

Trafficking Networks and the Mexican Drug War*

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Abstract: Drug trade-related violence has escalated dramatically in Mexico since 2007, and recent years have also witnessed large-scale efforts to combat trafficking, spearheaded by Mexico's conservative PAN party. This study examines the direct and spillover effects of Mexican policy towards the drug trade. Regression discontinuity estimates show that drug-related violence increases substantially after close elections of PAN mayors. Empirical evidence suggests that the violence reflects rival traffickers' attempts to usurp territories after crackdowns have weakened incumbent criminals. Moreover, the study uses a network model of trafficking routes to show that PAN victories divert drug traffic, increasing violence along alternative drug routes.

Keywords: Drug trafficking, networks, violence.

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1 Introduction

Drug trade-related violence has escalated dramatically in Mexico since 2007, claiming over 50,000 lives and raising concerns about the capacity of the Mexican state to monopolize violence. Recent years have also witnessed large scale efforts to combat drug trafficking, spearheaded by Mexico's conservative National Action Party (PAN). While drug traffickers are economic actors with clear profit maximization motives, there is little empirical evidence on how traffickers' economic objectives have conditioned the outcomes of Mexico's war on drug trafficking. More basically, it remains controversial whether government policies have caused the marked increase in violence, or whether violence would have risen substantially in any case (Guerrero, 2011; Rios, 2011a; Shirk, 2011). This study uses variation from close mayoral elections and a network model of drug trafficking to examine the direct and spillover effects of Mexican crackdowns on the drug trade.

Mexico is the largest supplier to the U.S. illicit drug market, with Mexican drug traffickers earning approximately 25 billion USD each year in wholesale U.S. drug markets (U.N. World Drug Report, 2011). In addition to drugs, Mexican trafficking organizations engage in a wide variety of illicit activities including protection rackets, kidnapping, human smuggling, prostitution, oil and fuel theft, money laundering, weapons trafficking, arson, and auto theft (Guerrero, 2011, p. 10). Official data described later in this study document that in 2008, drug trafficking organizations maintained operations in two thirds of Mexico's municipalities, and illicit drugs were cultivated in 14% of municipalities.

The study uses three main inputs to analyze how crackdowns affect violence and drug trafficking routes: a network model of trafficking routes, plausibly exogenous variation in local drug policy, and confidential data on the drug trade. In the network routes model, traffickers' objective is to minimize the costs of transporting drugs from producing municipalities in Mexico across the road network to U.S. entry points. In the simplest version, traffickers take the shortest route to the U.S. that avoids municipalities experiencing crackdowns. I also specify and estimate richer versions of the model in which trafficking costs are a function of additional relevant factors.

The state does not randomly combat drug trafficking in some places but not others, and the government may choose to crack down in municipalities where violence is expected to increase. In order to isolate plausibly exogenous variation in local policy towards the drug trade, I exploit the outcomes of close mayoral elections in 2007 and 2008 involving the PAN party.¹ The PAN's role in spearheading the war on drug trafficking, as well as qualitative evidence that PAN mayors have contributed to these efforts, motivate this empirical strategy.

¹See Lee, Moretti, and Butler (2004) for a pioneering example of a regression discontinuity design exploiting close elections. A number of studies have used discontinuous changes in policies, in the cross-section or over time, to examine illicit behavior. See Zitzewitz (2011) for a detailed review.

While municipalities where PAN candidates win and lose by wide margins are likely to be different, when we focus on close elections it becomes plausible that election outcomes are driven by idiosyncratic factors that do not themselves affect violence. I show that the outcomes of close elections are in fact uncorrelated with baseline municipal characteristics.

The network model, variation from close mayoral elections, and data on drug trade-related outcomes are used to examine three sets of questions. First, the study tests whether the outcomes of close mayoral elections involving the PAN affect drug trade-related violence in the municipalities experiencing these elections. It also examines the economic mechanisms mediating this relationship. Second, it tests whether trafficking routes are diverted to other municipalities following close PAN victories and examines whether the diversion of drug traffic is accompanied by violence spillovers. Finally, it discusses policy applications and uses the trafficking model to examine the allocation of law enforcement resources.

Regression discontinuity (RD) estimates document that the monthly drug trade-related homicide probability is 8.4 percentage points higher after a PAN mayor takes office than after a non-PAN mayor takes office. This compares to a sample average monthly probability of drug-related homicide equal to six percent. The drug trade-related homicide rate is likewise higher after PAN inaugurations: drug-related violence declines slightly following PAN losses, whereas it increases sharply following PAN victories. In contrast, the non-drug homicide rate is uncorrelated with the outcomes of close elections. The homicide response to PAN victories consists primarily of individuals involved in the drug trade killing each other. Analysis using information on the industrial organization of trafficking suggests that the violence reflects rival traffickers' attempts to wrest control of territories after crackdowns initiated by PAN mayors have weakened the incumbent traffickers.

These results support qualitative and descriptive studies arguing that Mexican government policy has been the primary cause of the large increase in violence in recent years. Guerrero (2011) compiles extensive qualitative and descriptive evidence suggesting that government policies have ignited violent conflicts between traffickers. Escalante (2011) documents a strong state level correlation between homicides and deployment of the Mexican military and federal police, and Merino (2011) expands Escalante's analysis by using state level data and a matching strategy to argue that Mexican homicides in 2008-2009 would have totaled 14,000 rather than 19,000 in the absence of federal law enforcement intervention. This study's findings contrast with other studies arguing that the increase in violence in recent years can primarily be explained by the diversification of drug trafficking organizations into new criminal activities, by increased arms availability, by increased U.S. deportation of immigrants with a criminal record, by job loss, or by cultural shifts in morality (see Williams, 2012; Escalante et al, 2011, Rios, 2011a for a discussion). The results also relate to work by Angrist and Kugler (2008) documenting that exogenous increases in coca prices increase

violence in rural districts in Colombia because combatant groups fight over the additional rents. In Mexico, crackdowns likely reduce rents from criminal activities while in effect, but by weakening the incumbent criminal group they also reduce the costs of taking control of a municipality. Controlling territory is likely to offer substantial rents from trafficking and a variety of other criminal activities once the crackdown subsides.

The study’s second set of results examines whether close PAN victories exert spillover effects. When policy leads one location to become less conducive to illicit activities, organized crime may relocate elsewhere. For example, descriptive evidence suggests that coca eradication policies in Bolivia and Peru during the late 1990s led cultivation to shift to Colombia, and large-scale coca eradication in Colombia in the early 2000s has since led cultivation to re-expand in Peru and Bolivia, with total coca cultivation unchanged between 1999 and 2009 (Isacson, 2010; Leech, 2000; UN Office on Drugs and Crime 1999-2009). On a local level, work by Di Tella and Schargrotsky (2004) documents that the allocation of police officers to Jewish institutions in Buenos Aires substantially reduced auto theft in the immediate vicinity but may also have diverted some theft to as close as two blocks away. While a number of studies have examined the drug trade and organized crime, to the best of my knowledge this study is the first to empirically estimate spillover patterns in drug trafficking activity.²

I use the network routes model to locate municipalities where violence spillovers are likely to occur. In the model, close PAN victories increase the costs of trafficking drugs through a municipality, diverting least cost routes elsewhere.³ Elections occur at different times during the sample period, generating plausibly exogenous within-municipality variation in predicted routes throughout Mexico. To assess whether the model is reasonable, within-municipality variation in model predicted routes is compared to within-municipality variation in actual illicit drug confiscations, as illustrated in Figure 1. Illicit drug confiscations increase by 18.5% when a municipality acquires a predicted shortest path route, and this estimate is significant at the 1% level. Traffickers may care about the routes other traffickers take, and thus I also estimate a richer model that imposes congestion costs when routes coincide. The richer model is similarly predictive, and further robustness and placebo checks also support the validity of the network approach as a tool for locating spillovers. Predicted routes for the beginning of the sample period are shown in Figure 2.

After showing that the network routes model is predictive, the study provides evidence

²Studies of the economics of organized crime include Levitt and Venkatesh’s analysis of the finances of a U.S. drug gang (2000); Gambetta’s economic analysis of the Sicilian mafia (1996); Pinotti’s (2012) study of the economic costs of organized crime in southern Italy; Bandiera (2003), Dimico et al. (2012) and Buonanno et al.’s (2012) investigations of the historical origins of the Sicilian mafia; Varese’s (2005) and Frye and Zhuravskaya’s (2000) analyses of the rise of the Russian mafia; and Mastrobuoni and Patacchini’s (2010) study of the network structure of crime syndicates.

³The model exploits close election outcomes because they allow spillovers to be isolated from correlations that are due to environmental factors (Manski, 1993).

that crackdowns increase violence along alternative routes. When a municipality acquires a predicted route, the monthly probability that a drug trade-related homicide occurs increases by around 1.4 percentage points, relative to a baseline probability of 4.4%. There is some evidence that violence spillovers are concentrated in municipalities where multiple routes coincide. I also show that the trafficking model provides more insight into where violence spillovers are likely to occur than looking at areas adjacent to crackdowns, a common reduced form approach for locating crime spillovers.

Finally, I discuss policy interpretations and extend the trafficking model to include the government’s law enforcement allocation problem. In addition to endogenizing crackdowns, I consider how the costs of violence can be incorporated into this problem and how the violent response to crackdowns may be reduced. While we would not expect there to be easy solutions to the challenges facing Mexico, the network framework provides unique information with the potential to contribute to a more economically informed law enforcement policy.

The next section provides an overview of Mexican drug trafficking, and Section 3 develops the network trafficking model. Section 4 tests whether the outcomes of close elections affect violence in the municipalities experiencing these elections and examines the economic mechanisms underlying the relationship between PAN victories and violence. Section 5 tests whether PAN victories exert spillovers on drug trafficking activity and violence. Finally, Section 6 discusses policy applications, and Section 7 concludes.

2 Drugs and Violence in Mexico

2.1 The Drug Trafficking Industry

Mexican drug traffickers dominate the wholesale illicit drug market in the United States, earning between 14 and 48 billion USD annually.⁴ According to the U.N. World Drug Report, Mexico is the largest supplier of heroin to U.S. markets and the largest foreign supplier of marijuana and methamphetamine. Official Mexican government data, obtained from confidential sources, document that fourteen percent of Mexico’s municipalities regularly produce opium poppy seed (heroin) or cannabis. Moreover, 60 to 90 percent of cocaine consumed in the U.S. transits through Mexico (U.S. Drug Enforcement Agency, 2011). The U.S. market provides substantially more revenue than Mexico’s domestic drug market, which is worth an estimated 560 million USD annually (Secretaría de Seguridad Pública, 2010).⁵

⁴Estimates are from the U.S. State Department (2009). Estimates by U.S. Immigration and Customs Enforcement, the U.S. Drug Enforcement Agency, and the Mexican Secretaría de Seguridad Pública are broadly similar and also contain a large margin of error.

⁵According to the U.S. National Survey on Drug Use and Health, 14.2 percent of Americans (35.5 million people) have used illicit drugs during the past year, as contrasted to 1.4 percent of the Mexican population

At the beginning of this study's sample period, in December 2006, there were six major drug trafficking organizations (DTOs) in Mexico. Official data obtained from confidential sources document that 68 percent of Mexico's 2,456 municipalities were known to have a major DTO or local drug gang operating within their limits in early 2008. These data also estimate that 49 percent of drug producing municipalities were controlled by a major trafficking organization, with the remaining controlled by local gangs.

The term 'cartel', used colloquially to refer to DTOs, is a misnomer, as these organizations do not collude to reduce illicit drug production or to set prices. Alliances between DTOs are highly unstable, and there is considerable decentralization and conflict within DTOs (Williams, 2012; Guerrero, 2011, p. 10, 106-108). Decisions about day-to-day operations are typically made by local cells, as this ensures that no single trafficker will be able to reveal extensive information if captured by authorities. Moreover, the number of major DTOs increased from six in 2007 to 16 by 2011, with groups splitting over leadership disputes.

In addition to trafficking drugs, Mexican DTOs engage in a host of illicit activities that range from protection rackets, kidnapping, human smuggling, and prostitution to oil and fuel theft, money laundering, weapons trafficking, arson, and auto theft (Guerrero, 2011, p. 10). Notably, protection rackets involving the general population have increased substantially in recent years (Rios, 2011b; Secretariado Ejecutivo del Sistema Nacional de Seguridad Pública, 2011). The poor, who have limited recourse to state protection, are particularly likely to be extorted (Díaz-Cayeros et al., 2011).

