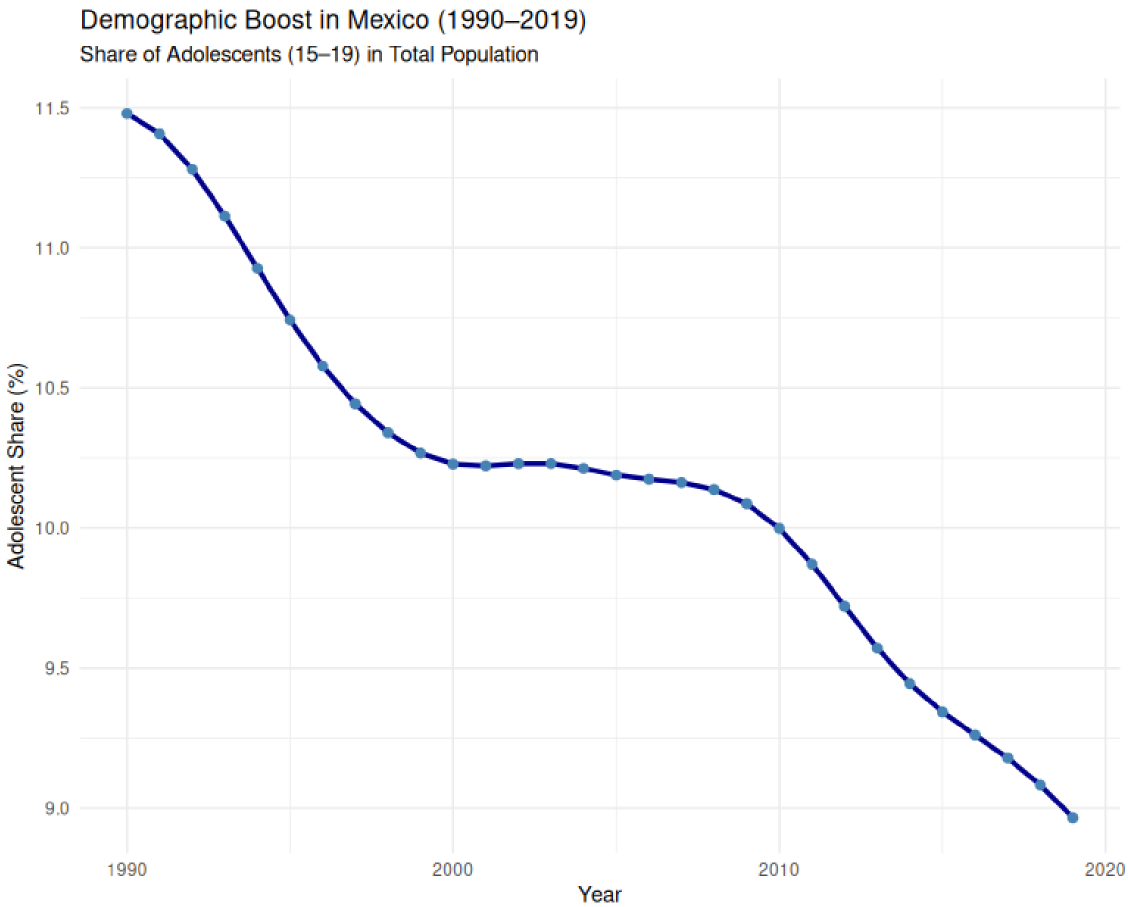
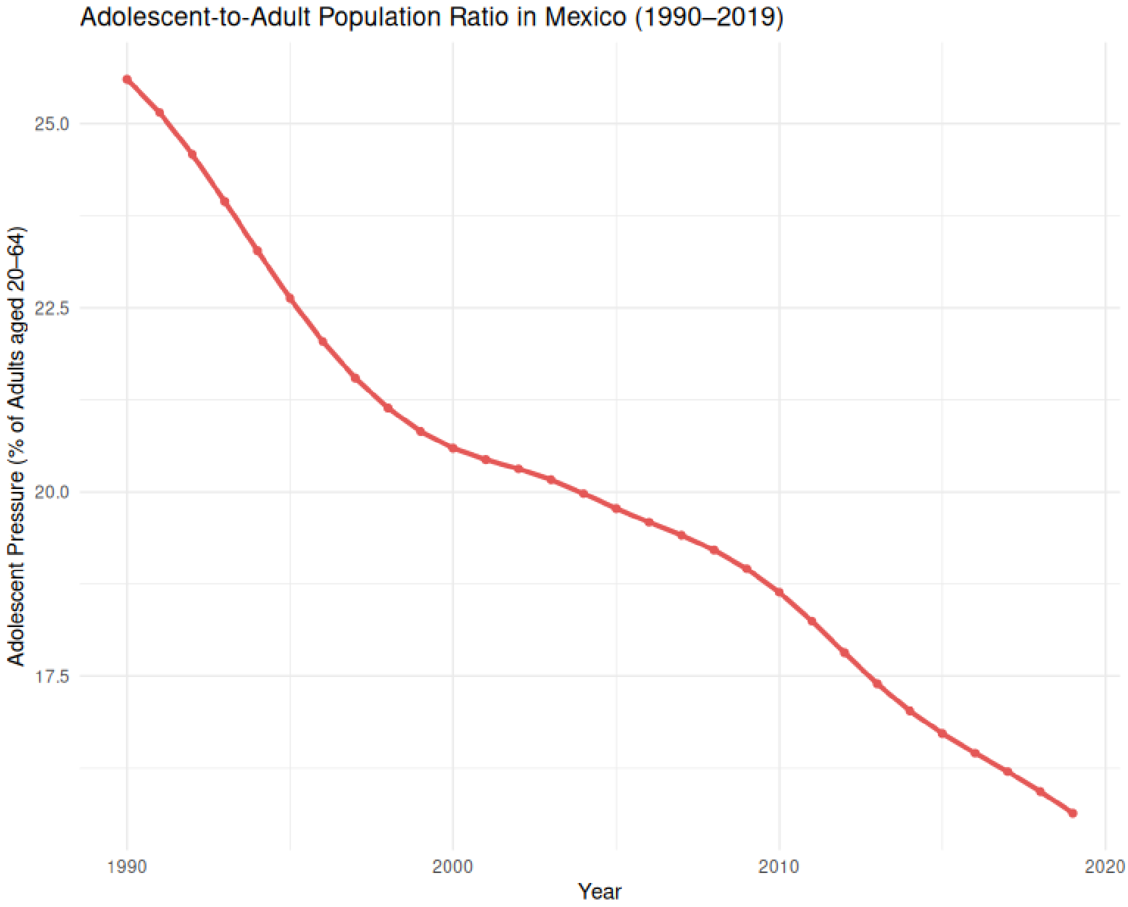


Figure 2.4 Adolescent-to-adult population ratio in Mexico (1990–2019)



Taken together, these figures undermine the notion that a purely demographic explanation can account for the rise in adolescent births. Instead, behavioral or contextual factors such as earlier sexual activity, reduced access to contraception, or shifting norms around early marriage appear more relevant. In areas affected by violence, these changes in behavior and access may significantly influence adolescents' reproductive choices and future planning. To better isolate behavioral change, the Adolescent Fertility Rate (AFR) can be examined. This measure adjusts for the size of the adolescent female population (aged 15–19), offering a more accurate reflection of reproductive behavior within this specific age group. In contrast, indicators such as EA (the share of adolescent births in total births) are more sensitive to the overall age structure and total fertility levels.

Figure 2.5 displays the stark contrast between the adolescent fertility rate and the population share of adolescents, particularly during the 2007–2013 period. Figure 2.6 further illustrates the temporal dynamics, showing a surge in AFR around 2007 that subsequently declined, while EA followed a more gradual trajectory. This temporal heterogeneity indicates that, although national-level trends provide valuable insights, they fail to capture localized fertility shocks associated with specific episodes of cartel-related violence.

Figure 2.5 Fertility behavior vs. demographic share (1990–2019)

