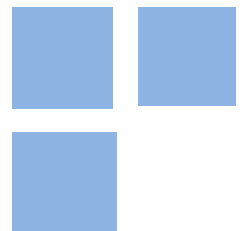




The Role of Public Security Reforms on Violent Crime Dynamics

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Abstract:

In the context of increasing violence, public security reforms are commonly advocated as a solution to the problem despite the lack of empirical evidence. We address this question by evaluating the effect of the Pacto pela Vida program, a comprehensive reform on the public security of the state of Pernambuco, Brazil. We document a reduction of 16 homicides per 100,000 inhabitants following the program implementation. We show that a reduction in crimes occurring on the streets and associated with young males and firearm availability are likely to have contributed to the program's effect.

Keywords: crime, reform, policy evaluation, Brazil

JEL Codes: H76, K42, R58

The Role of Public Security Reforms on Violent Crime Dynamics

Danilo Souza and Mateus Maciel*

May 2024

In the context of increasing violence, public security reforms are commonly advocated as a solution to the problem despite the lack of empirical evidence. We address this question by evaluating the effect of the *Pacto pela Vida* program, a comprehensive reform on the public security of the state of Pernambuco, Brazil. We document a reduction of 16 homicides per 100,000 inhabitants following the program implementation. We show that a reduction in crimes occurring on the streets and associated with young males and firearm availability are likely to have contributed to the program's effect.

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1 Introduction

Evidence on the causal effect that state reforms might have on crime is scarce. Most of the literature on the subject is descriptive. It usually focuses on changes in political regimes as the source of variation in how public security is structured (Cruz, 2011). In comparison, there is an enormous literature on the effect of changes in specific aspects of the public security policy, such as policing intensity and the police structure (Ater, Givati and Rigbi, 2014; Owens and Ba, 2021). Yet, an evaluation of a comprehensive reform of public security as a whole is still missing. In this paper, we follow Ratton, Galvão and Fernandez (2014), and Wolff (2017) assessments on the nature of a profound reform on the public security of the Brazilian state of Pernambuco to fill this gap.

The homicide rate in Pernambuco was never below 40 per 100,000 inhabitants between 1996 and 2009 (Ratton and Daudelin, 2018), which ranked the state as one of the most violent regions in the country¹. At the beginning of 2007, following the election of a new state governor, a workforce composed of governmental and non-governmental authorities launched a state plan for security, the *Pacto pela Vida* (PPV) program, which aimed to reduce homicides by 12% per year. Police management changed as the committee divided the state into 26 security areas and improved crime data collection. By doing so, the government intended to better identify the crime hot spots and allocate resources effectively. In addition, the program changed the level of coordination among public security institutions, which led to an increase in the state’s investigative capacity and public security governance (Wolff, 2017).

da Mota Silveira Neto et al. (2022) document an annual reduction of 10.1 homicides per 100,000 following the PPV implementation. After 2014, the homicide rate started to increase again, which, according to the authors, was associated with the governor leaving office in 2014. The valorization of the police force was also a relevant component of the program since its beginning (Wolff, 2017). Ten years after the program’s implementation, an explicit performance bonus for police officers who seized firearms was deployed. Using a synthetic-control approach, Barros et al. (2022) show that this performance-based incentive positively affected firearm seizures. While a decline in overall crime rates is also noted, they argue that this reduction cannot be directly attributed to the bonus policy.

Our paper contributes to a broad literature that evaluates the effect of organizational reforms on several aspects of the public security system. More specifically, we contribute to the understanding of how a comprehensive reform affects crime dynamics. In this

¹According to the FBI’s UCR, Chicago’s homicide rate was about 20 per 100,000 in 2022.

sense, our paper is probably most related to Soares and Viveiros (2017), who assess the impact of a reform on the public security structure of some municipalities in the state of Minas Gerais. Authors show that, following the implementation of the IGESP program, property crimes decreased by 23% but the effect on other crimes is estimated less precisely. Differently from Soares and Viveiros (2017), we explore the effect on violent crimes of a comprehensive reform that affected the entire state of Pernambuco.

We also complement da Mota Silveira Neto et al. (2022) and Barros et al. (2022) by evaluating the effect of the PPV program through a difference-in-differences and event-study approach. By doing so, we can directly test if the treated and control groups' crime trajectories were similar before the program's implementation. Moreover, we evaluate the program's effect in the first years of implementation, when Pernambuco was the only northeast state experiencing a public security reform. Finally, we also explore several potential mechanisms through which the effect on homicides emerged.