The second half of the 2000s witnessed large, rapid increases in drug trade-related violence. Over 50,000 people were killed by drug trade-related violence between 2007 and 2012, and homicides increased by at least 30% per year during most of this period (Rios, 2011b). By 2010, violent civilian deaths per capita had reached levels higher than in Iraq and Afghanistan during the same period, higher than in Russia during the 1990s, and higher than in Sicily following the Second World War (Williams, 2012). Over 85 percent of the drug violence consisted of people involved in the drug trade killing each other, 95 percent of the victims were male, and 45 percent were under age 30. The violence has been public and brutal, with bodies hung from busy overpasses and severed heads placed in public spaces (Williams, 2012). Public displays of brutality and activities such as kidnapping and extortion affect the general public, and 2011 public opinion surveys found that security was more likely than the economy to be chosen as the largest problem facing the country.

(1.1 million people) (National Addiction Survey, 2008).

2.2 Mexico's War on Drug Trafficking

Combating drug trafficking has been a major priority of the Mexican federal government in recent years. Notably, President Felipe Calderón (December 2006 - 2012) of the conservative National Action Party (PAN) made fighting organized crime the centerpiece of his administration. During his second week in office, Calderón deployed 6,500 federal troops to combat trafficking, and by the close of his presidency approximately 45,000 troops were involved.

For most of the 20th century, a single party, the PRI (Institutionalized Revolutionary Party), dominated Mexican politics. The PRI historically took a passive stance towards the drug trade, and widespread drug-related corruption is well-documented (Shannon, 1988; Chabat, 2010). Mexicans elected their first opposition president in 2000, and today Mexico has three major parties: the PAN on the right, the PRI, and the PRD (Party of the Democratic Revolution) on the left. While presidents Ernesto Zedillo (1994-2000, PRI) and Vicente Fox (2000-2006, PAN) did implement some security reforms and crackdowns (Chabat, 2010), these were on a lesser scale than Calderón's. Calderón's crackdown appears to have been unanticipated, as the 2006 presidential election - decided by an extremely narrow margin - made limited mention of security issues (Aguilar and Castaneda, 2009).

Mexico's crackdown on trafficking has focused on arrests and interdiction, whereas crop eradication has declined somewhat as resources have been diverted to respond to violence (National Drug Intelligence Center, 2010). Confiscations and high level arrests are typically made by the federal police and military, who have the requisite training and weaponry to fight heavily armed traffickers. Municipal police are relevant because they can provide local information for federal interventions, which often target specific actors about whom reliable information is available (Chabat, 2010). Municipal police also serve as valuable allies for traffickers, collecting information on who is passing through a town. This information is essential for protecting criminal operations and anticipating attacks by federal authorities and rivals.⁶ Municipal police form the largest group of public servants killed by drug-related violence (Guerrero, 2011).

The federal government passed major judicial reforms in 2008, but the Mexican criminal justice system remains weak. It is estimated that during the 2000s only 2% of felony crimes were prosecuted, and trafficking operations can be run from prison (Shirk, 2011). Prison fights in which dozens are killed have become common, and in one instance prison guards provided arms and transport to an imprisoned death squad and released them nightly to kill (Garcia de la Garza, 2012).

Mayors name the municipal police chief and set policies regarding police conduct. Thus, PAN mayors could assist Calderón's drug war by appointing amenable law enforcement

⁶See for example *El Pais*, August 26 2010.

authorities and by encouraging them to share information with the PAN federal government. PAN mayors may have been more likely to aid Calderón’s war on drugs because authorities from the same party cooperate more effectively, because of differences in corruption, or because of ideology.⁷ Moreover, they plausibly had strong career incentives to cooperate. Mexican mayors are barred from consecutive reelection and securing a subsequent political post typically requires support from party leaders.⁸ For example, the mayorship is a common stepping stone to national politics, and a substantial part of the Mexican Congress is elected from closed party lists.⁹ PAN party leaders choose these lists, and if a candidate is placed high enough, she will enter the legislature (Langston, 2008; Wuhs, 2006). Parties likewise distribute millions of pesos in public campaign resources, and the federal government controls thousands of appointed posts (Langston, 2008). Qualitative evidence indicates that PAN mayors under Calderón were more likely to request law enforcement assistance from the PAN federal government than their non-PAN counterparts and also suggests that operations involving the federal police and military have been most effective when local authorities are politically aligned with the federal government (Guerrero, 2011, p. 70).¹⁰

3 A Network Model of Drug Trafficking

This section develops a simple model of the network structure of drug trafficking that will serve as an empirical tool for analyzing the direct and spillover effects of local drug trafficking policy. In this model, traffickers minimize the costs of transporting drugs from producing municipalities in Mexico across the road network to U.S. points of entry. They incur costs from the physical distance traversed and from crackdowns and thus take the shortest route to the U.S. that avoids municipalities with crackdowns. This baseline model provides a starting point for examining patterns in the data without having to first develop extensive theoretical or empirical machinery. In Section 5, I specify and estimate a richer version that imposes congestion costs when trafficking routes coincide and also examine additional extensions,

⁷I have analyzed official data on corruption, made available by confidential sources. These data record drug trade-related corruption of mayors in 2008, as measured by intercepted calls from traffickers to officials. Corruption was no more common in municipalities where a PAN candidate barely won versus lost.

⁸The PAN controlled the mayorship in around a third of municipalities at the beginning of the sample.

⁹In a survey of 1,400 representatives who had served in Mexico’s lower house of Congress, 77% of the PAN legislators had previously been involved in municipal politics (Langston, 2008). 200 of the 500 seats in the lower house of Congress and 32 of the 128 Senate seats are filled from the party lists.

¹⁰For example, while drug trade-related violence initially increased in Baja California in response to a large federal intervention, the violence has since declined, and the state is frequently showcased as a federal intervention success story (Guerrero, 2011). The governor of Baja California belonged to the PAN, and the federal intervention began under the auspices of a PAN mayor in Tijuana. On the other hand, in Ciudad Juárez both the mayor and governor belonged to the opposing PRI party, and conflicts and mistrust between municipal and federal police have been rampant.

such as territorial ownership by DTOs.

The model setup is as follows: let $N = (\mathcal{V}, \mathcal{E})$ be an undirected graph representing the Mexican road network, which consists of sets $\mathcal{V}$ of vertices and $\mathcal{E}$ of edges. Traffickers transport drugs across the network from a set of origins to a set of destinations. The routes are calculated using Dijkstra’s algorithm (Dijkstra, 1959), an application of Bellman’s principal of optimality. The appendix provides a formal statement of the problem.

Destinations consist of Mexico - U.S. border crossings and major Mexican ports. While drugs may also enter the United States between terrestrial border crossings, the large amount of legitimate commerce between Mexico and the United States offers ample opportunities for drug traffickers to smuggle large quantities of drugs through border crossings and ports (U.S. Drug Enforcement Agency, 2011).¹¹ All destinations pay the same international price for a unit of smuggled drugs.

Each origin i produces drugs and has a trafficker whose objective is to minimize the cost of trafficking these drugs to U.S. entry points. Producing municipalities are identified from confidential Mexican government data on drug cultivation (heroin and marijuana) and major drug labs (methamphetamine). In practice we know little about the quantity of drugs cultivated, and hence I make the simplifying assumption that each origin produces a single unit of drugs. Opium poppy seed and marijuana have a long history of production in specific regions with particularly suitable conditions, and thus the origins for domestically produced drugs are relatively stable throughout the sample period. In contrast, cocaine - which can only be produced in the Andean region - typically enters Mexico along the Pacific coast via small vessels at locations that are flexible and less well-known (U.S. Drug Enforcement Agency, 2011). Thus, I focus on trafficking routes for domestically produced drugs.

In the baseline spillovers analysis, I assume that close PAN victories increase the costs of trafficking drugs through a municipality to infinity, diverting drug traffic elsewhere. I also examine robustness to assuming non-infinite costs and to estimating costs imposed by PAN victories. I focus on close victories because they allow spillovers in trafficking activity and violence to be identified, but for completeness I also estimate a specification in which all municipalities with PAN victories become more costly to traverse.

4 Direct Effects of Close PAN Victories on Violence

This section uses a regression discontinuity approach to test whether the outcomes of close mayoral elections affect violence in the municipalities experiencing these elections. It first

¹¹There are 370 million entries into the U.S. through terrestrial border crossings each year, and 116 million vehicles cross the land borders with Canada and Mexico (U.S. Drug Enforcement Agency, 2011). Each year more than 90,000 merchant and passenger ships dock at U.S. ports, and these ships carry more than 9 million shipping containers. Commerce between the U.S. and Mexico exceeds a billion dollars a day.

describes the data and identification strategy. Then it examines the relationship between PAN victories and violence, as well as the economic mechanisms underlying this relationship.

4.1 Data

The analysis uses official government data on drug trade-related outcomes, obtained from confidential sources unless otherwise noted. Data on drug trade-related homicides occurring between December of 2006 and 2009 were compiled by a committee with representatives from all ministries that are members of the National Council of Public Security. This committee meets each week to classify which homicides from the past week are drug trade-related.¹² Drug trade-related homicides are defined as any instance in which a civilian kills another civilian, with at least one of the parties involved in the drug trade. The classification is made using information in the police reports and validated whenever possible using newspapers. The committee also maintains a database of how many people have been killed in armed clashes between police and organized criminals. Month x municipality confidential daily data on all homicides occurring between 1990 and 2008 were obtained from the National Institute of Statistics and Geography (INEGI). Month x municipality confidential data on high level drug arrests occurring between December of 2006 and 2009 are also employed.¹³

This section also uses official government data on which of Mexico's 2456 municipalities had a DTO or local drug gang operating within their limits in early 2008. This offers the closest available approximation to pre-period DTO presence, given that systematic municipal-level data about DTOs were not collected before this time.

Finally, electoral data for elections occurring during 2007-2008 were obtained from the electoral authorities in each of Mexico's states. The sources for a number of other variables, used to examine whether the RD sample is balanced, are listed in the notes to Table 1.

4.2 Econometric Framework

This study uses a regression discontinuity (RD) approach to estimate the impact of PAN victories on violence. The RD strategy exploits the fact that the party affiliation of a municipality's mayor changes discontinuously at the threshold between a PAN victory and loss. Municipalities where the PAN wins by a large margin are likely to be different from municipalities where they lose by a wide margin. However, when we narrow our focus to the set of municipalities with close elections, it becomes more plausible that election outcomes are determined by idiosyncratic factors and not by systematic municipal characteristics that could also affect violence. Thus, under certain conditions municipalities where the PAN

¹²Previous homicides are also considered for reclassification if new information becomes available.

¹³High level traffickers include DTO kingpins, regional lieutenants, assassins, and financiers.

barely lost can serve as a reasonable counterfactual for municipalities where they barely won. This section examines the plausibility of the RD identifying assumptions in detail, but first it is helpful to specify the regression form. The baseline analysis estimates the following local linear regression model within a narrow window around the PAN win-loss threshold:

$$y_{ms} = \alpha_0 + \alpha_1 PANwin_{ms} + \alpha_2 PANwin_{ms} \times spread_{ms} + \alpha_3(1 - PANwin_{ms}) \times spread_{ms} + \delta X'_{ms} + \beta X'_{ms} PANwin_{ms} + \alpha_s + \epsilon_{ms} \quad (1)$$

where y_{ms} is the outcome of interest in municipality m in state s . $PANwin_{ms}$ is an indicator equal to 1 if the PAN candidate won the election, and $spread_{ms}$ is the margin of PAN victory. Some specifications also include α_s , a state-specific intercept and X'_{ms} , demeaned baseline controls. While baseline controls and fixed effects are not necessary for identification, their inclusion improves the precision of the estimates. A triangular kernel is used to ensure that the weight given to each observation decays with distance from the threshold. The sample includes elections occurring throughout 2007 and 2008 in which the PAN won or came in second. I limit the sample to municipalities with at least half a year of violence data prior to the elections, in order to be able to check for violence pre-trends.¹⁴

Identification requires that all relevant factors besides treatment vary smoothly at the threshold between a PAN victory and loss. Formally, letting y_1 and y_0 denote potential outcomes under a PAN victory and loss, identification requires that $E[y_1|spread]$ and $E[y_0|spread]$ are continuous at the win-loss threshold. This assumption is needed for municipalities where the PAN barely lost to be an appropriate counterfactual for those where they barely won. This assumption would be violated if the outcomes of close elections were determined not by idiosyncratic factors but by a systematic advantage of winners.¹⁵

To assess its plausibility, Table 1 compares 28 crime, political, economic, demographic, road network, and geographic characteristics across the PAN win-loss threshold. The sample is limited to elections with a vote spread of five percentage points or less. Appendix Figure A1 shows a map of the close election municipalities, which are located throughout Mexico. Column (1) reports the mean value of each characteristic in municipalities where the PAN won, column (2) does the same for municipalities where they lost, and column (3) reports the t-statistic on the difference. In no case are there statistically significant differences, including for political characteristics such as turnout and the party of the incumbent.¹⁶ Drug trade-

¹⁴I show in Appendix Table A3 and Appendix Figure A13 that results are similar when I include the few municipalities that have elections early in 2007 and thus do not have a half year of pre-election data.