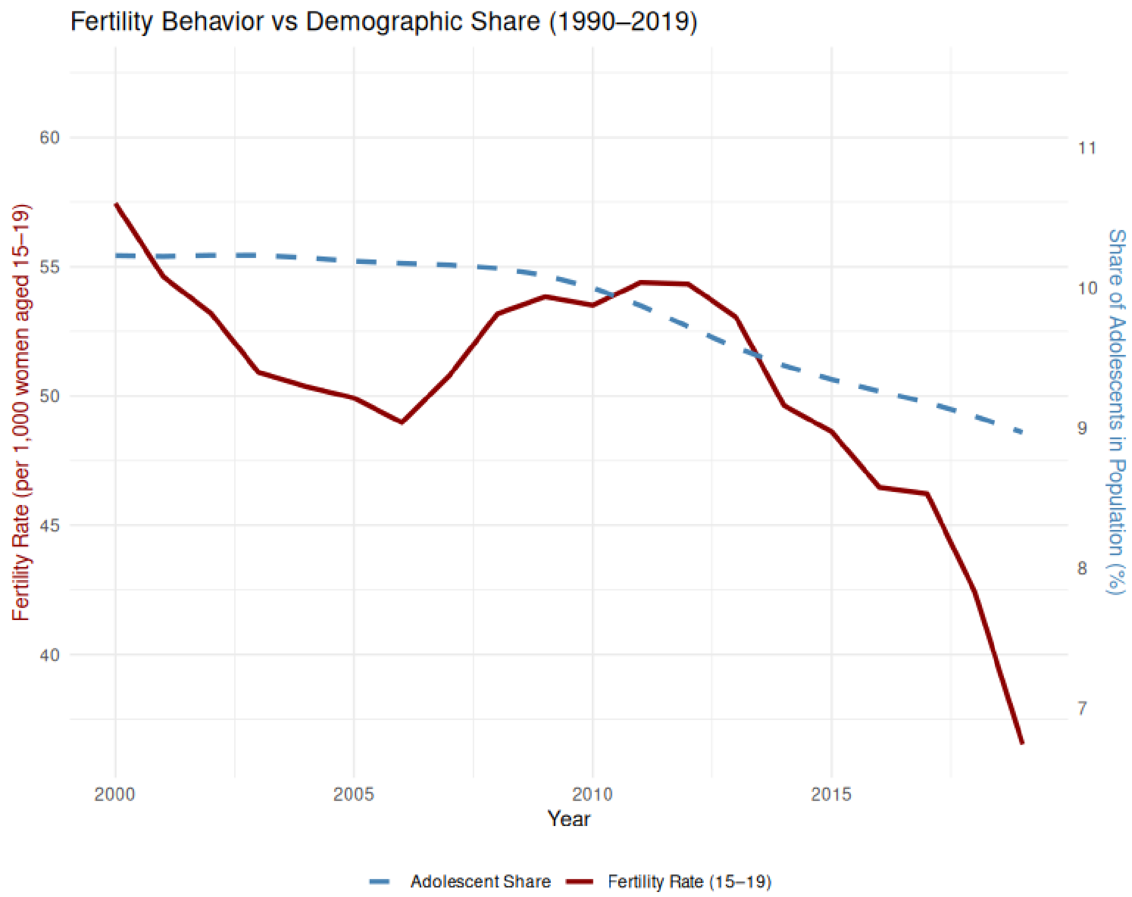
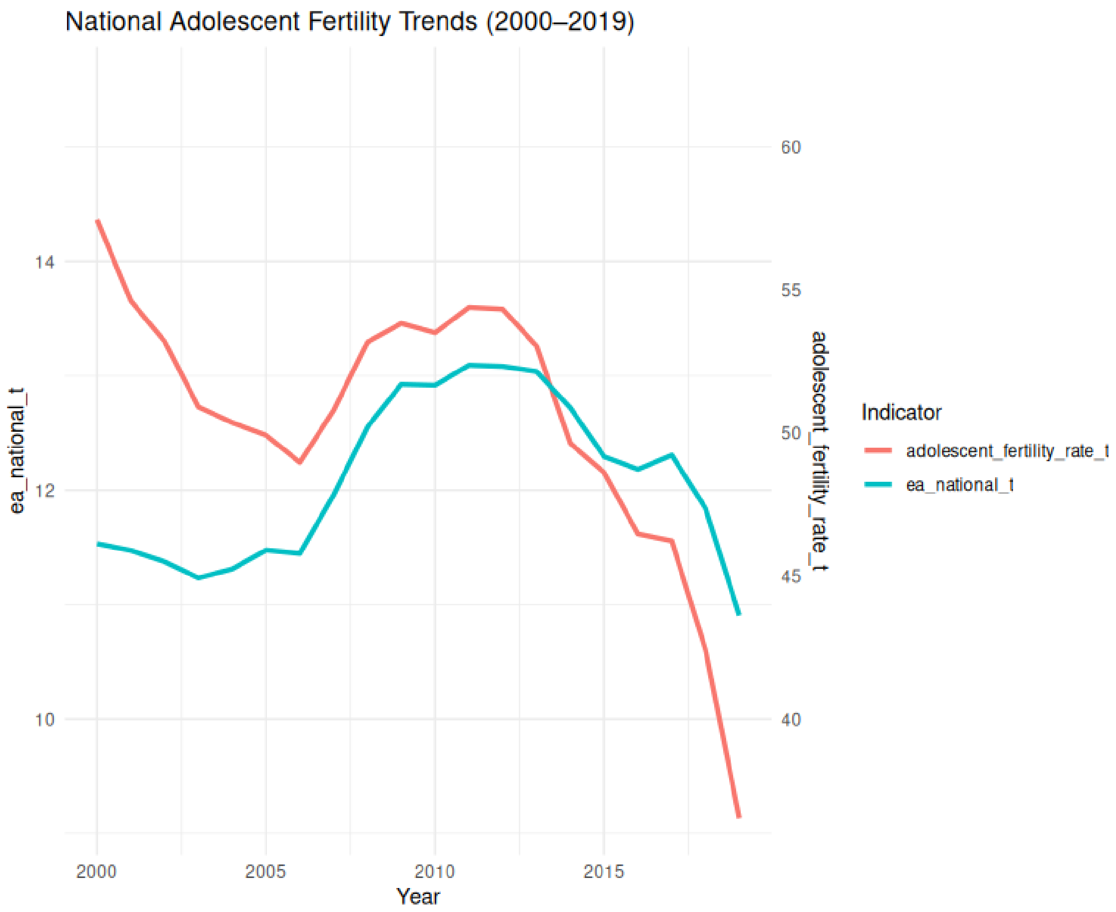
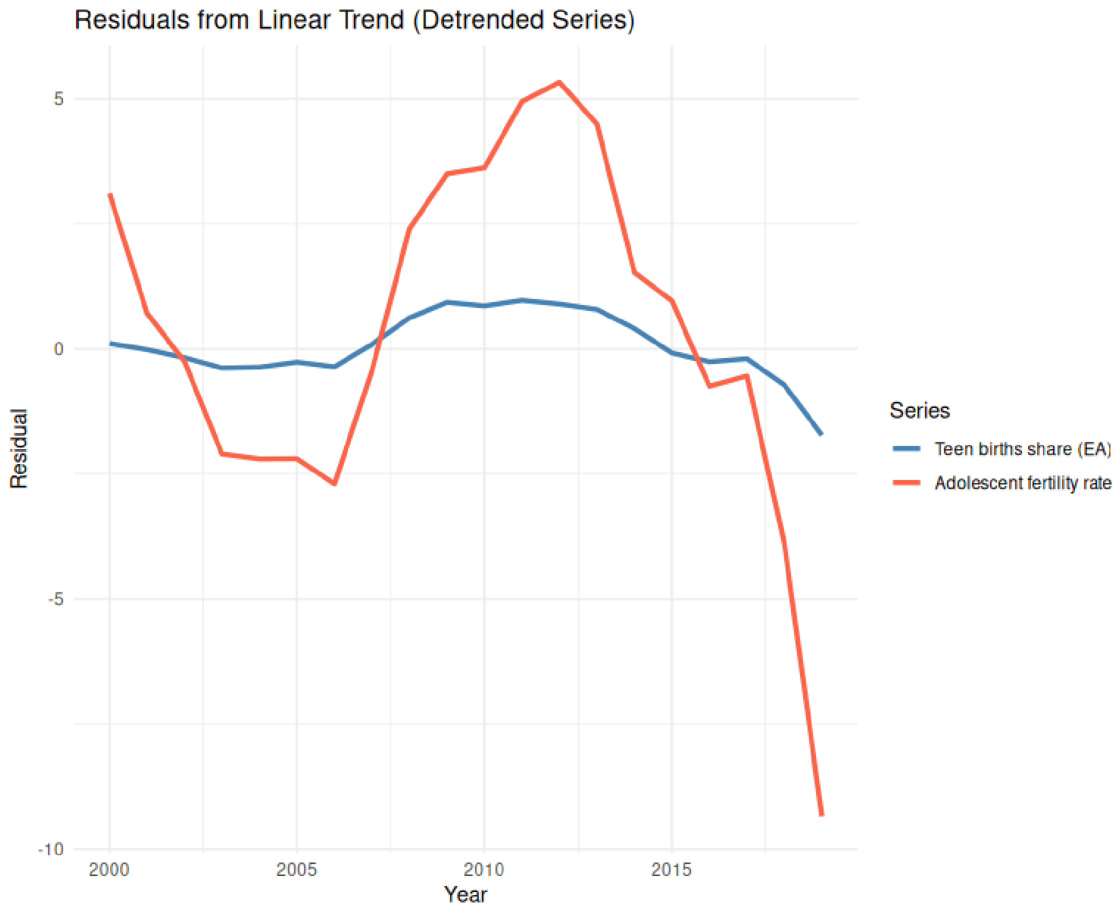


Figure 2.6 National adolescent fertility trends (2000–2019)



To investigate this further, both the AFR and EA were detrended using linear models, and their residuals were analyzed. As shown in Figure 2.7, while the EA remains relatively stable, the AFR residuals spike in the late 2000s and then drop sharply, highlighting a short-term disruption in adolescent reproductive behavior.

Figure 2.7 Residuals from linear trend (detrended series)



To explore temporal heterogeneity in fertility responses, municipalities are classified based on their levels of local violence prior to 2007, serving as a proxy for historical cartel presence. Local violence is defined as homicides in which both the victim and the perpetrator are residents of the same municipality. This metric captures violence that is more endemic and community-rooted, rather than transient or externally driven criminal activity.

Local projection impulse response functions (IFRs) are applied to trace how adolescent fertility responded to the initial outbreak of violence in 2007 across different contexts. In municipalities with high levels of pre-war local violence, often long-standing cartel strongholds, the IRFs reveal a sharp and immediate spike in adolescent fertility, forming a single-wave pattern that peaks after the conflict's onset, as shown in Figure 2.8. This pattern reinforces the idea that the presence of drug trafficking organizations (DTOs) plays a central role in shaping demographic responses.

In contrast, municipalities with low pre-war local violence show no early fertility shift. Instead, they exhibit a delayed increase starting around 2013, coinciding with the territorial expansion of the Cártel de Jalisco Nueva Generación (CJNG). These municipalities had previously been spared from direct conflict but became newly affected as DTO activity expanded. This delayed response is shown in Figure 2.9.

This two-wave IRF pattern underscores the importance of spatial and temporal disaggregation in understanding adolescent fertility trends. Moreover, the municipalities with early fertility surges (high-violence group) tend to overlap with strategic DTO locations such as poppy cultivation zones, major Pacific ports, and U.S. border crossings, suggesting a relationship between fertility responses and DTO logistics networks.

To test this relationship, IRFs are estimated specifically for municipalities linked to strategic cartel functions. As shown in Figure 2.10, areas associated with poppy cultivation, cross-border trade, and port infrastructure display a pronounced early fertility response, aligning with the first wave observed in cartel strongholds. These findings further support the notion that adolescent fertility responses were shaped not only by violence itself, but also by its intersection with DTO territorial control and strategic geography.