2 Data

We built a panel of Brazilian municipalities from the Northeast region in the 2004–2011 period². One of our primary data sources is the Brazilian Ministry of Health's administrative records (DATASUS–SIM), which contains detailed information on deaths by homicides and other causes classified according to the International Statistical Classification of Diseases and Related Health Problems (ICD). From each death record, we also have information on the death's location, as well as the victims' demographics. Additionally, we use data from the Brazilian Census Bureau (IBGE) on local GDP, Human Development Index, population estimates, and density. Finally, we make use of data from the *Relação Anual de Informações Sociais*, an administrative dataset from the Brazilian Ministry of Labor providing information on the universe of formal labor contracts.

3 Empirical Strategy

The PPV program was implemented in Pernambuco in May 2007. Municipalities from the other northeast states did not experience a similar intervention during our analysis period. We rely on this cross-section variation to build our main treated – Pernambuco's

²Pernambuco was the only northeast state experiencing such a comprehensive reform in public security during this period. After 2011, neighboring states began to implement similar policies: Paraíba and Bahia states deployed their reforms by the end of 2011 and the beginning of 2012. Thus, to avoid contamination from other states' reforms, we do not use data from 2012 onwards.

municipalities – and control – municipalities from the rest of the northeast region – groups. Then, to assess the impact of the program, we use a difference-in-differences strategy and estimate the following equation:

$$Y_{it} = \beta_0 + \beta_1(T_t \times D_i) + X'_{it}\phi + \theta_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is the outcome in municipality i , and year t , D_i is a dummy variable indicating Pernambuco’s municipalities, and T_t represents the treatment period. X_{it} is a vector of covariates interacted with year dummies, whereas θ_i and λ_t indicate municipality and year fixed effects, respectively. The municipality’s population in 2000 weighs observations. Standard errors are clustered at the state level.

When estimating such models unobservable cofounders that change around the treatment period pose a threat to the identification strategy. In other words, we assume that treated and control groups display similar trajectories were it not for the PPV implementation. To provide evidence for this parallel trend assumption we use an event-study approach and estimate the following:

$$Y_{it} = \alpha_0 + \alpha_t(D_i \times Year_t) + X'_{it}\phi + \theta_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where $Year_t$ is a dummy variable that equals one in year t . All other variables, weights, and clusters are defined as before. The omitted year is 2006, the first pre-PPV year.

Even though the PPV program was implemented as a state-wide policy, it could be the case that Pernambuco’s municipalities were, in practice, differently affected over time. This could raise concerns about the validity of our estimations. To be more agnostic about functional forms and estimate the program effect more flexibly, we also present results using Callaway and Sant’Anna (2021) estimator, which generalizes for multi-periods environments the Sant’Anna and Zhao (2020) double-robust estimator.

4 Estimation results

4.1 Descriptive evidence

Figure 1 illustrates the evolution of the homicide rate in the Northeast region. Despite a similar upward trend, Pernambuco’s homicide rate was at least 2 times higher than the region’s average in 2004 – 2006. After 2007, the state’s homicide rate began to fall, dropping from 51 homicides per 100,000 to a rate of 37 in 2011. Despite still being one of the most violent states, Pernambuco displayed a downward trend while the neighboring

states continued on the path of increasing violence³. This marked difference between the periods before and after 2007 suggests that something happened only in Pernambuco that reverted the region’s violent trend.