¹⁵For example, Caughey and Sekhon (2011) show that in U.S. House elections between 1942 and 2008, close winners have financial and incumbency advantages.

¹⁶The economically large difference in surface area is driven by a single large municipality, Ensenada.

related violence during the pre-period is also balanced.¹⁷ Appendix Table A1 performs the same exercise limiting the sample to municipalities with a vote spread of four, three, and two percentage points or less, documenting similar patterns.

I also estimate the RD specification given by equation (1) using each of the baseline characteristics as the dependent variable and the Imbens-Kalyanaraman optimal RD bandwidth (2012). The coefficients on PAN win are in column (4) and t-statistics in column (5). The coefficients tend to be small and statistically identical to zero. RD plots for each characteristic are shown in Appendix Figures A2 - A9, and Appendix Table A2 documents that results are similar when I use bandwidths of 5, 4, 3, and 2 percentage points.

Regional characteristics could also differ across the PAN win-loss threshold, and thus I calculate the average of each baseline characteristic in the municipalities that border each municipality in the RD sample. Columns (6) and (7) repeat the local linear regression analysis using these average neighbor characteristics as the dependent variable. Only 1 of the 28 coefficients on PAN win is statistically significant at the ten percent level, providing strong evidence that neighbors' observable characteristics are balanced.

Identification also requires the absence of selective sorting around the PAN win-loss threshold. This assumption would be violated, for example, if elections were rigged in favor of the PAN in municipalities that would later experience an increase in violence. To formally test for sorting, I implement McCrary's (2008) test by collapsing the election data to one percentage point vote spread bins and using the observation count in each bin as the dependent variable in equation (1). Appendix Figure A10 shows that the density does not change discontinuously at the threshold, documenting that neither the PAN nor its opponents systematically win close elections. For manipulation of the threshold to be consistent with Figure A10 and Table 1, there would need to be an equal number of elections rigged in favor of and against the PAN, and the characteristics in Table 1 would need to be the same on average in these municipalities and their neighbors, a scenario that appears unlikely.

The absence of selective sorting is also institutionally plausible. Elections in Mexico are coordinated by a multi-partisan state commission, and genuine recourse exists in the case of suspected fraud. While traffickers may have incentives to intimidate voters and candidates, recall that mayors prior to the Calderón administration had limited capacity to challenge heavily armed traffickers given the absence of a widespread federal crackdown.¹⁸ The sample period is at the beginning of Calderón's crackdown, when traffickers were unlikely to have anticipated how sustained it would be and the role mayors would play. Thus, they may not have found it worthwhile to influence local elections. Consistent with this conjecture,

¹⁷This lasts from December of 2006, when these data were first collected, to June of 2007, when the first authorities elected during the sample period were inaugurated.

¹⁸I will show later that the outcomes of close elections prior to the Calderón administration are uncorrelated with subsequent violence.

systematic killings of mayors by traffickers began only after the federal crackdown had been sustained for several years, after this study’s sample period.

4.3 Graphical Analysis

I begin by graphically analyzing the relationship between close election outcomes and violence. Figure 3 examines average homicides during the months following the inauguration and preceding the election of new authorities. It plots violence against the PAN margin of victory, with a negative margin indicating a PAN loss. Each point represents the average value of the outcome in vote spread bins that are one quarter of a percentage point wide. The solid line plots predicted values from a local linear regression, with separate vote spread trends estimated on either side of the win-loss threshold, and the dashed lines show 95% confidence intervals.

Panel A documents that the average probability that a drug trade-related homicide occurs in a given month during the five months following the inauguration of new authorities is around nine percentage points higher after a PAN mayor takes office than after a non-PAN mayor takes office. This compares to a sample average monthly homicide probability of six percent. Panel B shows that violence during the one to five month period between the election and inauguration of new authorities is similar regardless of whether the PAN won or lost.¹⁹ Finally, Panel C examines the average monthly probability of drug trade-related homicides during the half year prior to elections. This placebo check documents the absence of a discontinuity at the PAN win-loss threshold prior to the relevant elections, providing additional evidence that the RD sample is balanced.²⁰ Appendix Figure A11 shows that these patterns are similar for the drug trade-related homicide rate.

While homicides are classified as drug trade-related by a national committee, it is possible that the police reports used to make this classification systematically differ across municipalities. To explore whether the discontinuity in Panel A reflects the reclassification of homicides as drug trade-related by PAN authorities, Panels D through F examine the non-drug trade-related monthly homicide rate per 10,000 municipal inhabitants, for the post-inauguration, lame duck, and pre-election periods, respectively. There are no statistically significant discontinuities, and Appendix Table A4 documents that this is also the case when an indicator measure of non-drug related homicide is used. During the sample period, about half of Mexican homicides were drug trade-related. As will be discussed subsequently, it is likewise implausible that PAN authorities discovered enough additional bodies to explain the effects.

To uncover more detail about the relationship between violence and PAN victories, I

¹⁹The length of this lame duck period varies by state.

²⁰The probability of drug trade-related violence tends to be higher on either side of the threshold than further away from the threshold because population is also higher; see Appendix Figures A4-d and A5-a.

next estimate equation (1) separately for each month prior to the election and following the inauguration of new authorities. Time is defined relative to each municipality’s election and inauguration. Figure 4 plots the coefficients on PAN win as well as 95% confidence intervals against time. The lame duck period is excluded due to its varying length by state.

In Panel A, the dependent variable is an indicator equal to one if a drug trade-related homicide occurred in a municipality-month. Prior to the elections, drug trade-related homicides occurred with similar frequency in places where the PAN would later lose and win. In contrast, the PAN win coefficients are large, positive, and statistically significant in all periods following the inauguration of new authorities, except for six months after.²¹

As an additional check, I explore the relationship from an alternative perspective that exploits the full panel variation in the homicide data. Panel B of Figure 4 plots the γ_τ coefficients from the following differences-in-differences specification against time:

$$y_{mst} = \beta_0 + \sum_{\tau=-T_{ms}}^{T_{ms}} \beta_\tau \zeta_{\tau m} + \sum_{\tau=-T_{ms}}^{T_{ms}} \gamma_\tau \zeta_{\tau m} PANwin_{ms} + f(spread_{ms}) Post_{mst} + \psi_{st} + \delta_m + \epsilon_{mst} \quad (2)$$

where $\{\zeta_\tau\}$ is a set of months-to-election and months-since-inauguration indicators, $Post_{mst}$ is an indicator equal to 1 for all periods t in which the new authorities have assumed power, $f(\cdot)$ is the RD polynomial, which is assumed to take a quadratic form, ψ_{st} are state x month fixed effects, and δ_m are municipality fixed effects. ϵ_{mst} is clustered by municipality.

Panel B shows that the magnitudes of the γ_τ coefficients are similar to the cross-sectional RD estimates, and Appendix Figure A11 documents that the results are robust to using the drug trade-related homicide rate. Finally, Panels C and D repeat the cross-sectional and panel specifications for non-drug homicides. Both document the absence of differences across the PAN win-loss threshold, before and after the inauguration of new authorities.

4.4 Further Results and Robustness

Table 2 further examines the relationship between PAN victories and violence. The dependent variable is the average monthly drug trade-related homicide probability in Panel A and the drug trade-related homicide rate in Panel B.²² Using the RD specification from equation (1), Column 1 estimates that the average probability that at least one drug-related homicide occurs in a municipality in a given month is 8.4 percentage points higher after a PAN mayor takes office than after a non-PAN mayor takes office, and this effect is statistically signifi-

²¹ Appendix Figure A12 shows that when the post-period is extended to a year following the inauguration, the coefficients are more volatile during the latter half of this period. Whether this is due to PAN authorities successfully deterring crime or results from them being co-opted is not possible to establish definitively.

²² Analysis of the non-drug trade-related homicide rate robustly shows no discontinuity at the PAN win-loss threshold and due to space constraints is presented in Table A4.

cant at the one percent level.²³ The drug trade-related homicide rate per 10,000 municipal inhabitants is around 0.05 (s.e. = 0.02) higher following a close PAN victory, which can be compared to the average monthly homicide rate of 0.06. In contrast, columns (2) and (3) show that the PAN win effects during the lame duck and pre-inauguration periods are small and statistically insignificant.²⁴ Columns (4) and (5) document that the PAN win effect is robust to excluding state fixed effects as well as both fixed effects and controls.²⁵

Next, I use the panel specification, replacing the series of months until election and months since inauguration dummies in equation (2) with a lame duck dummy and a post-inauguration dummy. Pre-election is the omitted category. Column (6) specifies the RD polynomial as linear, estimating that the probability of drug-related violence is 14.7 percentage points higher after a PAN inauguration than after a non-PAN inauguration. The coefficient on lame duck $\times$ PAN win is smaller and statistically insignificant.

While the RD figures suggest that the data are reasonably approximated by a linear functional form, columns (7), (9), and (11) estimate the cross-sectional specification and columns (8), (10), and (12) estimate the panel specification using quadratic, cubic, and quartic vote spread polynomials, respectively. The estimated effects of close PAN victories are large, positive, and statistically significant, with coefficients tending to increase when higher order terms are used. Appendix Table A5 documents that alternative vote spread bandwidths yield similar estimates.²⁶

Next, Table 3 examines whether violence following the inauguration of PAN mayors could result from some other political characteristic correlated with PAN victories. The dependent variable is the average monthly probability of drug trade-related homicides during the post-inauguration period, and coefficients are estimated using local linear regression.²⁷ Column (1) reports the baseline result from Table 2, column (1), whereas column (2) distinguishes whether the PAN was the incumbent party. Since Mexican mayors cannot run for re-election, a new mayor takes office each electoral cycle. This specification includes the same terms as the baseline and also interacts PAN win, spread, and PAN win $\times$ spread with the incumbency dummy. The estimated violence effect is large and statistically significant, regardless of whether the PAN held the mayorship previously. Violence increased sharply after the inauguration of PAN mayors and decreased slightly following the inauguration of non-PAN

²³The post-inauguration period extends for five months, beyond which the violence effects become more volatile (Figure A12). The baseline controls are from Table 1. I omit households without water and electricity, since marginality is constructed from these, as well as PRI never lost, which is highly correlated with historical alternations of the mayorship.

²⁴The pre-election period extends to six months prior to the election.

²⁵The estimated effects for the lame duck and pre-election periods are also similar when state fixed effects and baseline controls are excluded.

²⁶When bandwidths of less than 3 percentage points are used, the estimates become extremely noisy.

²⁷Appendix Table A6 documents that results are similar when I instead use a panel data specification.

mayors, whether or not the PAN held the incumbency.²⁸

There are at least two plausible explanations for these patterns. First, recall that mayors typically require assistance from higher levels of government to combat heavily armed traffickers. Incumbent mayors were elected in 2004 and 2005, before the sustained federal crackdown, and thus it would have been difficult for them to initiate crackdowns at the beginning of their terms. Consistent with this conjecture, Appendix Figure A14 shows that between 2004 and 2006, the outcomes of close elections were uncorrelated with the subsequent homicide rate. Unable to crack down initially, some incumbent mayors may have been corrupted by the time Calderón took office. Recall also that mayors typically depend on patrons at higher levels of government for their next political position. It is possible that PAN incumbents, all elected during the administration of PAN President Vicente Fox, were more likely to have patrons in Fox's faction of the PAN, whereas those elected during the Calderón administration were more likely to have patrons in Calderón's faction.²⁹ If so, PAN incumbent mayors may have had weaker career incentives to aid Calderón's war on drugs.

State governors control the deployment of state police, disbursement of state funds, and appointment of various civil service posts. Column (3) shows, subject to limited statistical power, that the impact of PAN victories on violence is similar regardless of the governor's party.³⁰ Next, column (4) reports a specification that distinguishes whether the PAN faced an opponent from the PRI, which opposed the PAN in around three quarters of elections. The PAN win effect does not statistically differ with the party of the opponent.