Figure 2.8 Impulse response functions by high local violence exposure

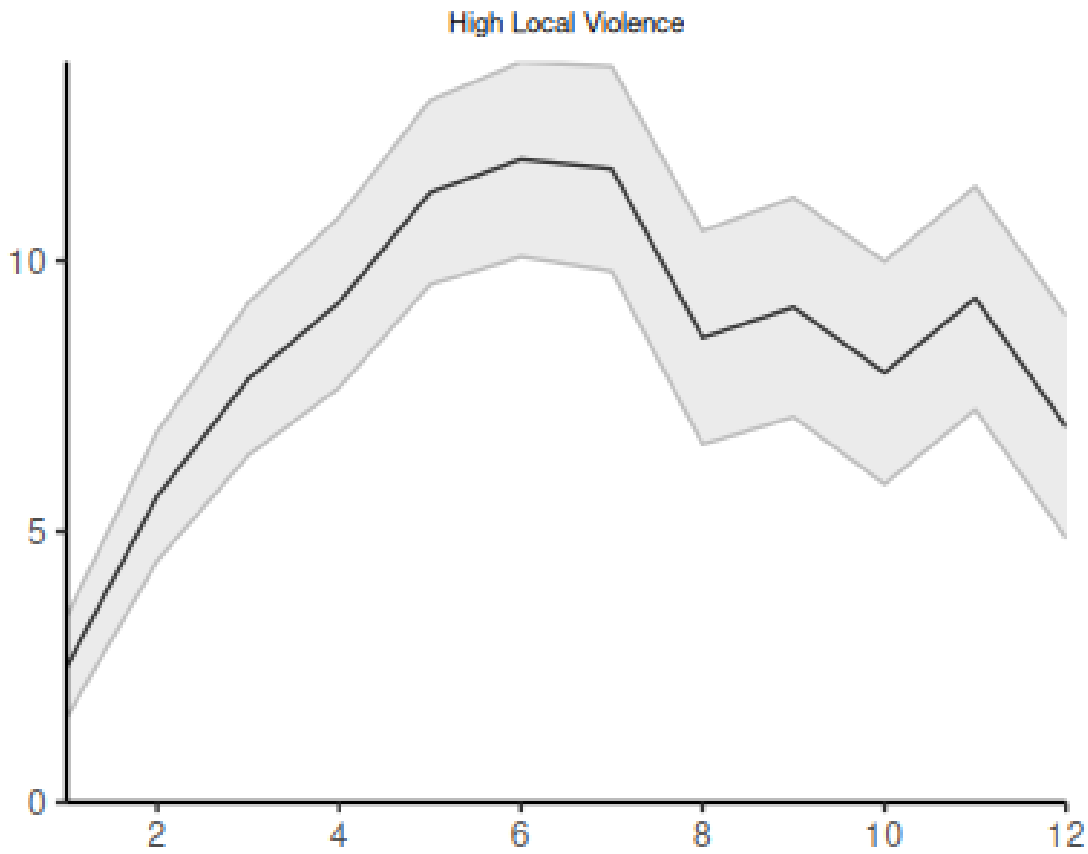


Figure 2.9 Impulse response functions by low local violence exposure

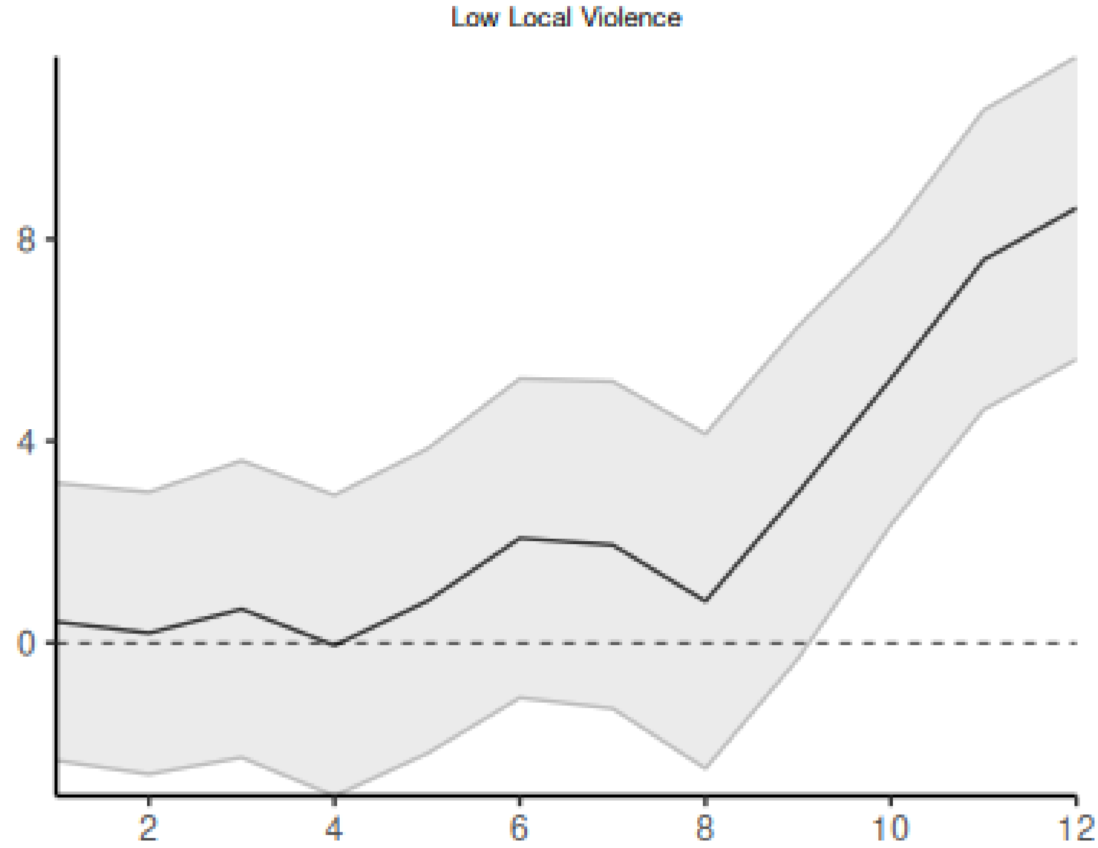
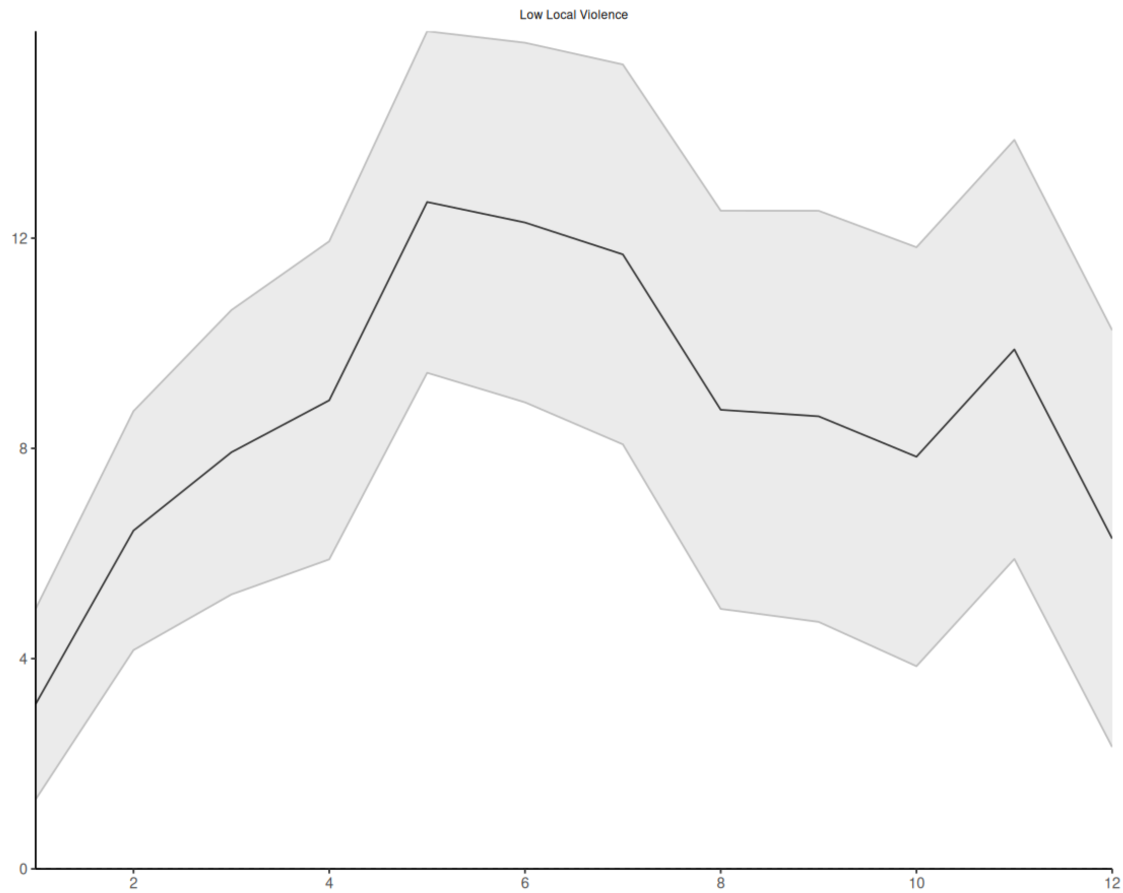


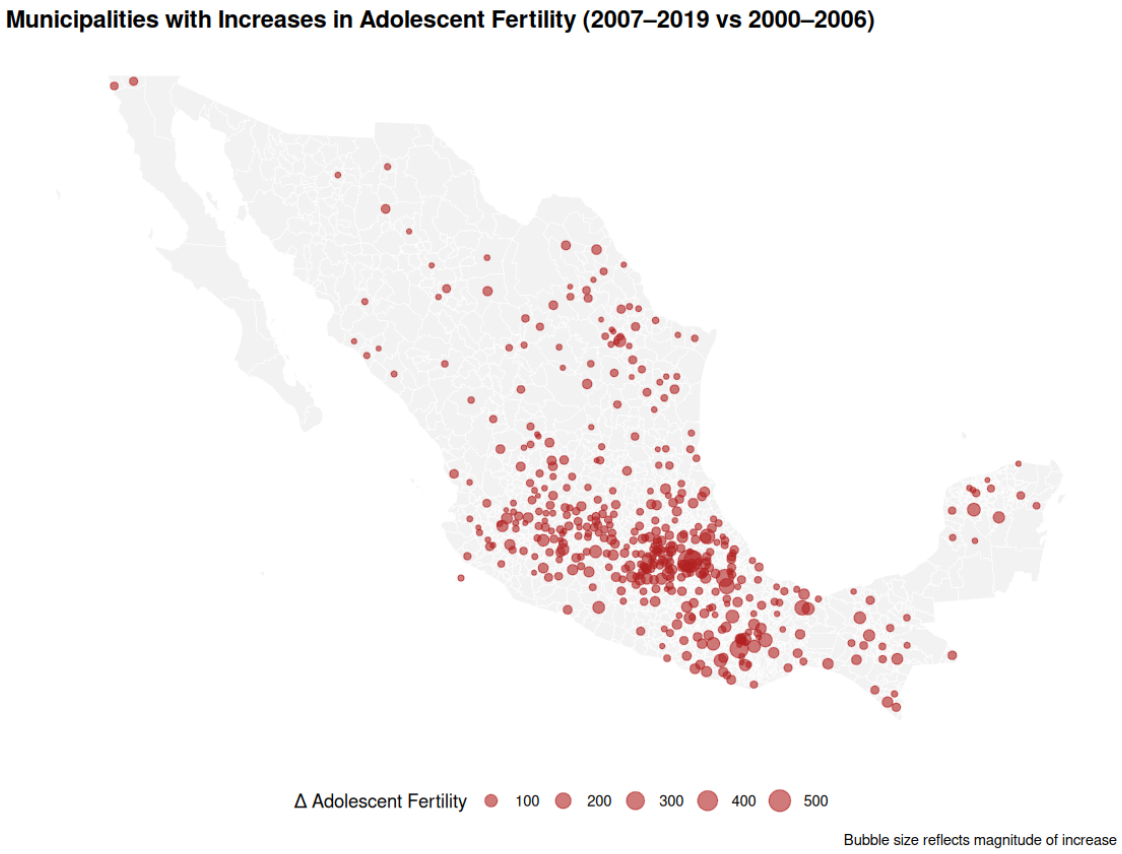
Figure 2.10 IRF for strategic DTO locations



2.3 Spatial Patterns of Teen Pregnancy in Mexico

The spatial analysis begins by examining the absolute change in adolescent fertility rates (AFR) at the municipal level, comparing averages before and after the onset of the drug war in 2007. As shown in Figure 2.11, the most significant increases in AFR are concentrated in central Mexico, including traditional cartel strongholds in northern states such as Sinaloa and Tamaulipas.

Figure 2.11 Municipalities with increases in adolescent fertility



The second wave of adolescent fertility, particularly the post-2013 increase observed in central Mexico, is examined with the expansion of fentanyl trafficking routes operated by the Cártel de Jalisco Nueva Generación (CJNG). To explore this possibility, the 50 municipalities with the most significant post-war increases in adolescent fertility are identified. As illustrated in Figure 2.12, these municipalities form distinct horizontal, corridor-like alignments across central Mexico.