Next, column (5) considers close elections where the PRI and PRD - Mexico's other major parties - received the two highest vote shares, replacing the PAN win indicator with a PRI win indicator. While the coefficient on PRI win is positive, it is about half the magnitude of the baseline PAN win coefficient and is not statistically significant. Column (6) considers all close elections (including those in which the PAN was not the winner or runner-up), replacing the PAN win indicator with an indicator equal to one if there was an alternation in political party. The alternation effect is small and statistically insignificant. Overall, these results show that the effects in Table 2 are driven by PAN mayors taking office and not by changes in the party controlling the mayorship.

I have focused on close elections because they allow for identification of causal effects. Nevertheless, for the sake of completeness column (7) examines all municipalities with elections in 2007 and 2008, reporting results from an ordinary least squares regression of the

²⁸Prior to the elections, the monthly probability of drug trade-related violence was modestly higher in municipalities with a PAN incumbent (0.067 as compared to 0.048).

²⁹The PAN contains traditional, more ideological members and more pragmatic, less ideological members. Fox belongs to the latter group, whereas Calderón belongs to the former (Beer, 2006). Fox supported Calderón's opponent in the primary.

³⁰Only around ten percent of municipalities with close PAN elections in 2007-2008 had a PAN governor during the mayor's subsequent term.

average drug-related homicide probability during the post-inauguration period on a PAN win indicator, controls, and state fixed effects. While the correlation between PAN victories and violence is large and positive, it is imprecisely estimated.

4.5 Interpretation

This section first examines whether crackdowns occur following PAN inaugurations. Municipality level data on military and federal police deployment cannot be released to individuals outside these organizations, complicating efforts to test for crackdowns directly. Instead, I examine confidential data on police and military casualties. While these are rare, occurring during the sample period in only 12 municipalities with a vote spread of less than 5%, they are the best available measure.³¹

Deaths in police-criminal confrontations are ten times higher during the post-inauguration period in municipalities where the PAN barely won as compared to where they barely lost. When I estimate the baseline specification with the average number of post-inauguration confrontation deaths per 10,000 municipal inhabitants as the dependent variable, the PAN win effect of 0.07 (s.e.=0.06) is large, as compared to a sample mean of 0.06 deaths, but noisily estimated. In contrast, the effect in the pre-election period is a precisely estimated zero (-0.01, s.e.= 0.02). When the analysis is limited to municipalities that had a major DTO operating within their limits, the PAN win effect is again large, at 0.19 (s.e.= 0.12), whereas the PAN win effect is a precisely estimated zero in municipalities without a major DTO. Arrests of high level members of the drug trade, while rare, likewise occur more frequently following PAN victories than PAN losses.³²

I now examine the mechanisms through which crackdowns could affect violence. Recall that over 85% of drug trade-related violence consists of individuals involved in the drug trade killing each other. Crackdowns may result in the removal of a senior trafficker, leading members in the organization to fight over ascension. In addition, crackdowns weaken the incumbent trafficking group, potentially creating incentives for rival DTOs to violently wrest control of territory while the incumbent is vulnerable. While it may not be lucrative to control a municipality during a crackdown, crackdowns are unlikely to affect the long-run returns to controlling a municipality by much since they are unlikely to be permanent. Incentives for a group to usurp territory are plausibly greatest when the territory is nearby, as controlling an entire region allows traffickers to monopolize the many criminal activities

³¹While one could attempt to measure crackdowns using newspapers, much of the Mexican press does not report on the drug trade due to violent intimidation. The sample period predates widespread tweeting about the drug war, which has been used to document drug trade-related activity more recently.

³²The federal government does not maintain a database of all drug-related arrests, since most are never prosecuted. During the post-inauguration periods, 49 high level arrests occurred in municipalities where the PAN barely won, as compared to 26 in municipalities where they barely lost.

in which they engage. For example, a DTO can charge higher prices for prostitution if it controls brothels throughout a region than if it has to compete with a rival group.

To test this hypothesis, I categorize municipalities into four groups using confidential data on DTOs. The categories are: 1) municipalities controlled by a major DTO that border territory controlled by a rival (10%), 2) municipalities controlled by a major DTO that do not border territory controlled by a rival DTO (20%), 3) municipalities controlled by a local drug gang (33%), and 4) no known drug trade presence (37%).³³ Municipalities with no known drug trade presence had not experienced drug trade-related homicides or illicit drug confiscations at the time the DTO data were compiled, and local authorities had not reported the presence of a drug trade-related group.

Table 4 examines whether the impact of PAN victories is different in these four groups of municipalities. For comparison, column (1) reports the baseline cross-sectional estimate from Table 2. In column (2), the dependent variable is the average monthly probability that a drug trade-related homicide occurs during the post-inauguration period, and the specification includes the same terms as the baseline RD as well as interacting PAN win, spread, and PAN win $\times$ spread with dummies for local drug gang, major DTO bordering a rival, and major DTO not bordering a rival. Close PAN victories increase the probability of drug trade-related homicides by a highly significant 53 percentage points in municipalities controlled by a major DTO that border a rival DTO's territory. Amongst these municipalities, there are an average of 17.4 drug-related homicides during the post-inauguration period when the PAN barely wins, as compared to 1.8 when they barely lose. It is unlikely that differences of this magnitude are driven by differences in reporting. In municipalities controlled by a major DTO that do not border territory controlled by a rival, close PAN victories increase the probability of drug-related violence by around 15 percentage points. This suggests that crackdowns also spur conflicts within criminal organizations. The effects for municipalities with a local drug gang and with no known drug trade presence are small and statistically insignificant.³⁴

We would also expect traffickers to fight more over municipalities that are more valuable to control. While it is infeasible to measure the size of the illicit economy, I focus on one specific dimension: the cost required for trafficking routes to circumvent a municipality. Estimated detour costs equal the sum of the lengths of shortest paths from all producing municipalities to the U.S. when paths are not allowed to pass through the municipality under consideration minus the sum of the lengths of all shortest paths when they can pass through any municipality in Mexico. Municipalities with a longer total detour are more

³³The major DTOs during the sample period are Beltran, Familia Michoacana, Golfo, Juarez, Sinaloa, Tijuana, and Zetas.

³⁴Appendix Table A7 documents that results are robust to using the panel specification and alternative functional forms for vote spread.

costly to circumvent, and thus the traffickers controlling them could likely charge more for protection and other services to traffickers passing through. Column 3 interacts PAN win with standardized detour costs.³⁵ A one standard deviation increase in detour costs increases the PAN win effect by around seven percentage points, as compared to a PAN win effect of 8.7 percentage points at the sample mean of detour costs.³⁶

The characteristics in Table 4 are highly correlated, and the territorial organization of DTOs is likely an outcome of the network structure. Thus, I cannot separately identify the impacts of territorial ownership and the network. Nevertheless, together the results suggest that the organization of trafficking conditions the violent response to PAN victories.

An alternative hypothesis is that PAN mayors received more economic transfers from the PAN federal government, inducing traffickers to fight over extorting the additional government resources. 90 percent of Mexican state and local spending are financed by federal transfers (Haggard and Webb, 2006). However, in contrast to law enforcement resources, economic resources are allocated transparently to municipalities using formulas.³⁷ Since the RD sample is balanced on the characteristics used in these formulas, economic transfers do not differ between PAN and non-PAN municipalities.

5 A Network Analysis of Spillover Effects

Thus far the analysis has focused on how crackdowns in a given municipality affect that location, but crackdowns may also impact other municipalities by motivating traffickers to relocate their operations. This section utilizes the network trafficking model to provide economic insight into where spillovers are likely to occur. It first uses data on drug confiscations to test whether the shortest paths model predicts the diversion of drug traffic following close PAN victories. It then examines whether close PAN victories increase violence along alternative trafficking routes. Finally, it develops several extensions of the trafficking model.

³⁵Results are similar, but more difficult to interpret, when I do not standardize the detour costs measure. Table A7 documents robustness to using the panel specification and higher order vote spread terms.

³⁶I also find that the violent response following PAN inaugurations is significantly lower when a municipality contains a major divided highway (12% of the sample), which presumably increases the difficulty of extracting rents from traffickers who are passing through.

³⁷Municipalities receive federal resources through two main funds: the Fondo para la Infraestructura Social Municipal, which is distributed proportionally to the number of households living in extreme poverty, and the Fondo de Aportaciones para el Fortalecimiento de los Municipios, which is distributed proportionally to population. Resource transfers from state to local governments are less transparent, but recall that I do not find differences by the party of the state governor.

5.1 Spillovers and the Shortest Paths Model

In order to test whether local crackdowns affect violence and drug trafficking elsewhere, it is necessary to specify a model of where spillovers are likely to occur. DTOs are profit-maximizing entities who face economic constraints, and the shortest paths framework developed in Section 3 models this in a simple and transparent way. Recall that in this model, traffickers take the lowest cost route to the nearest U.S. entry point. The cost of traversing each edge is equal to the physical length of the edge unless a close PAN victory has occurred, in which case the edge latency increases to infinity.³⁸ Because municipal elections occur at different times throughout the sample period, this generates plausibly exogenous within-municipality variation in predicted routes across Mexico.

If the aim of the exercise were purely predictive, predicted routes in the baseline specification could potentially vary with landslide elections and other time varying characteristics. However, such an approach would not provide a test for spillovers, due to the well-known reflection problem (Manski, 1993). For example, support for the PAN and drug trafficking activity could be growing in tandem in a region because of economic factors, generating correlations between municipal politics and violence patterns elsewhere. In contrast, Table 1 shows that the outcomes of close elections are uncorrelated with neighbors' characteristics.

To shed light on whether this simple model provides reasonable predictions of where spillovers are likely to occur, this section examines the relationship between model predicted routes and actual illicit drug confiscations between December of 2006 and 2009. Official government data on confiscations of different types of drugs were obtained from confidential sources. To be consistent with the model, confiscations should increase when a municipality acquires a predicted trafficking route if enforcement is held constant, an assumption that will be examined. The empirical specification is as follows:

$$conf_{mst} = \beta_0 + \beta_1 Routes_{mst} + \psi_{st} + \delta_m + \epsilon_{mst} \quad (3)$$

where $conf_{mst}$ is confiscations of domestically produced drugs (marijuana, heroin, and methamphetamine) in municipality m , state s , month t . Both an indicator and a continuous measure are examined. $Routes_{mst}$ is a measure of predicted trafficking routes, ψ_{st} is a month x state fixed effect, and δ_m is a municipality fixed effect. The error term is clustered simultaneously by municipality and state-month to address spatial correlation (Cameron, Gelbach, and Miller, 2011), and the sample excludes municipalities that themselves experience a close election.³⁹ This empirical approach is summarized in Figure 1.

³⁸I define close elections as those with a vote spread of five percentage points or less.

³⁹It also excludes producing municipalities, since much of the analysis focuses on the extensive margin of trafficking routes and producing municipalities mechanically contain a predicted trafficking route. Results

The municipality fixed effect ensures that β_1 is identified from within municipality variation. Thus, if enforcement is constant within municipalities over time, confiscations will provide a proxy for actual drug traffic. Typically, local politics does not change when a municipality acquires a predicted route, and thus relatively constant enforcement appears plausible. This assumption will be further examined in the empirical analysis.

Panel A of Table 5 reports estimates from equation (3), specifying $Routes_{mst}$ as an indicator equal to one if municipality m contains a predicted route in month t . In column (1), the dependent variable is also an indicator, equal to one if domestically produced drugs (marijuana, heroine, or methamphetamine) were confiscated in the municipality-month. When a municipality acquires a predicted route, the probability of confiscating drugs during a given month increases by around 1.6 percentage points, as compared to a sample average monthly confiscation probability of 5.3%. The effect is significant at the 1% level. In column (2), the dependent variable equals the log value (in US dollars) of confiscations if confiscations are positive and equals zero otherwise. This measure is always non-negative, as even the smallest confiscations are worth thousands of dollars.⁴⁰ Acquiring a predicted trafficking route is associated with an 18.5% increase in the total value of confiscated domestic drugs, and again the correlation is significant at the 1% level. Appendix Table A8 documents similar patterns using the count of predicted routes instead of the indicator for route presence, and Appendix Table A9 shows that estimates are robust to including post x initial party trends.⁴¹

These results suggest that the model predicts the diversion of drug traffic following PAN victories. However, if alternative routes traverse nearby municipalities and if the military or federal police become active throughout a region when deployed to PAN municipalities, this could generate a correlation between changes in predicted routes and confiscations that is unrelated to the diversion of drug traffic. In contrast, it is difficult to tell a plausible story in which PAN victories directly affect confiscations along alternative routes located further away. Columns (3) and (4) examine whether the model is predictive when I exclude municipalities bordering those with close PAN victories. The estimated coefficients are similar to those in columns (1) and (2) and remain statistically significant.

Another concern is that authorities along alternative routes may have increased enforcement efforts in response to a small increase in drug traffic. In this case the model would correctly identify the locations of spillovers, which is its central aim, but the confiscations data would exaggerate the magnitudes. To assess this possibility, I examine whether pre-

(available upon request) are robust to including these municipalities.

⁴⁰Working in logs is attractive because drug confiscations are highly right-skewed, with several drug busts confiscating tens of millions of dollars of drugs.

⁴¹The value of confiscations increases by 2.3 percent for each additional trafficking route acquired, and this effect is statistically significant at the one percent level. However, in the model with congestion that I develop in the next section, the count measure is smaller and statistically insignificant.

dicted domestic drug routes are correlated with cocaine confiscations. While cocaine and domestic routes ultimately intersect before reaching the U.S., in general they are different since cocaine entry points and drug producing municipalities are in distinct locations. When domestic drug traffic changes in a town that also contains a cocaine route, its cocaine route often will be unaffected by the change in local politics that diverted domestic drug traffic. Thus, if enforcement is constant, cocaine confiscations will on average change little when a municipality acquires or loses a domestic route. In contrast, if changes in enforcement drive most of the large increases in domestic drug confiscations that occur when a municipality acquires a predicted route, cocaine confiscations should also increase. Columns (5) and (6) document that within-municipality variation in predicted domestic routes is in fact uncorrelated with variation in the presence and value of cocaine confiscations.⁴²

In reality, PAN victories do not increase edge costs to infinity, and thus Appendix Figure A15 examines whether the relationship between predicted routes and confiscations is robust to assuming that close PAN victories proportionally increase edge length by a factor α . The x-axis plots values of α ranging from 0.25 to 10, and the y-axis plots the correspondent coefficient on the routes dummy from equation (3). When placebo routes are predicted using cost factors 0.25 and 0.5, which imply that PAN victories reduce trafficking costs, the routes dummy is uncorrelated with confiscations. In contrast, the coefficients estimated using cost factors greater than one are similar to the baseline estimate in Table 5.

As a final check on the model, I show that the strong correlation between predicted routes and actual confiscations that Table 5 documents is unlikely to have arisen by chance. I randomly assign placebo close PAN victories such that the number of randomly selected municipalities that are infinitely costly to traverse increases each month by the number of close PAN inaugurations that actually occurred that month. I calculate predicted routes and regress confiscations on an indicator for the presence of a predicted route (along with municipality and state x month fixed effects), repeating this exercise 1000 times and plotting the coefficients in Appendix Figure A16. Only six of the coefficients are statistically different from zero at the 5% level, and the coefficient from column (2) of Table 5 is in the far right tail of the coefficient distribution, more than three standard deviations above the mean.

Next, Table 6, Panel A tests whether violence changes when predicted routes change. It estimates the same panel specification as above, with violence as the dependent variable. First, column (1) shows that the presence of a predicted route increases the monthly drug trade-related homicide probability by 1.3 percentage points (s.e.=0.005), as compared to the sample average probability of 4.4%. Column (2) distinguishes whether the municipality con-

⁴²Results are similar when I limit the sample to municipalities with cocaine confiscations during the beginning of the sample period. Because of the municipality fixed effects, municipalities without cocaine confiscations only affect the routes coefficient through their influence on the fixed effects estimation.

tains one or more than one predicted route. While one might expect violence to concentrate where multiple routes coincide, the coefficients on the one and more than one route indicators are statistically identical. Columns (3) and (4) use the drug trade-related homicide rate as the dependent variable, documenting similar patterns. Next, columns (5) and (6) examine the limited sample that excludes municipalities bordering a close PAN victory. While the effects are no longer statistically significant, the routes coefficients in the full and limited samples are not statistically different. Finally, column (7) documents that predicted routes are uncorrelated with the non-drug homicide rate, alleviating concerns that municipalities on alternative routes experience increases in violence for reasons unrelated to the drug trade.

I also show that a conventional reduced form approach is unable to locate spillovers unless combined with economically informed predictions about where spillovers are likely to occur. In Appendix Table A10, I replicate the RD specification from Section 4, except that the dependent variable is violence in municipalities bordering a close election municipality instead of violence in the municipality experiencing the close election. Column (1) shows that when I include all neighboring municipalities, the coefficient on PAN win is statistically indistinguishable from zero. Then, I divide municipalities into three groups: 1) those that border a close election municipality on a shortest path trafficking route and that are on the shortest detour route around that municipality, 2) those that border a close election municipality on a shortest path route but are not on the detour around that municipality, and 3) those that border a close election municipality that is not located on a shortest path trafficking route. Detours are calculated assuming that the close election municipality becomes infinitely costly to traverse, whereas edge latencies in other municipalities remain equal to the edge length.

There is a large, marginally significant increase in violence for the first group, with the probability of drug trade-related homicides rising by 11 percentage points (s.e. = 0.06). In contrast, the PAN win coefficients are small, statistically insignificant, and precisely estimated for the latter two (larger) groups. While this approach has limited statistical power, it further alleviates concerns that the relationship between predicted routes and violence is spurious. It also underlines the importance of economic insight for locating crime spillovers.

5.2 Extensions

I now introduce more realism into the shortest paths model by incorporating congestion costs when trafficking routes coincide. There are several reasons why edge latencies may depend on drug flows: as drug traffic increases, the probability of conflict with other traffickers may change; the quality of hiding places may decline, particularly at U.S. entry points; and law enforcement may direct more or less attention per unit of traffic.

The setup for the model with congestion costs is as follows: as in the shortest paths model, every origin produces a unit of drugs and has a trafficker who decides how to transport those drugs to U.S. entry points, which have a size given by the number of commercial lanes for terrestrial border crossings and the container capacity for ports. All U.S. entry points pay the same international price for a unit of drugs. Each edge e has a cost function $c_e(l_e, x_e)$, where l_e is the length of the edge and x_e is the total drug flow on edge e . A trafficker's objective is to minimize the costs of transporting his municipality's drugs, taking aggregate flows as given. Recall that most trafficking decisions are made within local cells, so the assumption that traffickers are small is reasonable and simplifies the analysis. I will nevertheless relax this assumption later as a robustness check.

In equilibrium, the costs of all routes used to transport drugs from a producing municipality to the U.S. are equal and less than the cost that would be experienced by reallocating traffic to an unused route. These conditions were first formalized by John Wardrop (1952) and characterize the Nash equilibrium of the game. Formally, an equilibrium satisfies:

1. For all $p, p' \in \mathcal{P}_i$ with $x_p, x_{p'} > 0$, $\sum_{e \in p'} c_e(x_e, l_e) = \sum_{e \in p} c_e(x_e, l_e)$.
2. For all $p, p' \in \mathcal{P}_i$ with $x_p > 0, x_{p'} = 0$, $\sum_{e \in p'} c_e(x_e, l_e) \geq \sum_{e \in p} c_e(x_e, l_e)$.

where $\mathcal{P}_i$ denotes the set of all possible paths between producing municipality i and U.S. entry points and x_p denotes the flow on path p . An equilibrium routing pattern always exists, and if each c_e is strictly increasing, it is unique. The equilibrium is not typically socially optimal, since traffickers do not internalize the congestion externalities. Note that the shortest paths model is a special case of the more general model where congestion costs are assumed to be zero.

Beckmann, McGuire, and Winsten (1956) proved that the equilibrium can be characterized by a straightforward optimization problem, which is stated in the estimation appendix. For a given network, set of supplies, and specification of the congestion costs $c_e(\cdot)$, the problem can be solved using numerical methods, also detailed in the appendix.

Edge costs in this more general model are not directly observed. To make progress, I assume that congestion costs take a Cobb-Douglas form. In the most parsimonious specification, traffickers incur costs to enter the U.S. that depend on the amount of drug traffic using the entry point, normalized by the entry point's size. Formally, edges connecting Mexico to the U.S. (which by definition are of length zero) impose costs equal to $\phi_t(flow_e/lanes)^\delta$ for terrestrial border crossings and $\phi_p(flow_e/containers)^\delta$ for ports, where $\{\phi_t, \phi_p, \delta\}$ are parameters that will be estimated, *lanes* is the number of commercial crossing lanes, and *containers* is the port container capacity. δ captures the shape of congestion costs, and $\{\phi_t, \phi_p\}$ scale these costs to the same units as physical distance. Interior edges are not congested: $c_e^{int}(l_e, x_e) = l_e$. In the appendix I also estimate a more flexible specification with six

ϕ parameters for different sizes of terrestrial crossings and ports, as well as a specification with congestion costs on crossing and interior edges: $c_e^{int} = l_e(1 + \phi_{int}flow_e^\gamma)$, where ϕ_{int} and γ are parameters whose interpretations are analogous to ϕ_t/ϕ_p and δ .⁴³ Congestion costs, particularly in the most flexible models, should be interpreted broadly. For example, if traffickers prefer large crossings because they are closer to U.S. population centers, this will appear as lower estimated congestion costs for large crossings.

The above parameters, as well as a scaling parameter κ that maps model-predicted flows to model-predicted confiscations, are estimated using the simulated method of moments (SMM).⁴⁴ Every choice of the model’s parameters generates a set of moments that summarize model-predicted confiscations, and I estimate the parameters by matching these moments to their counterparts calculated from cross-sectional data on actual illicit drug confiscations during the beginning of the sample period.⁴⁵ The estimation appendix specifies the SMM objective, lists the moments, and discusses inference.⁴⁶

Appendix Table A11 reports the parameter estimates.⁴⁷ All three specifications estimate convex congestion costs on U.S. entry points ($\delta > 1$), and interior congestion appears modest, with total congestion costs at U.S. entry points 39 times larger than total interior congestion costs. This appears plausible, as U.S. entry points are bottlenecks with a large law enforcement presence. All specifications estimate that total congestion costs are nearly as large as total distance costs. Predicted pre-period routes are shown in Figure 2

As expected given the SMM approach, model predicted and actual pre-period confiscations are highly correlated. The more challenging test is whether the model, fitted using pre-period data, can predict changes in confiscations during later periods. I examine this by using the panel specification given in equation (3) to compare within-municipality variation in predicted routes and actual confiscations.⁴⁸ Panel B of Table 5 shows that the congestion model offers only a modest improvement in predictive power over the shortest paths model. Columns (1) and (2) estimate that when a municipality acquires a predicted route, the probability of confiscations increases by 1.5 percentage points, and the value of confiscations increases by around 19.5%. Columns (3) and (4) document robustness to ex-

⁴³Results are robust to specifying interior costs as $l_e + \phi_{int}flow_e^\gamma$.

⁴⁴ κ likely varies with the local environment, but it is not possible to estimate this dependence.

⁴⁵This lasts from December 2006, when the data become available, until the first authorities elected during the sample period took office in July 2007.

⁴⁶As is often the case with choice problems, the SMM objective is not globally convex. Thus I minimize the objective using simulated annealing. It is not possible to guarantee that an estimation procedure will find the global minimum of a non-convex objective, but Monte Carlo type simulations suggest that the trafficking problem is well-behaved.

⁴⁷Conley standard errors are in brackets, and robust standard errors are in parentheses.

⁴⁸The routes are calculated using the three congestion parameters in column (1) of Table A11. Variation in these routes is most highly correlated with variation in actual confiscations. Appendix Tables A12 and A13 document robustness to using the parameters in columns (2) and (3) of Table A11.

cluding municipalities bordering a municipality that has experienced a close PAN victory, and columns (5) and (6) show that the correlations between predicted domestic routes and the presence/value of cocaine confiscations are low. Results are also robust to assuming that traffickers are non-atomic.⁴⁹ The similarity between the shortest paths and congestion results is consistent with a world in which the risk of confiscations by authorities and other criminals increases with time on the road, and hence traffickers prefer to use direct routes.

The violence spillovers are also similar to those estimated using shortest path routes. Panel B of Table 6 shows that the probability of drug trade-related violence increases by 1.5 percentage points when a municipality acquires a predicted route. Column (2) suggests that violence spillovers are concentrated where multiple routes coincide, but this result should be interpreted cautiously since it differs from the shortest paths estimate.