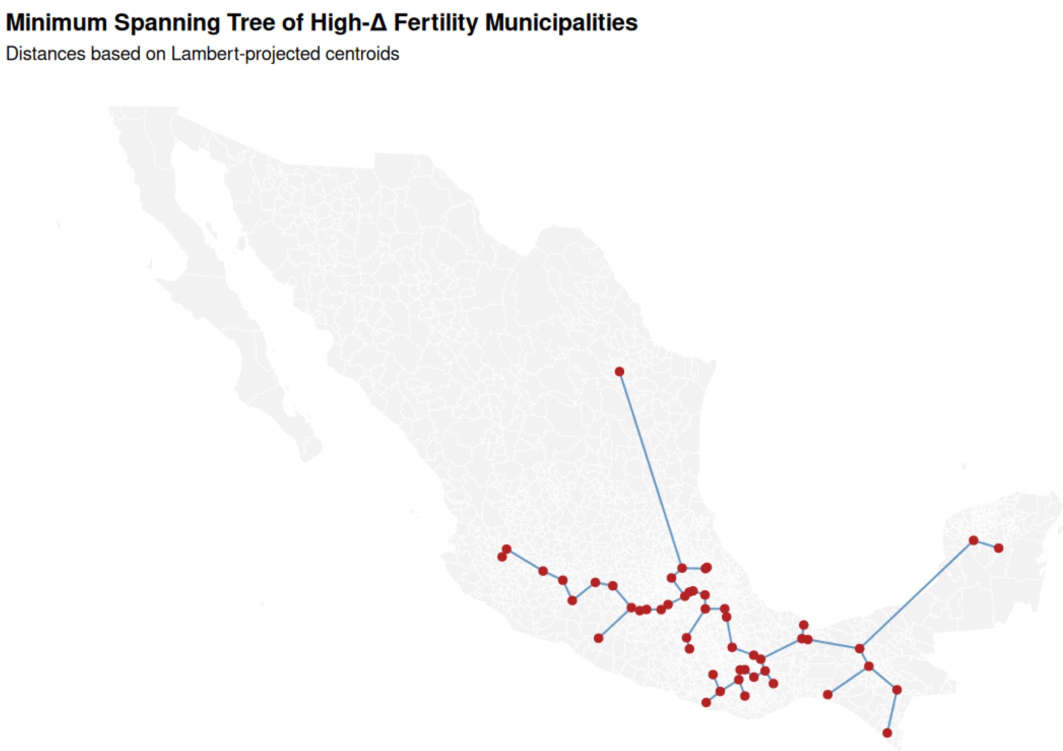
To systematically assess whether these demographic shifts align with strategic drug trafficking corridors, a Minimum Spanning Tree (MST) analysis is applied to the selected municipalities. Although geographically dispersed, these locations may not be functionally independent of one another. Instead, they appear embedded within a broader, interconnected network shaped by DTO logistics and territorial strategies.

The MST framework, drawn from graph theory (Graham and Hell (1985)), facilitates this analysis by constructing the most spatially efficient network that connects all municipalities in the sample. The MST algorithm identifies the shortest possible configuration of edges (i.e., geographic links) that connect all nodes (municipalities) without forming cycles. This yields a tree structure that minimizes total travel distance while preserving connectivity (Gastner and Newman 2006).

This approach enables the assessment of whether the apparent spatial fragmentation of high-fertility municipalities conceals a more cohesive territorial logic. In this context, the MST serves as a representation of DTO behavior, which likewise prioritizes efficiency and continuity in trafficking infrastructure.

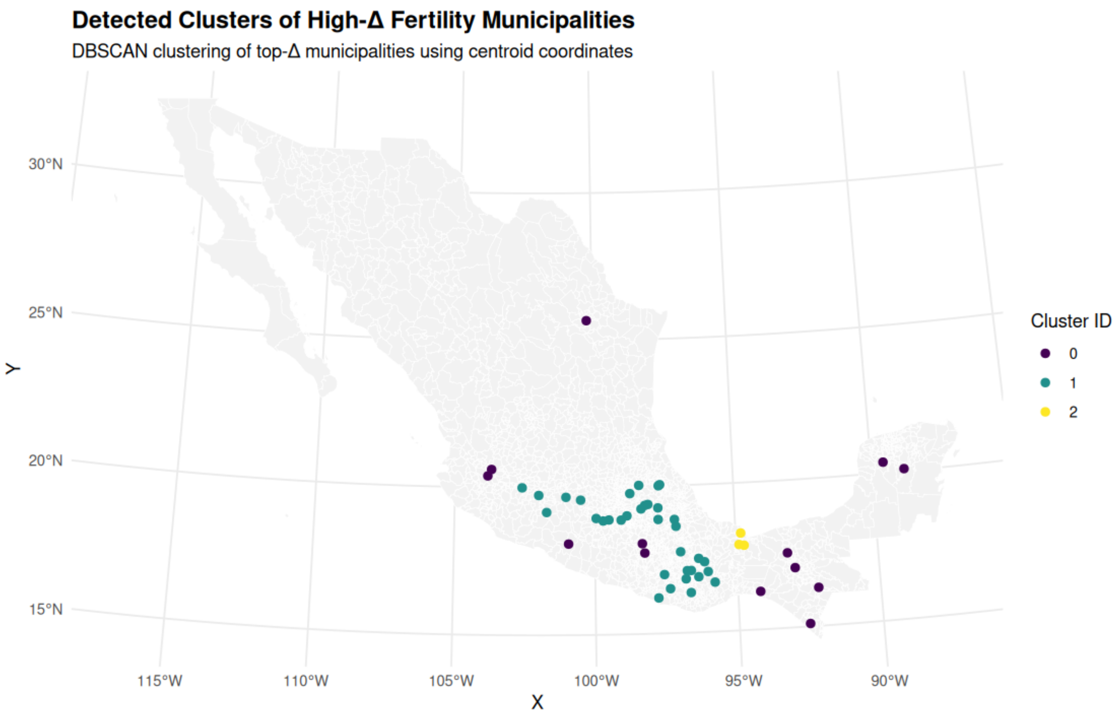
The results of the MST analysis reveal a striking pattern: long, uninterrupted alignments extending from Pacific port cities such as Manzanillo and Lázaro Cárdenas through inland and northern regions toward the U.S. border. These spatial configurations mirror established CJNG trafficking routes, suggesting that the observed rise in adolescent fertility may be following the diffusion of cartel-related violence and logistical control. In this sense, the MST provides a structural lens through which the second wave of adolescent fertility increases can be understood not as scattered local events, but as components of a broader, spatially coherent shift tied to organized crime infrastructure (Figure 2.12).

Figure 2.12 Minimum spanning tree of high fertility municipalities



To further examine the spatial structure of fertility increases, the MST analysis is complemented with DBSCAN clustering, a density-based spatial algorithm. Unlike the MST, which seeks to construct a minimal connecting path, DBSCAN identifies clusters of municipalities where fertility changes are geographically concentrated. This method is particularly effective at detecting irregularly shaped and densely packed groups in spatial data without requiring prior knowledge of the number of clusters (Ester et al. 1996). When applied to our sample, DBSCAN reveals dense, corridor-like groupings of municipalities with high fertility change, particularly across central Mexico (Figure 2.13).

Figure 2.13 Detected clusters of high fertility municipalities



The spatial distribution of these clusters aligns with the same East-West trajectories highlighted by the MST analysis, reinforcing the idea that adolescent fertility patterns are not driven solely by local violence or isolated shocks. Instead, these patterns are embedded in broader DTO logistics strategies, suggesting that regions integrated into drug trafficking routes, especially during CJNG's territorial expansion, experienced delayed but synchronized demographic consequences.

Together, the MST and DBSCAN analyses provide complementary evidence that recent shifts in adolescent fertility are not random nor purely reactive. Instead, they reflect the evolving spatial logic of cartel operations, with fertility responses mapped along DTO corridors. These findings underscore how violence, infrastructure, and fertility intersect and reveal spatial dynamics that are invisible in national-level aggregates.

3. DATA AND VARIABLES

This study utilizes a panel dataset comprising 2,455 Mexican municipalities, which are observed annually from 2000 to 2019. Observations from 2019 and later are excluded to avoid distortions associated with the COVID-19 pandemic. The dataset includes detailed yearly information on fertility rates, levels of violence, access to infrastructure, presence of organized crime, and key socioeconomic indicators. Observations with missing or implausible values in fertility or population variables are excluded, and all indicators are aggregated at the municipality-year level. To account for potential serial correlation in panel regressions, standard errors are clustered at the municipality level. All calculations were provided in R programming.

3.1 Outcome Variables

The primary outcome of interest is the Adolescent Fertility Rate (AFR), which measures the intensity of adolescent childbearing while taking into account population structure. Formally:

$$\mathrm{AFR}_t = \frac{\text{Births to females aged 15–19 in year } t}{\text{Female population aged 15–19 in year } t} \times 1000$$

This rate represents the number of live births per 1,000 adolescent girls and is widely used to measure adolescent reproductive behavior over time and across different geographic areas. As a complementary measure, the Early Adolescent Share (EA):

$$\mathrm{EA}_t = \frac{\text{Births to females aged 15–19 in year } t}{\text{Total births in year } t} \times 100$$

While sensitive to the overall fertility structure, EA highlights the relative weight of adolescent births in total municipal fertility rates. Both indicators are computed annually at the municipality level using data from INEGI (2016).

3.2 Treatment Definition: Violence Exposure and DTO Relevance

Treatment exposure is defined based on two non-mutually exclusive criteria:

1) Pre-war violence intensity: Municipalities with homicide rates in the top quartile during the pre-war period (2000–2006), reflecting areas with entrenched cartel activity. Homicide data are sourced from INEGI (1990–2019).

2) Strategic Relevance to Drug Trafficking Organizations (DTOs): Municipalities are also considered exposed if they meet any of the following conditions: (a) they host major fentanyl entry ports; (b) they are located along optimal drug trafficking routes to the United States; or (c) they are major poppy cultivation zones.

Strategic port locations are identified following González (2020) and Juárez (2021), who list seven Pacific ports recognized as primary fentanyl precursor entry points. These ports are categorized by international trade relevance, as reported by the Mexico City National Chamber of Commerce (CANACO 2023).

To model DTO trafficking routes, travel costs specific to each DTO are computed using INEGI's 2014 national road network and the presence index from Signoret et al. (2021). DTO dominance in a municipality is determined using the following formula:

$$c_{d,s,t} = \sum_{k \neq d} \text{ind}_{k,s,t} - \text{ind}_{d,s,t}$$

where $c_{d,s,t}$ denotes the cost of DTO d operating in state s at time t, and $\text{ind}_{k,s,t}$ represents the presence of competing DTOs. A municipality is considered dominated by DTO d if $c_{d,s,t} \leq 0$. Shortest paths to U.S. border crossings are calculated using Dijkstra's algorithm and optimized via the Lin-Kernighan heuristic.

For poppy cultivation zones, data from Resa (2016) on hectares of destroyed poppy fields (2007–2015) are spatially transformed into a raster format using 50 km grid cells. Municipalities falling within the top 25 percent of the resulting intensity distribution are identified as high-cultivation areas.

3.3 Control Variables

To account for baseline differences across municipalities, several control variables are included. These consist of both time-varying and time-invariant measures:

1) Child Dependency Ratio: The ratio of the population under age 15 to the working-age population (ages 15–64).

2) Average Household Size: The mean number of individuals per household.

3) Access to Piped Water: The percentage of households with access to piped water services.

4) Historical Government Coercion: Measured by the number of military personnel killed by firearms in 1990. This variable reflects prior government confrontations with organized crime (López Cruz and Torrens 2024).

These indicators may influence both adolescent fertility behavior and vulnerability to organized crime.

4. EMPIRICAL STRATEGY

This section outlines the identification strategy used to estimate the causal impact of the Mexican War on Drugs (MWD) on adolescent fertility outcomes. The empirical approach exploits the quasi-experimental nature of the MWD's rollout, leveraging variation across municipalities in pre-war cartel presence and strategic importance to drug trafficking operations.

4.1 Policy Context and Quasi-Experimental Design

Between 2000 and 2006, Mexico experienced relative political stability and a steady decline in adolescent fertility rates at the national level. This pre-treatment period offers a stable baseline against which to evaluate subsequent changes. In late 2006, however, the Calderón administration launched the MWD, marking a sharp shift in national security policy. The federal government began deploying military forces to dismantle drug trafficking organizations (DTOs), triggering a significant escalation in violence across many parts of the country.