Thus far, the model has not imposed costs for transporting drugs through territory controlled by a rival DTO. With ideal data, one could estimate these costs by matching predicted routes for each DTO to confiscations made from that DTO. However, DTO x municipality x month confiscations data are not available. Additionally, 51% of producing municipalities were controlled by local gangs, and there is not information on which larger organizations, if any, these groups coordinated with to transport drugs. Finally, DTO territorial costs impose player-specific edge latencies, and a trafficking equilibrium may not exist (Gairing, Monien, and Tiemann, 2011). While including accurate estimates of DTO territorial costs would plausibly improve the model’s predictive power, it is unclear whether incorporating costs estimated from available data would introduce more realism than noise. In any case, least cost routes between producing municipalities controlled by a major DTO and U.S. entry points tend to pass primarily through territory controlled by that DTO, so territorial costs may not influence the trafficking equilibrium much.

Nevertheless, for completeness the online appendix estimates a version of the trafficking model with territorial costs. Decisionmakers, consisting of a single representative for each DTO and drug producing gang, minimize the costs of transporting their group’s drugs to the U.S. Costs are incurred from passing through another DTO’s territory, as well as from distance or distance and congestion. To solve the routing game for a given set of parameters, I iterate the best response functions to convergence.⁵⁰ Parameters are estimated using SMM, and the moments are listed in the appendix. Appendix Table A14 shows that the coefficients from regressing actual confiscations or drug-related homicides on the predicted routes dummy

⁴⁹When I assume that non-atomic DTOs and local gangs make trafficking decisions, with a single decision-maker for each DTO, predicted routes are still statistically significantly correlated with actual confiscations, but these predicted routes lose a horse race to the atomic decisionmaker predicted routes. This is consistent with the qualitative evidence that most decisions within DTOs are decentralized.

⁵⁰Although an equilibrium is not guaranteed to exist, simulations show that the best responses always converge to a unique equilibrium regardless of the starting point.

are positive and at least marginally statistically significant, regardless of whether congestion costs are estimated or assumed to be zero. I also regress actual confiscations on both the routes dummy from this model and the routes dummy from the model without territorial costs, and only the coefficient on the latter is large and statistically significant (regardless of whether congestion costs are included). This supports the conjecture that territorial costs are noisily inferred from available data.

If the effects of PAN victories on trafficking are similar regardless of the margin of victory, the model’s predictions could also plausibly be improved by imposing a cost to pass through all municipalities with a PAN mayor. In the online appendix, I use variation from close elections to estimate how much PAN victories increase trafficking costs and then predict routes by plugging this cost into the trafficking model following all PAN inaugurations. The parameters in this richer model are identified in part by matching changes in actual and predicted confiscations, as the changes are what identify the costs imposed by PAN mayors. The appendix lists the moments used. This model cannot be validated using confiscations data because confiscations from all periods are used to estimate the parameters, and this is why the baseline model did not estimate political costs. Table A14 shows that the coefficient from regressing drug trade-related homicides on the routes dummy from this model is positive, highly significant, and similar to the estimate from the baseline model, regardless of whether congestion costs are included.

As a final extension, the online appendix also repeats the spillovers analysis using labor market outcomes from the National Occupation and Employment Survey (ENOE) as the dependent variable. ENOE surveys a representative sample of municipalities on a quarterly basis, and thus offers less power than the monthly census of violence outcomes. Appendix Table A15 shows that there is not an economically or statistically significant correlation between the predicted routes dummy and male labor force participation. In contrast, the presence of a predicted trafficking route lowers female labor force participation by 1.3 percentage points (s.e.= 0.57), relative to an average female participation rate of 51 percent. Cultural norms may make it less desirable for women to participate in the labor force when violence occurs nearby, and women may also be more vulnerable to extortion by traffickers because they are concentrated in the informal sector.⁵¹ Table A15 shows that predicted routes are uncorrelated with male, prime-aged formal sector wages, whereas male, prime-aged informal sector wages fall by around 2.3 percent (s.e.= 1.3) when a municipality acquires a predicted route.⁵² Informal sector workers are often self-employed, and the survey calculates wages as monthly profits divided by hours worked. If informal sector workers report their

⁵¹The presence of drug trafficking could also draw people into illicit employment that would not be reported in labor survey data, although this would likely affect men at least as much as women.

⁵²The analysis of wages is limited to prime age males to reduce concerns about selection bias. Formal sector workers are those that contribute to the federal social security system.

earnings as net of rents extracted by traffickers, then extortion could explain the decline in reported wages.⁵³ Further investigation of the channels through which trafficking impacts labor markets is an important area for future research.

6 Policy Applications

This study has shown that drug trade-related violence increases substantially following Mexican government crackdowns. Potential policy interpretations of the results vary widely, as expected given the complex and controversial nature of the war on drugs, and there are clearly no easy solutions to the problems that Mexico faces. This section discusses several policy interpretations and also extends the network model so that it can be used for policy analysis.

One potential conclusion is that the monetary and human costs of combating trafficking exceed the benefits, and thus Mexico should legalize drugs. While the government's aim was to raise traffickers' costs enough that they would rarely find it profitable to operate in Mexico, drugs are still being trafficked in large quantities, and drug consumption in the hemisphere has not declined (U.N. World Drug Report, 2011). Moreover, if drugs were legalized, traffickers might have fewer incentives to corrupt Mexican institutions and to use violence to resolve disputes. While the legalization of marijuana may or may not be politically feasible, the legalization of all drugs does not appear particularly likely in the immediate future since hemispheric politics create strong incentives to combat trafficking. Moreover, Mexicans tend to have little sympathy for traffickers, given their varied extortionary activities (Díaz-Cayeros et al., 2011).

Some have instead suggested that the government should broker a deal with DTOs exchanging a *de facto* decriminalization of trafficking for the cessation of predatory activities and/or violence (Kleiman, 2011). While predation impacts Mexicans more than drug transport, it is not clear that such a deal could be sustained, given the large number of DTOs, the limited control that DTO leaders have over their ranks, and political pressures.

An alternative view, advocated by policymakers such as Calderón, emphasizes that continued crackdowns are imperative because DTOs use their large profits to control the police department, the press, and other institutions. Crackdowns may increase violence in the medium term, but in the long run weakened traffickers will have fewer resources to co-opt the state. It is clearly deeply problematic when DTO assassins are the police homicide unit and DTO kidnappers staff the police anti-kidnapping division, as has often been true in Mexico historically (Molloy and Bowden, 2011). However, it is unclear whether crackdowns

⁵³In contrast, formal sector workers are likely to earn a fixed wage and report that.

reduce traffickers' profits enough to constrain their corrupting influence and whether drug interdiction is a necessary component for strengthening institutions.

Mexican drug policy has frequently been criticized for indiscriminately targeting traffickers, rather than focusing resources through a more systematic and theoretically informed approach (Guerrero, 2011; Kleiman, 2011). This suggests that there is scope to improve interdiction by using a systematic framework to model traffickers' responses to different patterns of law enforcement deployment. Improving law enforcement efficiency seems desirable, but this study underlines that collateral consequences may also result. First, a well-coordinated disruption of trafficking routes could increase violence, at least in the short run. It could also cause international spillovers, with more cocaine trafficked through the Caribbean and more Americans growing marijuana and cooking meth in their closets. Mexican traffickers would earn lower profits, but this might not be welfare improving for the Americas as a whole. Finally, if trafficking and other criminal activities are substitutes, unemployed Mexican traffickers might expand their extortion, kidnapping, and theft operations.

Quantitatively assessing which of the above perspectives is welfare maximizing would require a large number of assumptions, in part because neither legalization nor the long-run effects of Mexico's drug war have been observed and in part because it is controversial what Mexico's drug policy objectives should be. More research is needed on whether crackdowns strengthen institutions, on the likely costs and benefits of legalization, and on the elasticity of substitution between trafficking and other criminal activities. Because interdiction, particularly of hard drugs, is likely to continue in the near future, I focus here on how the trafficking model could inform interdiction and on how adverse consequences could be reduced.

So far, this study has used exogenous policy variation to identify causal effects. In order to apply the trafficking framework to policy analysis, it is necessary to endogenize government decisionmaking. I do this by embedding the trafficking model in a Stackelberg network game (Baş and Srikant, 2002). In the first stage, the government (a single player) decides how to allocate law enforcement resources to edges in the road network, subject to a budget constraint. Traffickers' costs of traversing an edge increase when law enforcement resources are placed on it. In the second stage, traffickers simultaneously select least cost routes to the U.S. The government's objective is to maximize the total costs that traffickers incur, and each trafficker minimizes his own costs. This framework can accommodate multiple types of resources with deployment costs that vary by edge.

There are several things to note about how the network structure conditions the equilibrium allocation of law enforcement resources. First, while a naive policy might allocate law enforcement to edges with the most drug traffic, the network model highlights that the extent to which law enforcement affects trafficking costs depends on available detours. In fact, increasing an edge's latency can decrease total trafficking costs if there are externali-

ties from congestion. This result, known as Braess’s paradox (1968), occurs for 15% of the edges in the congested trafficking equilibrium. Moreover, the effects of law enforcement in different locations are interconnected through the network structure, implying that resource allocation decisions should be made jointly rather than on a location-by-location basis.

The online appendix provides an illustrative example of how this framework can be used to inform the allocation of scarce law enforcement resources. I first show that the government’s allocation problem is NP hard, which implies that the time required to solve for the optimum increases quickly as the size of the problem grows. Intuitively, the problem is challenging because allocating resources to two edges at the same time might increase the government’s objective function more than the summation of changes in the objective when resources are allocated to each edge separately. Hence the order in which a solution algorithm proceeds may matter. The estimation appendix develops an algorithm for solving the game, and Appendix Table A16 documents robustness to changing the algorithm’s details.

I then show that if the government has enough resources to triple the latencies on 25 edges (this is the factor by which PAN victories are estimated to increase edge costs), this will increase traffickers’ total predicted costs by 17%. This exercise illustrates how the network model can contribute unique information to interdiction efforts, as the 25 edges chosen differ from the 25 most trafficked edges. Appendix Figure A17 shows that they also differ from the most violent municipalities. This exercise is a simplified illustrative example, but with appropriate data it would be straightforward to extend the model to make it more realistic. With data on the specific resources deployed in PAN crackdowns, one could estimate how much different resources increase trafficking costs using the approach developed in this study. It would then be straightforward to extend the model to include multiple types of law enforcement resources, as well as to incorporate deployment costs that vary by edge.

A major concern with improving interdiction is that violence may increase as a result. This could be explicitly incorporated into the model by including a violence term in the government’s resource allocation cost function. The magnitude of the edge-specific violence cost could depend on regional patterns of DTO territorial control, the edge’s centrality to the trafficking network, and other relevant characteristics.

Moreover, if the government reduced police corruption and strengthened criminal justice institutions, efforts to improve the allocation of law enforcement could plausibly reduce trafficking while generating fewer negative externalities. For example, if the state could credibly commit to long-term increases in non-corrupt law enforcement in certain locations, the present discounted value of controlling illicit activities in these locations would fall, and there would be a lower return to fighting over them. Examining how police and criminal justice reforms can be most effectively implemented is a central question for future research.

7 Conclusion

This study examines the direct and spillover effects of Mexican policy towards the drug trade, developing three sets of results. First, regression discontinuity estimates show that drug trade-related violence in a municipality increases substantially after the close election of a PAN mayor. The empirical evidence suggests that the violence largely reflects rival traffickers' attempts to wrest control of territories after crackdowns initiated by PAN mayors have challenged the incumbent criminals. Second, an economic model of equilibrium trafficking routes predicts the diversion of drug traffic following close PAN victories. When drug traffic is diverted to other municipalities, violence in these municipalities increases. Finally, the network model can serve as a potential tool for the allocation of law enforcement.

These results demonstrate how traffickers' economic objectives and constraints imposed by the routes network have conditioned the policy outcomes of the Mexican Drug War. While there are unlikely to be any easy solutions to the challenges that the drug trade poses, the results suggest that developing a more detailed understanding of how governments and organized criminals interact through networks could potentially improve the allocation of scarce public resources in Mexico and other contexts. This study has focused on the shorter-term consequences of the Mexican Drug War because at the time of writing, any longer term impacts on institutional quality and security had yet to be realized. Examining the conditions under which crackdowns lead to long-term changes in these outcomes is a particularly central area for future research.

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Table 1: Baseline Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Own municipality					Neighboring muns.	
	5% vote spread PAN won	PAN lost	t-stat on means difference	RD estimate	t-stat on RD estimate	RD estimate	t-stat on RD estimate
<i>Crime characteristics</i>							
Drug-trade homicide probability	0.03	0.04	(-0.51)	-0.01	(-0.38)	-0.02	(-0.47)
Confrontation death probability	0.04	0.04	(0.01)	0.01	(0.12)	0.01	(0.25)
Annual homicide rate (1990-2006)	1.37	1.50	(-0.46)	-0.07	(-0.20)	-0.07	(-0.31)
<i>Political characteristics</i>							
Mun. taxes per capita (2005)	59.84	56.75	(0.23)	15.86	(0.84)	9.01	(0.42)
Turnout	0.61	0.59	(0.99)	0.02	(0.85)	0.00	(0.71)
PAN incumbent	0.27	0.32	(-0.61)	0.00	(0.01)	-0.07	(-1.03)
PRD incumbent	0.17	0.13	(0.63)	0.02	(0.30)	0.00	(-0.02)
% alternations (1976-2006)	0.31	0.31	(-0.20)	0.01	(0.27)	-0.04	(-1.85)*
PRI never lost (1976-2006)	0.07	0.07	(-0.04)	-0.01	(-0.13)	0.01	(0.36)
<i>Demographic characteristics</i>							
Population (2005)	60259	50991	(0.35)	23169	(0.64)	3.67	(0.81)
Population density (2005)	220.23	191.05	(0.42)	8.63	(0.08)	-37.53	(-0.33)
Migrants per capita (2005)	0.02	0.02	(-0.69)	0.00	(-0.45)	0.00	(0.08)
<i>Economic characteristics</i>							
Income per capita (2005)	4.29	4.48	(-0.53)	-0.14	(-0.29)	-0.05	(-0.11)
Malnutrition (2005)	32.76	31.2	(0.53)	0.99	(0.28)	-1.63	(-0.51)
Mean years schooling (2005)	6.26	6.19	(0.32)	0.04	(0.15)	0.10	(0.36)
Infant mortality (2005)	22.54	22.26	(0.22)	0.14	(0.10)	0.35	(0.27)
HH w/o access to sewage (2005)	8.51	8.44	(0.05)	0.24	(0.15)	0.43	(0.36)
HH w/o access to water (2005)	16.14	18.22	(-0.62)	-0.94	(-0.23)	-1.58	(-0.52)
Marginality index (2005)	-0.15	-0.12	(-0.23)	-0.06	(-0.31)	-0.09	(-0.49)
<i>Road network characteristics</i>							
Detour length (km)	27.32	24.58	(0.14)	4.68	(0.16)	17.99	(0.85)
Road density (km/km^2)	0.15	0.13	(1.08)	0.01	(0.52)	0.00	(0.10)
Distance U.S. (km)	708.27	735.49	(-0.55)	-73.77	(-1.23)	-78.56	(-1.30)
<i>Geographic characteristics</i>							
Elevation (m)	1406.75	1380	(0.19)	-30.38	(-0.18)	-47.49	(-0.29)
Slope (degrees)	3.62	3.25	(0.89)	0.31	(0.58)	0.10	(0.25)
Surface area (km^2)	1787	725	(1.36)	1488	(1.46)	1089	(1.29)
Average min. temperature, C	11.76	12.23	(-0.57)	-0.39	(-0.38)	-0.45	(-0.47)
Average max. temperature, C	26.37	26.64	(-0.45)	-0.22	(-0.30)	-0.13	(-0.21)
Average precipitation, cm	115.16	105.2	(0.82)	10.87	(0.79)	2.10	(0.16)
Observations	70	82		430		430	

Notes: Data on population, population density, mean years of schooling, and migrants per capita are from *II Conteo de Poblacion y Vivienda*, INEGI (National Institute of Statistics and Geography, 2005). Data on municipal tax collection are from *Sistema de Cuentas Municipales*, INEGI. Data on household access to sewage and water are from CONAPO (National Population Council) (2005). Data on malnutrition are from CONEVAL (National Council for Evaluating Social Development Policy), *Indice de Reazgo Social* (2005). Data on infant mortality are from PNUD Mexico (UN Development Program, 2005). The marginality index is from CONAPO (2005). Data on distance to the U.S. and other road network characteristics are from the author's own calculations. Electoral data are from Mexico Electoral-Banamex and electoral results published by the Electoral Tribunals of each state. For 11 states, data on the total number of eligible voters, required to calculate turnout, are not reported. The geographic characteristics are from Acemoglu and Dell (2009). Data on homicides (1990-2006) are from INEGI and data on drug trade-related violence are from confidential sources. Columns (1) through (5) examine these variables for municipalities with close elections. Column (6) and (7) examine these characteristics for municipalities that border a municipality with a close election. Column (3) reports the t-statistic on the difference in means between municipalities where the PAN barely won and where they barely lost. Columns (4) and (6) report the coefficient on PAN win from equation (1) when the respective characteristic is used as the dependent variable, and columns (5) and (7) report the respective t-statistic. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 2: Close PAN Elections and Violence

	Post inaug.	Lame duck	Pre election	No FE	No FE or controls	Linear	Quadratic RD polynomial		Cubic	Quartic		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Probability of drug trade-related homicides												
PAN win						0.019 (0.058)		0.007 (0.059)		0.050 (0.088)		0.046 (0.090)
× lame duck						0.147*** (0.051)		0.132*** (0.047)		0.204*** (0.064)		0.204*** (0.062)
PAN win												
× post-inaug.												
PAN win	0.084*** (0.027)	0.005 (0.030)	0.014 (0.013)	0.093*** (0.026)	0.093*** (0.043)		0.127*** (0.036)		0.149*** (0.046)		0.179*** (0.060)	
R-squared	0.648	0.686	0.868	0.576	0.024	0.237	0.652	0.240	0.653	0.244	0.655	0.244
Clusters						152		152		152		152
Observations	430	430	430	430	430	1,960	430	1,960	430	1,960	430	1,960
Panel B: Drug trade-related homicide rate												
PAN win						0.026 (0.025)		0.018 (0.025)		0.068* (0.038)		0.068* (0.038)
× lame duck						0.089** (0.038)		0.088** (0.038)		0.107** (0.041)		0.103** (0.040)
PAN win												
× post-inaug.												
PAN win	0.046** (0.020)	0.007 (0.023)	0.005 (0.005)	0.044** (0.020)	0.047** (0.023)		0.066** (0.029)		0.096*** (0.037)		0.090** (0.040)	
R-squared	0.370	0.250	0.643	0.246	0.021	0.219	0.374	0.220	0.380	0.222	0.386	0.223
Clusters						152		152		152		152
Observations	430	430	430	430	430	1,960	430	1,960	430	1,960	430	1,960

Notes: In columns (1), (4), (5), (7), (9), and (11) the dependent variable is the average monthly homicide probability (Panel A) or rate (Panel B) in the post-inauguration period; in column (2) it is average homicides in the lame duck period, and in column (3) it is average homicides in the pre-election period. In columns (6), (8), (10), and (12), it is the homicide dummy (rate) in a given municipality-month. PAN win is an indicator equal to one if a PAN candidate won the election, lame duck is an indicator equal to one if the observation occurred between the election and inauguration of a new mayor, and post-inaug. is an indicator equal to one if the observation occurred after the inauguration of a new mayor. Columns (6), (8), (10), and (12) include a lame duck main effect, a post-inauguration main effect, month x state and municipality fixed effects, and interactions between the RD polynomial listed in the column headings and the lame duck and post-inauguration dummies. These columns limit the sample to municipalities with a vote spread of five percentage points or less. Columns (1) through (3), (7), (9), and (11) include state fixed effects and controls for baseline characteristics, estimated separately on either side of the PAN win-loss threshold. The coefficients in columns (1) through (5), (7), (9), and (11) are estimated using local regression, with separated trends in vote spread estimated on either side of the PAN win-loss threshold. Robust standard errors, clustered by municipality in columns (6), (8), (10), and (12), are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3: Local Politics and Violence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Elections involving PAN			Alternative samples			
	Baseline	PAN Incumbent	PAN Governor	PRI Opponent	PRI v. PRD	Any alternation	All muns.
PAN win	0.084*** (0.026)	0.067** (0.028)	0.089*** (0.028)	0.069** (0.029)			0.148 (0.250)
PAN win × PAN Incumbent		0.056 (0.040)					
PAN win × PAN Governor			-0.037 (0.079)				
PAN win × PRI opponent				0.021 (0.032)			
PRI win					0.050 (0.035)		
Alternate						0.012 (0.018)	
R-squared	0.648	0.648	0.648	0.649	0.571	0.554	0.577
Observations	430	430	430	430	259	780	1,286

Notes: The dependent variable is the average probability that a drug trade-related homicide occurred in a given municipality-month during the post-inauguration period. See text for variable descriptions. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 4: Trafficking Industrial Organization and Violence

	(1)	(2)	(3)
	Dep. var.: drug-related homicides		
PAN win	0.084*** (0.027)	0.020 (0.026)	0.087*** (0.025)
PAN win × borders rival		0.513*** (0.180)	
PAN win × borders allies		0.126* (0.071)	
PAN win × local gang		0.012 (0.032)	
PAN win × detour			0.070*** (0.022)
R-squared	0.648	0.633	0.671
Observations	430	430	430
Borders rival effect		0.533*** (0.174)	
Borders allies effect		0.146** (0.069)	
Local gang effect		0.032 (0.028)	

Notes: The dependent variable is the average probability that a drug trade-related homicide occurred in a given municipality-month during the post-inauguration period. See text for variable descriptions.

*significant at 10%, ** significant at 5%, *** significant at 1%.

Table 5: The Diversion of Drug Traffic

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample Domestic drug confiscations		Limited Sample		Full Sample Cocaine confiscations	
	Dummy	Value	Dummy	Value	Dummy	Value
<i>Panel A: Shortest Paths</i>						
Predicted	0.016***	0.170***	0.015**	0.162**	0.004	0.027
routes dummy	(0.005)	(0.050)	(0.006)	(0.063)	(0.004)	(0.020)
<i>Panel B: Model with Congestion Costs</i>						
Predicted	0.015***	0.178***	0.013**	0.159**	-0.002	0.014
routes dummy	(0.005)	(0.059)	(0.006)	(0.064)	(0.004)	(0.023)
Municipalities	1869	1869	1574	1574	1869	1869
Observations	69,153	69,153	58,238	58,238	69,153	69,153
Mean dep. var.	0.053	0.589	0.055	0.613	0.046	0.163

Notes: The dependent variable in columns (1) and (3) is an indicator equal to 1 if domestic illicit drug confiscations are made, in columns (2) and (4) it is the log value of domestic illicit drug confiscations (or 0 if no confiscations are made), in column (5) it is an indicator equal to 1 if cocaine confiscations are made, and in column (6) it is the log value of confiscated cocaine (or 0 if no confiscations are made). Columns (3) and (4) limit the sample to municipalities that do not border a municipality that has experienced a close PAN victory. Panel A predicts trafficking routes using the shortest paths model, and Panel B uses the model with congestion costs. All columns include month x state and municipality fixed effects. Standard errors clustered by municipality and month x state are reported in parentheses.

Table 6: Violence Spillovers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full Sample		Full Sample Drug-related homicide		Limited Sample		Full Sample Non-drug homicide
	dummy	dummy	rate	rate	dummy	rate	rate
<i>Panel A: Shortest Paths</i>							
Predicted	0.013***		0.021*		0.006	0.010	0.017
routes dummy	(0.005)		(0.011)		(0.006)	(0.011)	(0.014)
One route		0.014*		0.020*			
		(0.007)		(0.011)			
More than one route		0.012		0.021			
		(0.008)		(0.017)			
<i>Panel B: Model with Congestion Costs</i>							
Predicted	0.015***		0.022		0.018***	0.029	-0.000
routes dummy	(0.005)		(0.019)		(0.006)	(0.025)	(0.007)
One route		0.008		0.003			
		(0.006)		(0.013)			
More than one route		0.019***		0.035			
		(0.007)		(0.025)			
Municipalities	1869	1869	1869	1869	1574	1574	1869
Observations	69,153	69,153	69,153	69,153	58,238	58,238	69,153
Mean dep.var.	0.044	0.028	0.044	0.028	0.045	0.026	0.117

Notes: The dependent variable in columns (1), (2), and (5) is an indicator equal to 1 if a drug trade-related homicide occurred in a given month; in columns (3), (4), and (6) it is the drug trade-related homicide rate per 10,000 inhabitants, and in column (7) it is the non-drug trade-related homicide rate per 10,000 inhabitants. Columns (5) and (6) limit the sample to municipalities that do not border a municipality that has experienced a close PAN victory. All columns include month x state and municipality fixed effects. Standard errors clustered by municipality and month x state are reported in parentheses.