This policy shift created a quasi-natural experiment. The intervention's timing was exogenous to municipal fertility trends, and the spatial targeting was guided not by demographic considerations but by security concerns. Municipalities selected for intervention were those with entrenched DTO activity or prior exposure to drug-related violence. As such, the assignment of treatment was driven by patterns of criminal entrenchment rather than by trends in adolescent reproductive behavior, thereby fulfilling the key identification assumption of the difference-in-differences (DiD) framework.

4.2 Treatment Assignment and Group Construction

To estimate the causal impact of cartel-related violence on adolescent fertility, municipalities are categorized into treatment and control groups based on their degree of embeddedness in drug trafficking operations prior to the onset of the Mexican War on Drugs (MWD). This classification strategy accounts for both historical patterns of violence and the strategic geography of organized criminal activity.

Treated municipalities are defined as those exhibiting strong signs of cartel presence before 2007, identified through two complementary criteria. The first is an indirect measure of embeddedness based on levels of local violence. Specifically, municipalities falling within the top quartile of within-municipality homicides during the pre-war period (2000–2006) are classified as treated. This metric captures community-rooted violence, where both the perpetrator and the victim reside in the same municipality, thereby reflecting areas of sustained criminal control rather than transient violence.

The second criterion captures direct strategic relevance to DTO operations. Municipalities are treated if they contain key logistical or territorial assets essential to the drug trade. These include major Pacific ports (such as Manzanillo and Lázaro Cárdenas), high-volume border crossings with the United States, and known poppy cultivation zones. These locations are widely recognized as central to cartel logistics and are often prioritized targets in government-led counter-narcotics efforts.

A municipality is considered treated if it satisfies either the local violence or strategic relevance criterion. The treatment indicator takes a value of 1 for such municipalities in all years following the launch of the MWD in late 2006 and 0 otherwise.

By contrast, control municipalities are defined as those with low pre-war exposure to organized crime and no strategic DTO infrastructure. Specifically, these are municipalities in the bottom quartile of within-municipality homicide rates during the 2000–2006 period and which are not located near ports, border crossings, or poppy fields. These areas serve as a plausible counterfactual group, assuming that, absent the war, they would have continued to follow fertility trends similar to those observed in the treated group.

This dual-definition treatment framework facilitates a more refined analytical approach by distinguishing between two categories of municipalities. By disaggregating the treatment in this manner, the analysis can isolate the effects of militarized state intervention across distinct local contexts.

4.3 Identification Strategy and Assumptions

The validity of the DiD strategy rests on the parallel trends assumption: in the absence of treatment, adolescent fertility in treated and control municipalities would have followed similar paths. Event study plots confirm that this condition is met, as both groups exhibited comparable trends before the MWD.

The MWD serves as a sharp and exogenous policy shock, with military deployments based on pre-existing cartel presence and strategic logistics, not demographic patterns. Thus, treatment assignments are unrelated to fertility dynamics.

Although some spillover effects may have affected control municipalities (e.g., DTO displacement), the identification remains credible under the assumption that, conditional on pre-treatment characteristics and fixed effects, the treatment assignment is as good as random with respect to unobserved determinants of fertility. This framework justifies the use of DiD for causal inference and supports attributing post-2007 fertility changes to the impact of the MWD.

4.4 Model Specification and Estimation Setup

This analysis estimates the causal effect of the Mexican War on Drugs (MWD) on adolescent fertility using a difference-in-differences (DiD) approach with two alternative treatment definitions: (1) municipalities with high levels of local violence prior to 2007, and (2) municipalities that hold strategic importance to drug trafficking organizations (DTOs), such as ports, border crossings, or poppy production zones.

The baseline model can be formally expressed as:

$$Y_{it} = \beta_1 \cdot (\text{Post}_t \times \text{HighViolence}_i) + \mu_i + \lambda_i + \varepsilon_{it}$$

where Y_{it} denotes the adolescent fertility rate in municipality i at year t; Post_t is a post-2007 time dummy; and HighViolence_i indicates municipalities in the top quartile of pre-war homicides. The model includes municipality fixed effects μ_i, year fixed effects λ_t, and a municipality-level error term ε_{it}.

To account for observable differences in infrastructure and socioeconomic conditions, the model is extended by incorporating time-varying control variables. The updated specification is:

$$Y_{it} = \beta_1 \cdot (\text{Post}_t \times \text{HighViolence}_i) + X_{it}'\gamma + \mu_i + \lambda_i + \varepsilon_{it}$$

where X_{it} includes the percentage of households with piped water, average household size, and the child dependency rate.

To further strengthen the specification, a control for historical government coercion is included, measured by the presence of military personnel in 1990. The model is estimated as:

$$Y_{it} = \beta_1 \cdot (\text{Post}_t \times \text{HighViolence}_i) + X_{it}'\gamma + \delta_1 \cdot \text{GovViolence}_i + \mu_i + \lambda_i + \varepsilon_{it}$$

where GovViolence_i captures pre-existing patterns of militarization.

The three model variants are also estimated using an alternative treatment definition based on the strategic relevance of DTOs. In this case, the treatment indicator captures whether a municipality contains ports, major border crossings, or poppy cultivation zones. The corresponding model specification is:

$$Y_{it} = \beta_2 \cdot (\text{Post}_t \times \text{Strategic}_i) + X_{it}'\gamma + \delta_1 \cdot \text{GovViolence}_i + \mu_i + \lambda_i + \varepsilon_{it}$$

This set of specifications facilitates the comparison of the fertility effects of the MWD across municipalities that were either historically embedded in cartel activity or drawn into the conflict due to their strategic location.

5. RESULTS

5.1 Difference-in-Differences Results

Table 5.1 reports the results of six difference-in-differences (DiD) regressions estimating the effect of the Mexican War on Drugs (MWD) on adolescent fertility. The analysis is structured around two definitions of treatment. Columns 1–3 define treated municipalities based on high pre-war levels of local violence, while Columns 4–6 rely on an alternative classification based on strategic importance to drug trafficking organizations (DTOs), including proximity to ports, poppy fields, or major border crossings.

Table 5.1 Difference-in-Differences estimates of the effect of the MWD on adolescent fertility

	High Violence			**Strategic Areas**		
	(1)	(2)	(3)	(1)	(2)	(3)
Post × High Violence	9.843***	9.505***	9.513***			
	(1.742)	(1.692)	(1.696)			
Post × Strategic Area				8.247***	7.855***	7.786***
				(2.358)	(2.315)	(2.302)
Piped Water (%)		0.078	0.078		0.063	0.063
		(0.084)	(0.084)		(0.094)	(0.094)
Household Size		−3.891	−3.890		−4.242	−4.251
		(6.384)	(6.384)		(6.513)	(6.514)
Child Dependency Rate		0.424**	0.424**		0.414**	0.415**
		(0.134)	(0.134)		(0.145)	(0.145)
Gov. Violence (1990)			−0.163			0.985^{+}
			(0.318)			(0.549)
Num. Obs.	7501	7501	7501	6916	6916	6916
R^2	0.678	0.680	0.680	0.658	0.659	0.659
Adjusted R^2	0.651	0.653	0.653	0.628	0.630	0.630

Notes: Robust standard errors in parentheses. All models include fixed effects for both municipality and year. $^{+}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

In Columns 1 through 3, municipalities with high levels of within-municipality homicides during the pre-war period (2000–2006) are treated as high-violence areas. Column 1 presents the baseline specification, which includes municipality and year-fixed effects only. The interaction term between the post-treatment period and high-violence municipalities is positive and highly significant, with a coefficient of approximately 9.84. This suggests that, on average, adolescent fertility increased by nearly 10 births per 1,000 girls aged 15–19 in municipalities with entrenched cartel presence following the launch of the MWD.

Column 2 includes a set of socioeconomic controls, such as the percentage of households with piped water, average household size, and the child dependency rate. The estimated treatment effect remains strong and statistically significant (coefficient: 9.51), indicating that these observable differences in living conditions do not explain the observed fertility increase. Column 3 further includes a control for historical government violence, measured by the intensity of state military presence in 1990. The coefficient on this additional control is small and statistically insignificant, and the estimated treatment effect remains robust (9.51), suggesting that the results are not driven by longer-term patterns of militarization or state coercion.

Columns 4 through 6 present the same model sequence using the alternative treatment definition based on strategic DTO importance. Column 4 shows that the baseline treatment effect remains positive and significant (coefficient: 8.25), though slightly smaller in magnitude than the effect estimated for high-violence areas. The inclusion of socioeconomic controls in Column 5 yields a similar result (7.86), and the addition of the historical violence variable in Column 6 has little impact on the estimated treatment effect (7.79), which remains statistically significant.

Taken together, these results indicate that the MWD had a substantial and robust effect on adolescent fertility in municipalities with high cartel embeddedness or strategic value to DTO operations. The magnitude and consistency of the treatment effects across specifications suggest that exposure to militarized violence, particularly in areas with existing criminal infrastructure, disrupts adolescent life trajectories and increases early childbearing. The findings are not explained by pre-existing differences in socioeconomic conditions or historical state violence, strengthening the claim that the observed fertility effects are directly linked to the dynamics of the drug war.

5.2 Event Study and Pre-Trends

To further examine the plausibility of the parallel trend assumption, Figures 5.1 and 5.2 present event-study estimates based on the specifications in Columns 1 and 4 of Table 5.1. The graphs illustrate the dynamic effects of treatment on adolescent fertility over time, enabling a visual assessment of both pre-treatment trends and the evolution of the treatment effect.

Figure 5.1 Dynamic treatment effects on adolescent fertility – high-violence municipalities