Figure 1: Illustration of Spillovers Methodology

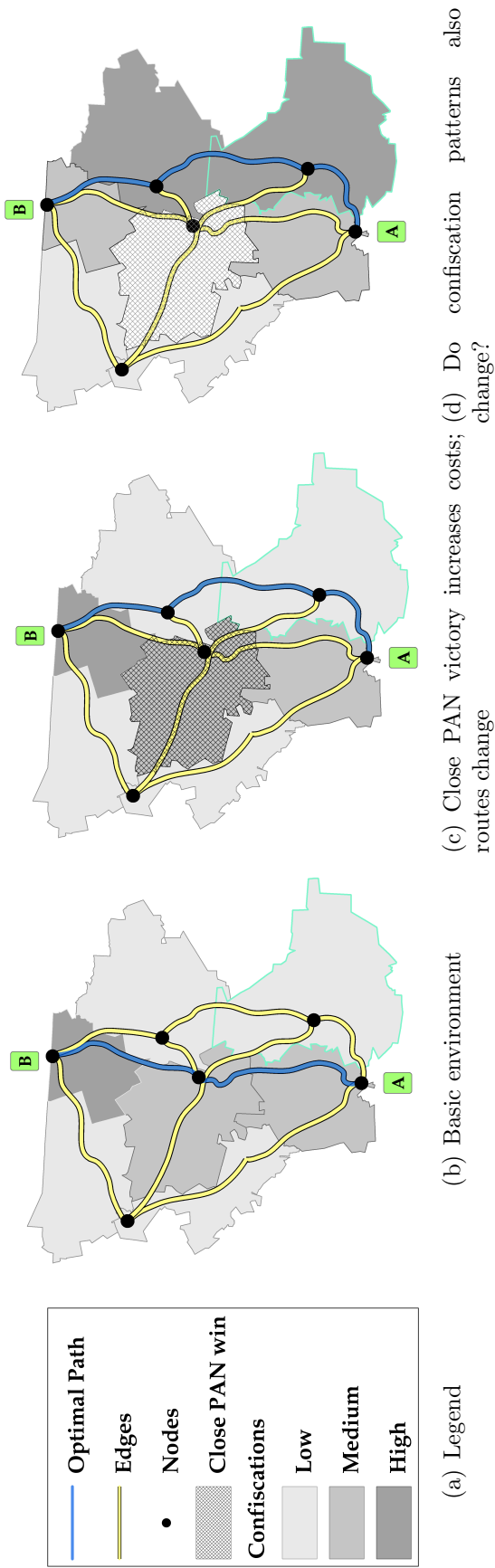
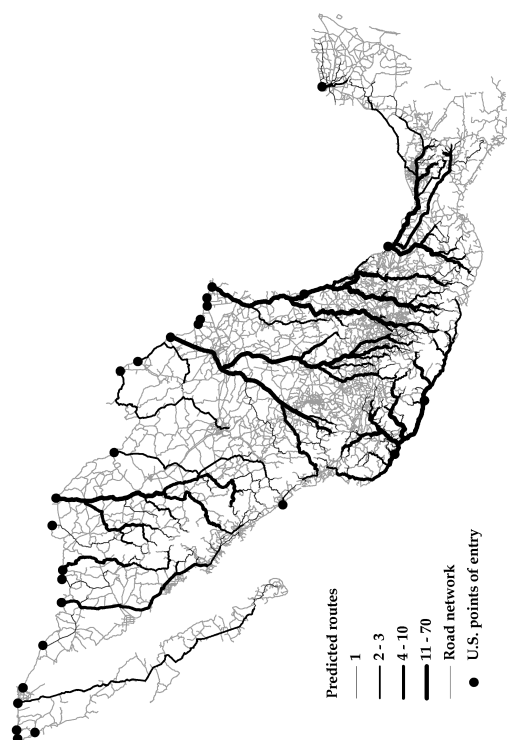
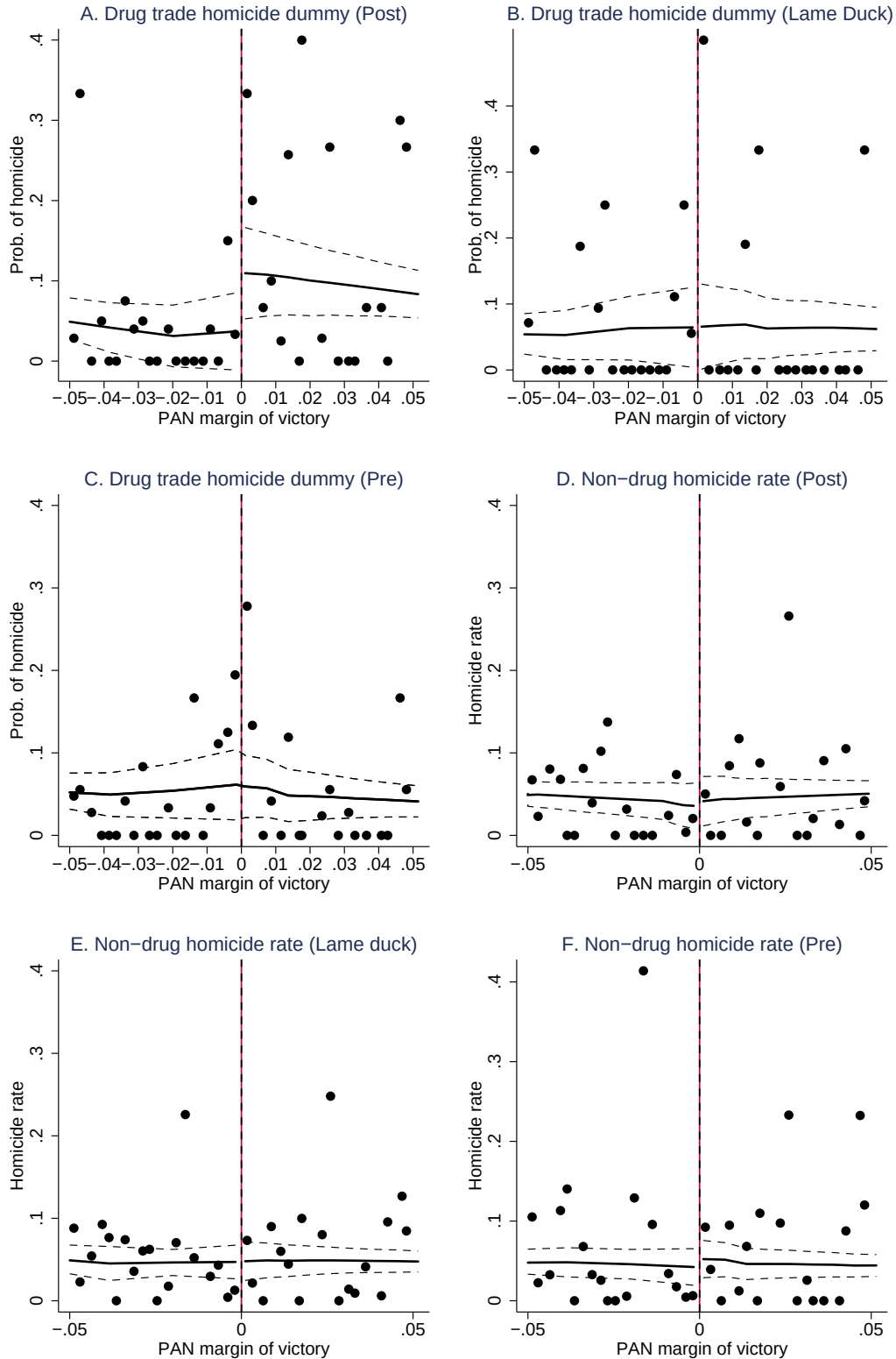


Figure 2: Road Network and Predicted Trafficking Routes



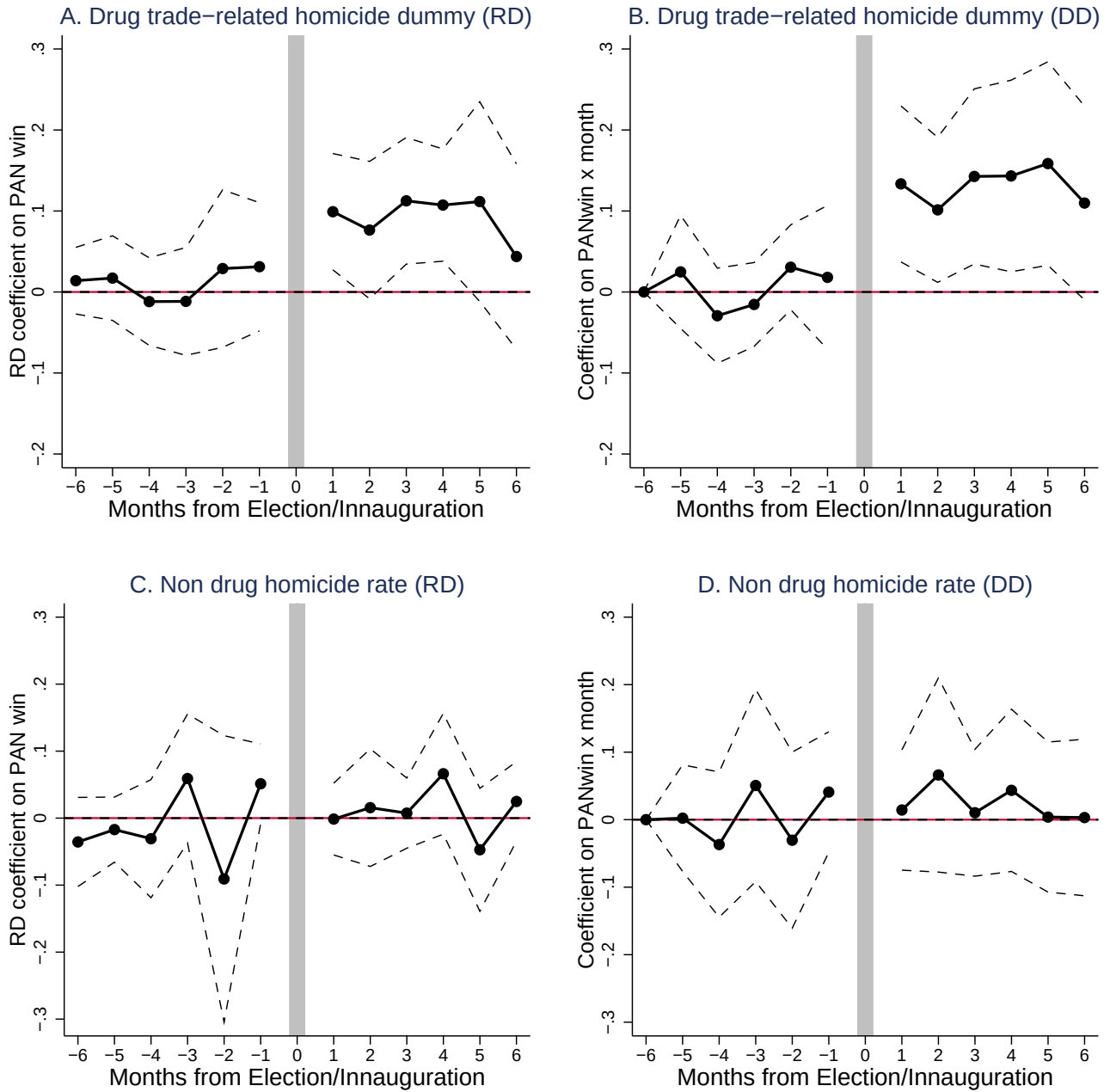
Notes: The least cost routes plotted in this figure are predicted using the network model with congestion costs.

Figure 3: Close PAN Victories and Violence



Notes: This figure plots violence measures against the PAN margin of victory, with a negative margin indicating a PAN loss. Each point represents the average value of the outcome in vote spread bins of width one quarter of a percentage point. The solid line plots predicted values from a local linear regression, with separate vote spread trends estimated on either side of the PAN win-loss threshold. The dashed lines show 95% confidence intervals. The bandwidth is chosen using the Imbens-Kalyanaraman bandwidth selection rule (2012).

Figure 4: RD Estimates by Month



Notes: Panels A and C plot the RD coefficients on PAN win from equation (1), estimated separately for each month prior to the election and following the inauguration of new authorities. Panels B and D plot the γ_T coefficients from equation (2). The dashed lines plot 95% confidence intervals.