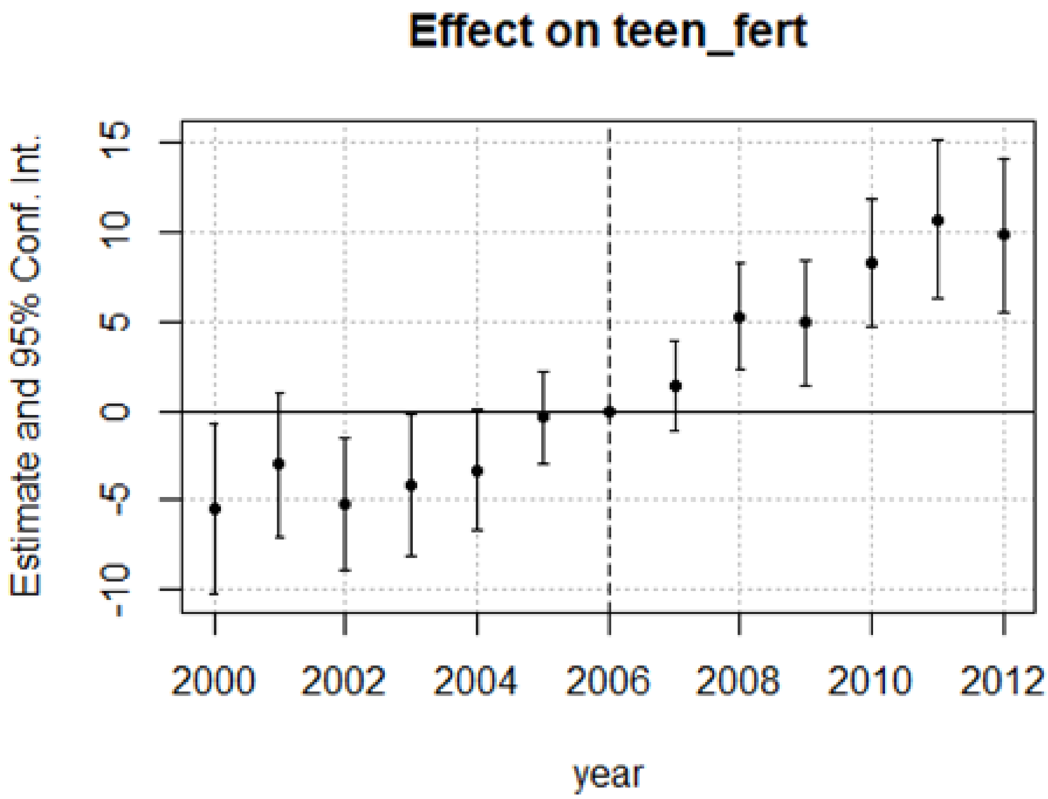
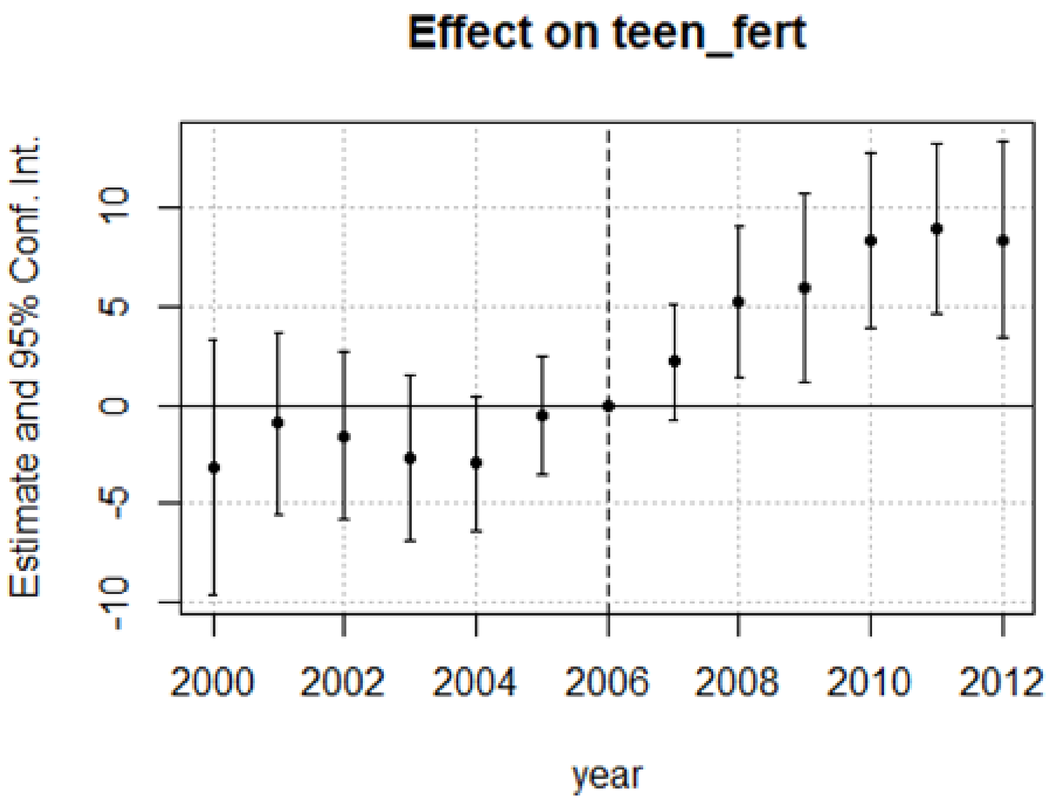


Figure 5.2 Dynamic treatment effects on adolescent fertility – strategic DTO municipalities



The results show no evidence of differential pre-trends between treated and control municipalities prior to the onset of the Mexican War on Drugs. From 2000 to 2006, the estimated coefficients fluctuate around zero and are statistically insignificant, supporting the assumption that treated and control groups followed parallel trends before the policy intervention.

Starting in 2007, the year immediately following the launch of the MWD, the treatment effect becomes positive and grows progressively larger. By 2009, the effect is both statistically significant and substantively large, resulting in an increase of approximately 8 to 10 additional births per 1,000 adolescent girls in treated municipalities compared to controls. This pattern is consistent with a delayed but meaningful response to increased violence and militarization, and it strengthens the causal interpretation of the DiD estimates.

Notably, the consistency of results across both treatment definitions based on high local violence and strategic DTO relevance demonstrates robustness. The estimates remain stable across model specifications that incorporate controls for socioeconomic status and historical government violence.

All standard errors are clustered at the municipality level to account for serial correlation in the panel data structure. This approach ensures that the reported significance levels are not overstated due to within-municipality error correlation over time.

6. ROBUSTNESS

6.1 Synthetic Difference-in-Differences (SDID) Analysis

To strengthen the robustness of the baseline findings, this study implements the Synthetic Difference-in-Differences (SDID) methodology proposed by Arkhangelsky et al. (2021). The adoption of SDID is particularly appropriate in the Mexican context, where the rollout of cartel-related violence and military interventions was highly localized and heterogeneous in both timing and intensity. Such variation challenges the credibility of the parallel trends assumption underpinning Difference-in-Differences (DiD) approaches, which rely on the premise that treated and untreated units would have followed similar trends in the absence of treatment.

The SDID method addresses this limitation by constructing a more credible counterfactual for each treated unit. Instead of imposing a single trend across all comparison units, SDID uses pre-treatment outcome trajectories to construct a synthetic control for each treated municipality. This synthetic control is a weighted average of untreated municipalities whose historical fertility trends most closely resemble those of the treated unit prior to the intervention. The treatment effect is then estimated as the difference between the observed post-treatment outcome of the treated unit and that of its synthetic counterpart.

The motivation for applying this method stems from several challenges inherent in the data. First, the effects under study are highly localized; cartel violence and military operations are often concentrated in specific municipalities. Second, there exists limited overlap and covariate imbalance between treated and control municipalities, particularly for baseline fertility trends and exposure to organized crime. Third, SDID provides a more flexible and data-driven approach to causal inference by matching pre-treatment dynamics rather than relying solely on fixed effects and aggregate controls.

In this setting, SDID allows for a more nuanced understanding of how militarized interventions shaped adolescent fertility, capturing the delayed and uneven nature of the Mexican War on Drugs. It is especially effective where treatment timing varies and pre-trends deviate across units, offering more precise and credible estimates.

By complementing the baseline DiD results with Synthetic Difference-in-Differences (SDID) estimation, the analysis reinforces the credibility of its causal claims. The SDID framework constructs a data-driven counterfactual that validates both the direction and magnitude of the estimated treatment effects, addressing potential concerns related to sample imbalance and model misspecification.

The subsections that follow present the empirical findings from the SDID approach, including point estimates, visual comparisons between treated and synthetic control units, and diagnostics on unit-level weights and effect distributions. These results collectively provide additional support for the study's conclusion.

6.1.1 Estimation Results (Full Sample)

The results from the Synthetic Difference-in-Differences estimation yield a point estimate of 9.59, with a 95 percent confidence interval ranging from 6.47 to 12.70. This suggests that, on average, exposure to cartel-related violence and militarized interventions is associated with an increase of approximately 9.6 births per 1,000 adolescent girls in treated municipalities relative to their synthetic counterparts. These estimates are derived using the same sample of municipalities employed in the baseline DiD analysis, ensuring comparability across estimation strategies. The statistical significance and magnitude of the effect are consistent with the findings from traditional DiD models, lending further support to the robustness of the central result.

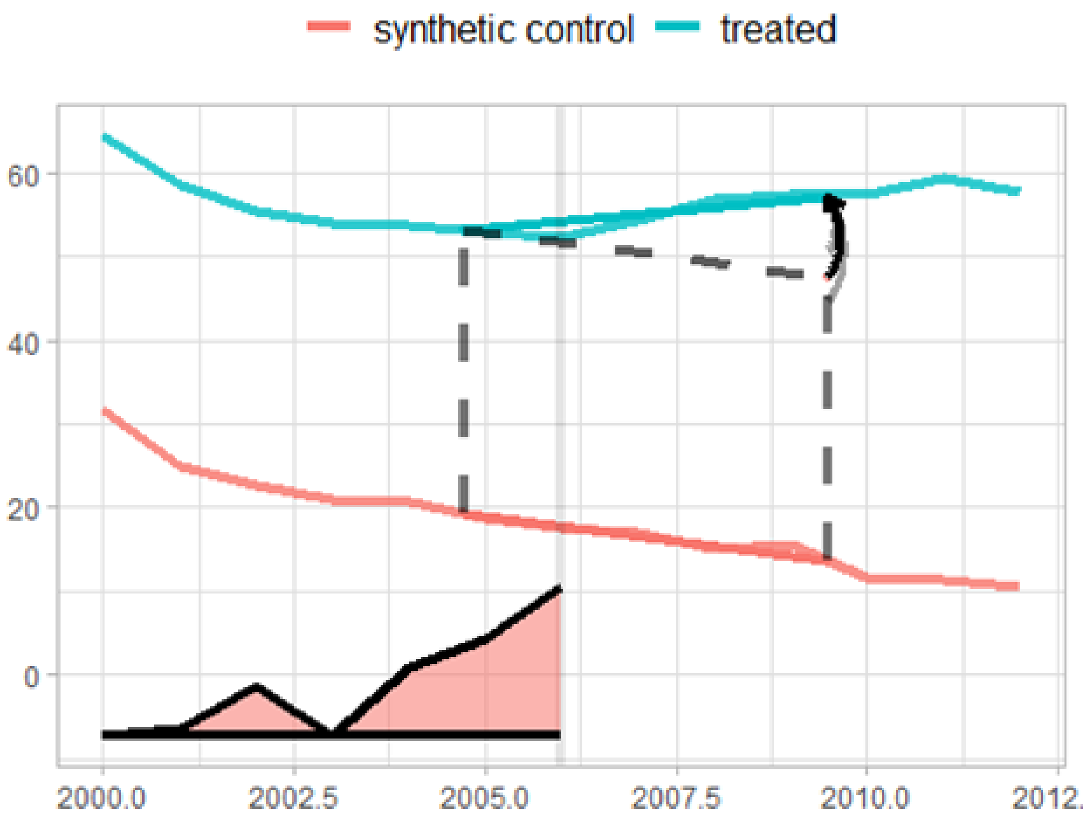
6.1.2 Outcome Trends: Treated vs. Synthetic Control

Figure 6.1 displays the outcome plot from the Synthetic Difference-in-Differences (SDID) analysis. The blue line represents the average adolescent fertility trajectory in treated municipalities. In contrast, the red line illustrates the synthetic control group's counterfactual trend constructed as a weighted average of untreated municipalities that mirrors the pre-treatment outcomes of the treated units.

The vertical line in 2006 marks the onset of the Mexican War on Drugs (MWD), signaling the beginning of treatment exposure. The bracket and arrow on the right side of the graph visually highlight the treatment effect, showing the divergence between the observed post-treatment trajectory of the treated municipalities and the counterfactual path they would have followed in the absence of militarized drug enforcement.

This visual evidence supports the magnitude and timing of the estimated effect, consistent with the numerical results previously reported. The treated municipalities exhibit a noticeable upward shift in adolescent fertility following the MWD. At the same time, synthetic control continues a flat or slightly declining path, suggesting a substantive and credible impact of the drug war on reproductive behavior.

Figure 6.1 Adolescent fertility trends, treated vs. synthetic control



6.1.3 Weight Plot for Synthetic Difference-in-Differences Estimates

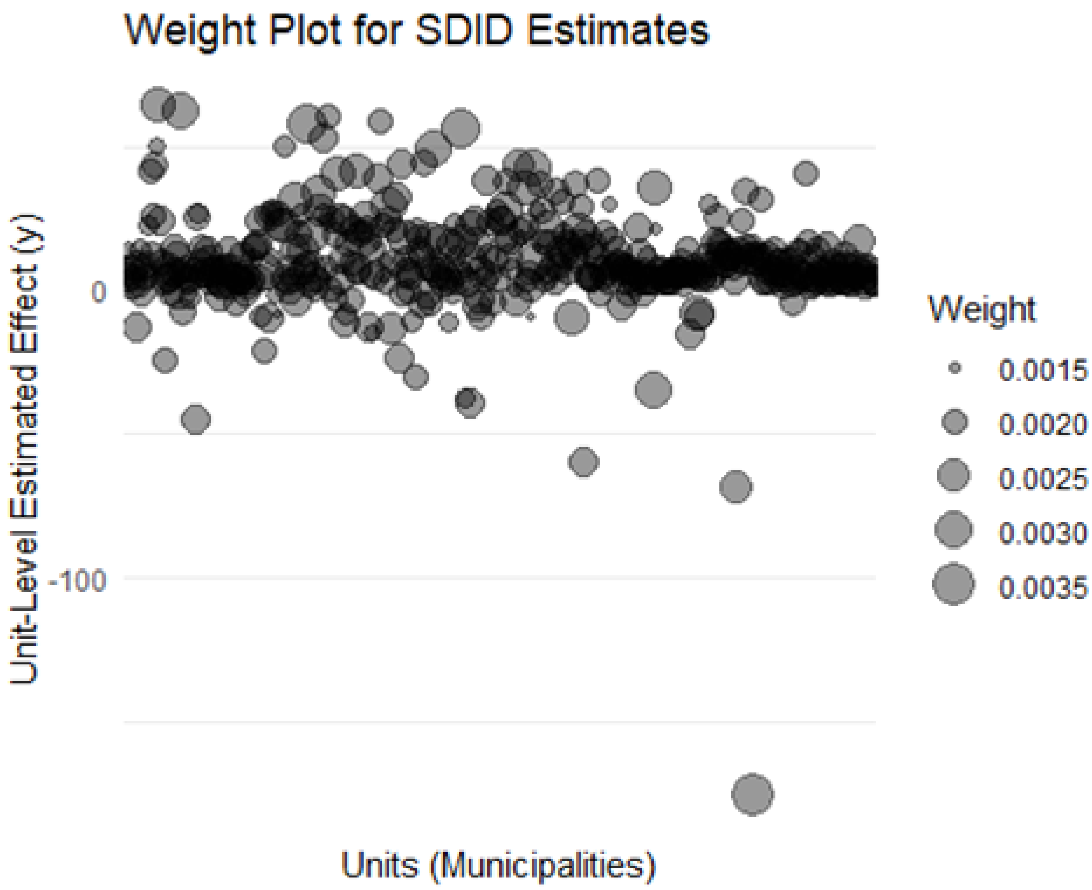
Figure 6.2 presents the weight plot from the Synthetic Difference-in-Differences (SDID) estimation. This visualization helps assess the contribution of each unit to the overall estimated treatment effect.

On the X-axis, each dot represents a municipality (treated or control). The Y-axis displays the unit-level estimated effect derived from the SDID model. The size of each dot reflects the weight assigned to that unit by the SDID algorithm in constructing the weighted average used for estimating the treatment effect.

The plot reveals that most units receive relatively small weights and cluster around zero, indicating they contribute incrementally to the average treatment effect. A smaller number of municipalities receive larger weights, suggesting that they are better matches in the pre-treatment period and thus play a more influential role in the estimation.

Notably, units with significant negative estimated effects tend to be assigned low weights. This distribution supports the robustness of the average effect reported in the primary analysis and illustrates the algorithm's capacity to minimize the influence of poorly matched or atypical units.

Figure 6.2 Weight plot for synthetic Difference-in-Differences estimates



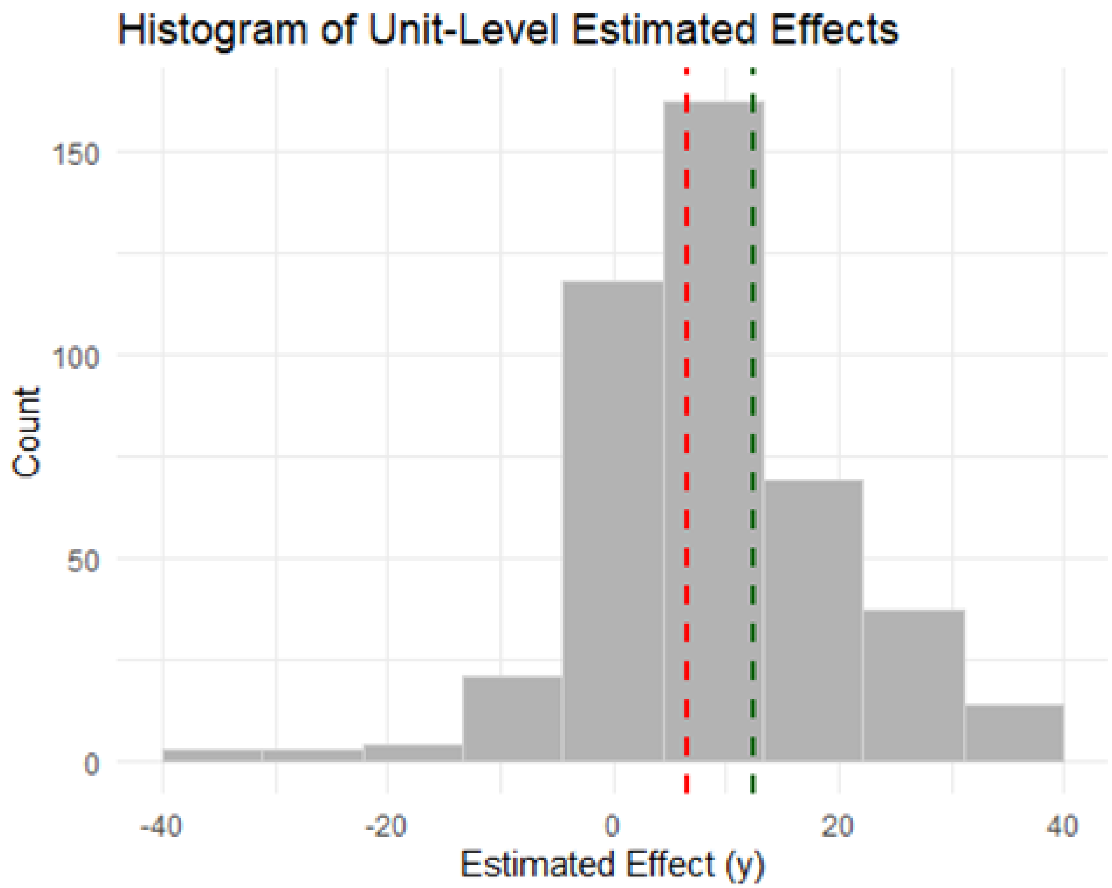
6.1.4 Distribution of Unit-Level Estimated Effects

Figure 6.3 presents a histogram of the unit-level estimated effects generated from the Synthetic Difference-in-Differences (SDID) analysis. Each bar reflects the frequency of municipalities according to their estimated treatment effect. The distribution is centered around the overall point estimate of 9.59, with the red dashed line marking the lower bound and the green dashed line indicating the upper bound of the 95 percent confidence interval (6.47 to 12.70). These bounds are constructed using the standard formula:

$$\text{Estimate} \pm 1.96 \times \text{SE}$$

The bulk of unit-level effects clusters near the central estimate, lending further credibility to the positive average treatment effect. While a few control units fall outside the confidence interval, some displaying extreme values, these outliers are relatively rare and likely reflect noisy or poorly matched donors. Their limited influence on the aggregate result is consistent with the robustness of the main findings.

Figure 6.3 Distribution of unit-level estimated effects from the SDID model



6.2 Robustness Check: Trimming Outlier Donors

To verify that the estimated effect of the Mexican War on Drugs (MWD) on adolescent fertility is not disproportionately influenced by a small number of atypical control units, this subsection implements a robustness check based on the trimming of outlier donors. The goal is to test whether the observed treatment effect persists when potentially unrepresentative municipalities are excluded from the donor pool.

The baseline Synthetic Difference-in-Differences (SDID) model constructs a synthetic control group by assigning weights to untreated municipalities based on their similarity to treated units. Ideally, each control municipality contributes in proportion to how closely its pre-treatment trajectory matches that of the treated unit. However, some donor municipalities exhibit extreme estimated effects when considered as stand-alone counterfactuals, either highly positive or highly negative.

These outliers are identifiable in the weight plot (Figure 6.2), where the vertical axis reflects the estimated treatment effect for each control unit individually, and the size of each bubble denotes the weight assigned by the SDID algorithm. Similarly, the histogram of unit-level effects (Figure 6.3) reveals the full distribution of estimated donor effects. The dashed vertical lines in the histogram mark the lower and upper bounds of the 95 percent confidence interval around the average SDID estimate, highlighting which units fall outside the typical range.

To assess the robustness of the baseline findings, all donor municipalities with estimated unit-level effects that lie outside the 95 percent confidence interval, specifically those below 6.47 or above 12.70, are excluded from the donor pool. The SDID model is then re-estimated using this trimmed sample. This procedure enables a more accurate assessment of whether the estimated treatment effect is driven by a broad set of consistent donor units or by a small number of influential outliers.

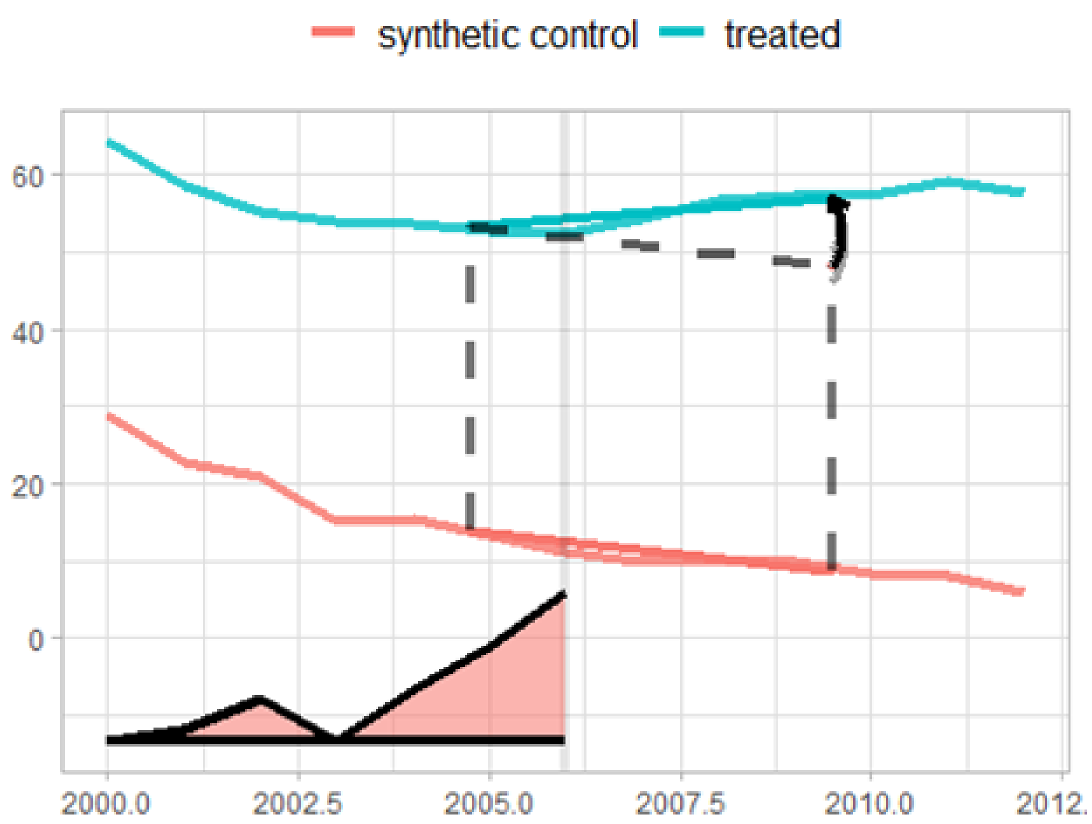
6.2.1 Estimation Results (Trimmed Sample)

The results of the trimmed model are presented. The updated point estimate is 9.02, with a 95 percent confidence interval of (6.97, 11.08). This estimate is remarkably close to the full-sample result of 9.59, indicating that the overall treatment effect is not driven by a small number of extreme donors. Instead, the result appears to be robust to exclusion of potentially influential or mismatched municipalities.

6.2.2 Outcome Trends: Treated vs. Synthetic Control (Trimmed Sample)

Figure 6.4 presents the updated Synthetic Difference-in-Differences (SDID) plot based on the trimmed dataset. This figure illustrates the evolution of adolescent fertility for treated municipalities compared to their synthetic controls, following the exclusion of outlier donor units. Despite the reduced sample, the post-treatment gap between the treated and synthetic control groups remains substantial, visually reinforcing the robustness of the estimated effect.

Figure 6.4 Adolescent fertility trends in treated vs. synthetic control municipalities (trimmed SDID sample)



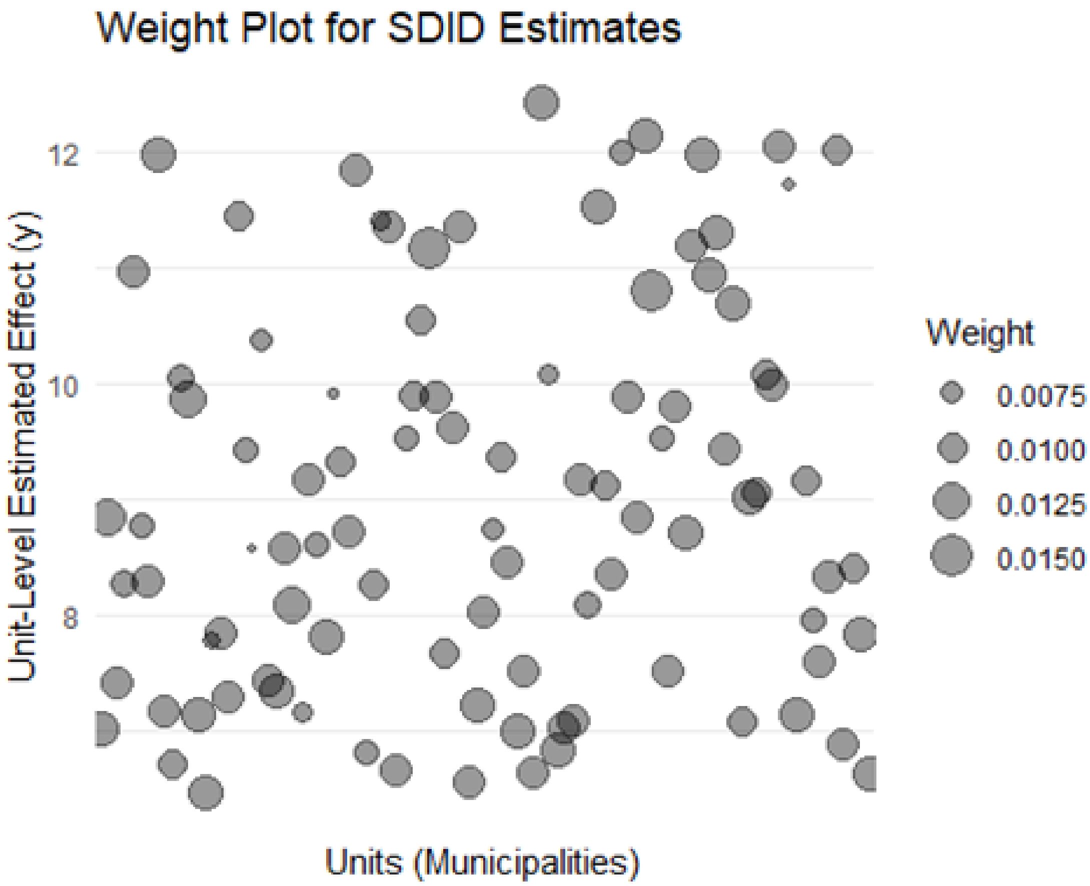
6.2.3 Weight Plot for Synthetic Difference-in-Differences Estimates (Trimmed Sample)

Figure 6.5 presents the weight plot based on the trimmed Synthetic Difference-in-Differences (SDID) estimation, which includes only donor municipalities whose unit-level estimated effects fall within the 95 percent confidence interval of the original estimate.

The visual distribution shows a tight clustering of estimated effects and larger assigned weights, indicating that the re-estimated treatment effect is derived from a more homogeneous and credible donor pool.

This trimming procedure enhances the robustness of causal inference by reducing the influence of noisy, atypical, or poorly matched units.

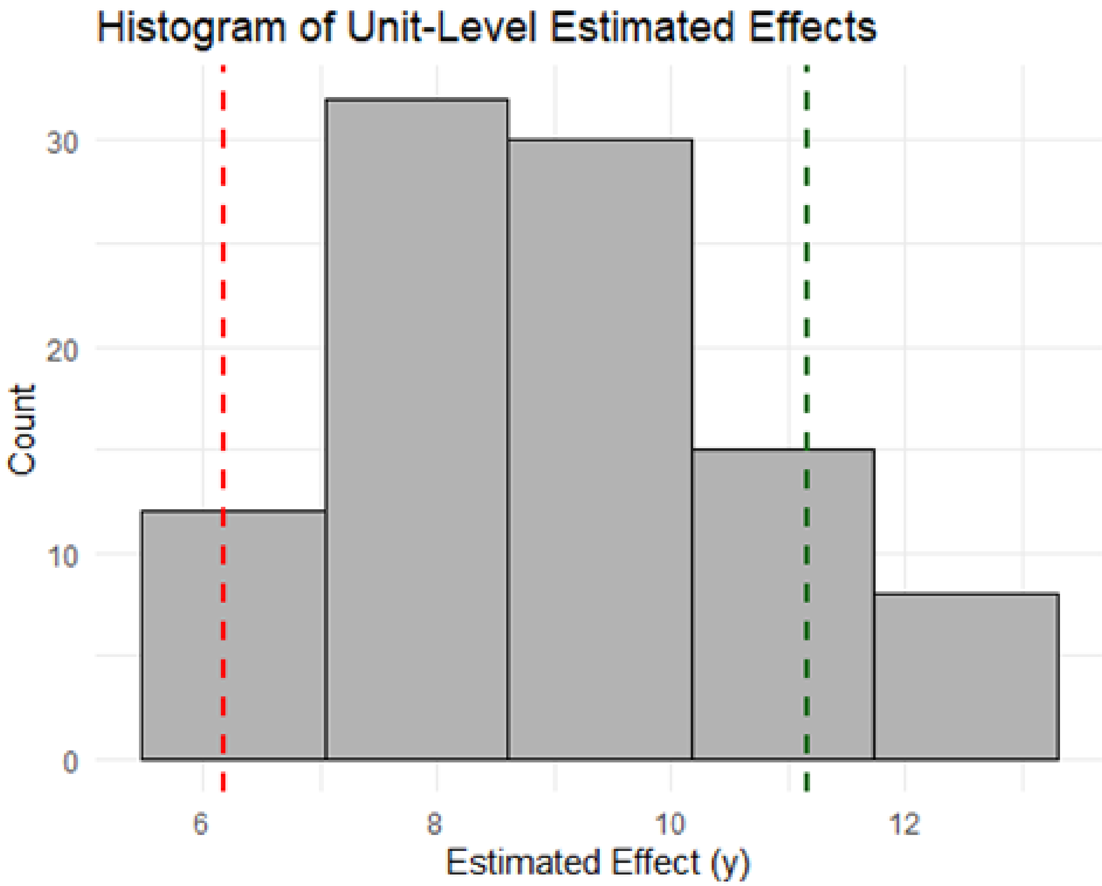
Figure 6.5 Weight plot for trimmed Synthetic Difference-in-Differences estimates



6.2.4 Distribution of Unit-Level Estimated Effects (Trimmed Sample)

Figure 6.6 presents the histogram of unit-level estimated effects based on the trimmed Synthetic Difference-in-Differences (SDID) sample. Compared to the full-sample distribution, the shape of the trimmed histogram is notably more symmetrical and concentrated around the central estimate. The vast majority of municipalities now fall within the confidence interval, indicating reduced variability in donor behavior. This visual pattern supports the conclusion that the trimmed donor pool provides a more stable and internally consistent basis for estimating the average treatment effect.

Figure 6.6 Distribution of unit-level estimated effects (trimmed sample)



The robustness check based on outlier trimming provides strong evidence that the positive treatment effect identified through the Synthetic Difference-in-Differences approach is not driven by a handful of influential or poorly matched donor municipalities. Even after restricting the donor pool to units whose estimated effects fall within the 95 percent confidence interval, the point estimate remains substantively similar, decreasing only slightly from 9.59 to 9.02. This minimal change reinforces the stability of the main finding.

Visual diagnostics further support this conclusion. As shown in Figures 17 through 19, the trimmed sample produces a treatment effect of similar magnitude to the full sample, along with more stable weight assignments across donor municipalities and a more concentrated distribution of unit-level estimated effects. These results indicate that the trimmed synthetic control group closely tracks the pre-treatment trends of the treated units and that the estimated treatment effect remains reliable, even after removing heterogeneous or extreme donor units.

Future versions of this project may explore in more detail the characteristics of municipalities with extreme unit-level estimates, which could reflect structural mismatches or unique local dynamics. However, for the present analysis, the trimming procedure serves as a rigorous diagnostic that enhances confidence in the validity of the central result.

7. CONCLUSION

This thesis departs from much of the existing literature on violence and adolescent fertility by shifting the focus from generalized exposure to the territorial embeddedness of organized criminal groups. While previous studies often treat all treated municipalities uniformly, this research emphasizes the significance of cartel entrenchment and strategic geography, such as border crossings, trafficking corridors, and poppy-growing regions.

The empirical analysis reveals a positive and statistically significant effect of the Mexican War on Drugs (MWD) on adolescent fertility, concentrated in municipalities with a sustained cartel presence or logistical importance. This pattern suggests that organized crime's territorial control and social influence shape reproductive behavior during periods of intensified violence. The findings are robust across both Difference-in-Differences and Synthetic DiD estimators, including sensitivity checks that strengthen the credibility of the results.

While the thesis establishes a robust causal link between cartel-linked violence and increased adolescent fertility, it does not investigate the underlying mechanisms. Whether this rise stems from fear, constrained opportunities, disrupted services, or imposed social norms remains an open question. Addressing these channels is a critical task for future research.

In sum, this study highlights how criminal governance reshapes not only the geography of violence but also key demographic outcomes. It urges policymakers to move beyond enforcement-based responses and consider how criminal territorial power affects long-term human development.

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