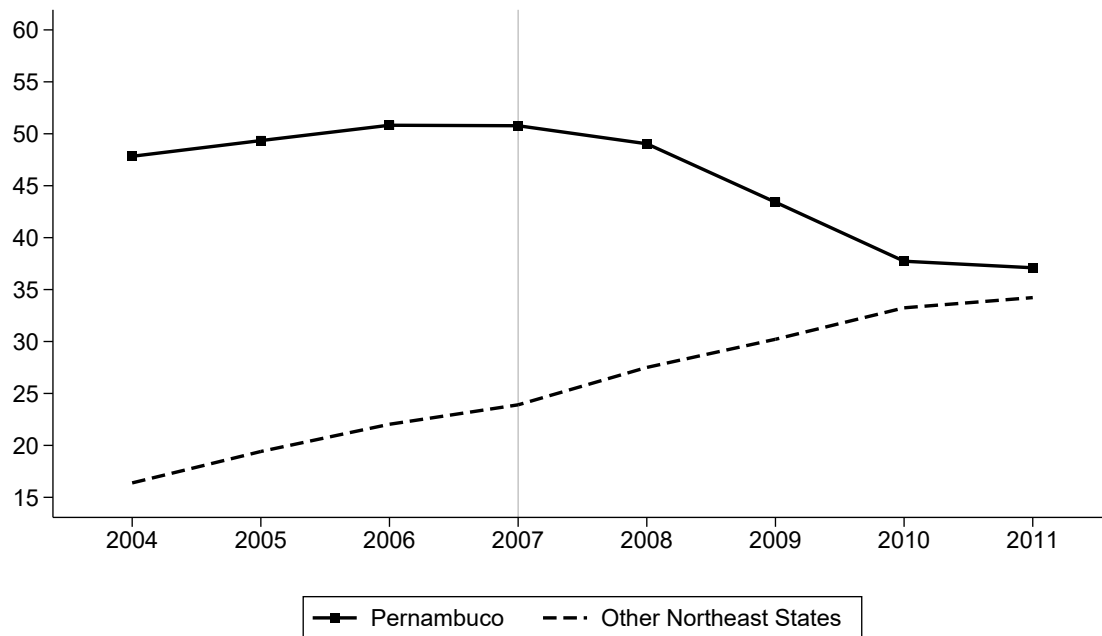


Figure 1: Homicides per 100,000 Inhabitants in the Brazilian Northeast Region

4.2 The PPV Effect on crime

Table 1 reports estimates for β_1 from equation (1) using TWFE, and also the average treatment effect using Callaway and Sant’Anna (2021) estimator. Columns (1)-(2) present results for the PPV program’s effect on the homicide rate. The table suggests that the program was responsible for a relative reduction of 15–16 homicides per 100,000. In both models, the coefficient is very robust to the inclusion of covariates.

Columns (3)-(5) present a robustness exercise to check whether our results depend on the treatment and control groups’ definitions. We increase comparability by limiting the estimation sample to geographically proximate municipalities (Appendix Figure A.1). There is a reduction in the coefficient’s magnitude once we move from the original sample to the sample that includes only municipalities that are, at most, 100 kilometers distant from Pernambuco’s border. This could be the result of dropping bigger municipalities

³Except for Pernambuco, all northeast states experienced an increase in the homicide rate during the 2004–2011 period. This increase was more than twofold in certain cases, reaching +170% in the case of Rio Grande do Norte.

Table 1: Homicides and the *PPV* Program

	Main results		Robustness: distance to PE border		
	(1)	(2)	< 100km (3)	< 75km (4)	< 50km (5)
TWFE Model	-16.068*** [1.934]	-16.301*** [1.855]	-9.286** [3.017]	-8.454** [2.526]	-7.770** [2.351]
Callaway and Sant’Anna (2021)	-14.877*** [1.413]	-16.014*** [1.525]	-6.857** [2.733]	-6.421** [2.951]	-7.139*** [2.259]
Covariates	No	Yes	Yes	Yes	Yes
Observations	14,288	14,288	3,432	2,744	1,880

Notes: All regressions are weighted by the municipality population in 2000. The covariates in columns (2)-(5) include the log of the municipality’s GDP per capita, the log of formal employment, the Human Development Index, and population density. In brackets, standard errors are clustered at the state level. Callaway and Sant’Anna (2021) estimator is implemented through the *csdid* Stata command. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

from the sample: the average population size falls from 27,400 (*std.* = 100,000) to 22,000 (*std.* = 56,000). Nevertheless, the coefficient’s magnitude reduction is smaller as we move from the sample with the 100-km window to a sample with smaller windows.

We complement this discussion by showing the dynamic effects of the PPV program on homicides. Figure 2 presents the results of estimating equation (2) by using both the TWFE and Callaway and Sant’Anna (2021) estimators. Estimated α_t coefficients are presented graphically, together with the 90% cluster-robust confidence intervals. Results suggest that before the PPV implementation in 2007, the homicide rate displayed a similar trajectory across the treated and control groups, supporting the validity of the parallel trends assumption. Figure 2 also shows that once the PPV program was deployed, the treated group homicide rate decreased monotonically. In 2010, the program’s accumulated effect was between -10 and -25 homicides per 100,000. This is in line with da Mota Silveira Neto et al. (2022) evidence for the 2007-2011 period and also Figure 1, but now in a setting that accounts for potential unobservable cofounders.

4.3 Potential Mechanisms

More than an intervention in only one aspect of public security, the PPV program changed how Pernambuco dealt with crime in many dimensions. Thus, rather than testing a specific channel, we explore many potential mechanisms that might have contributed to

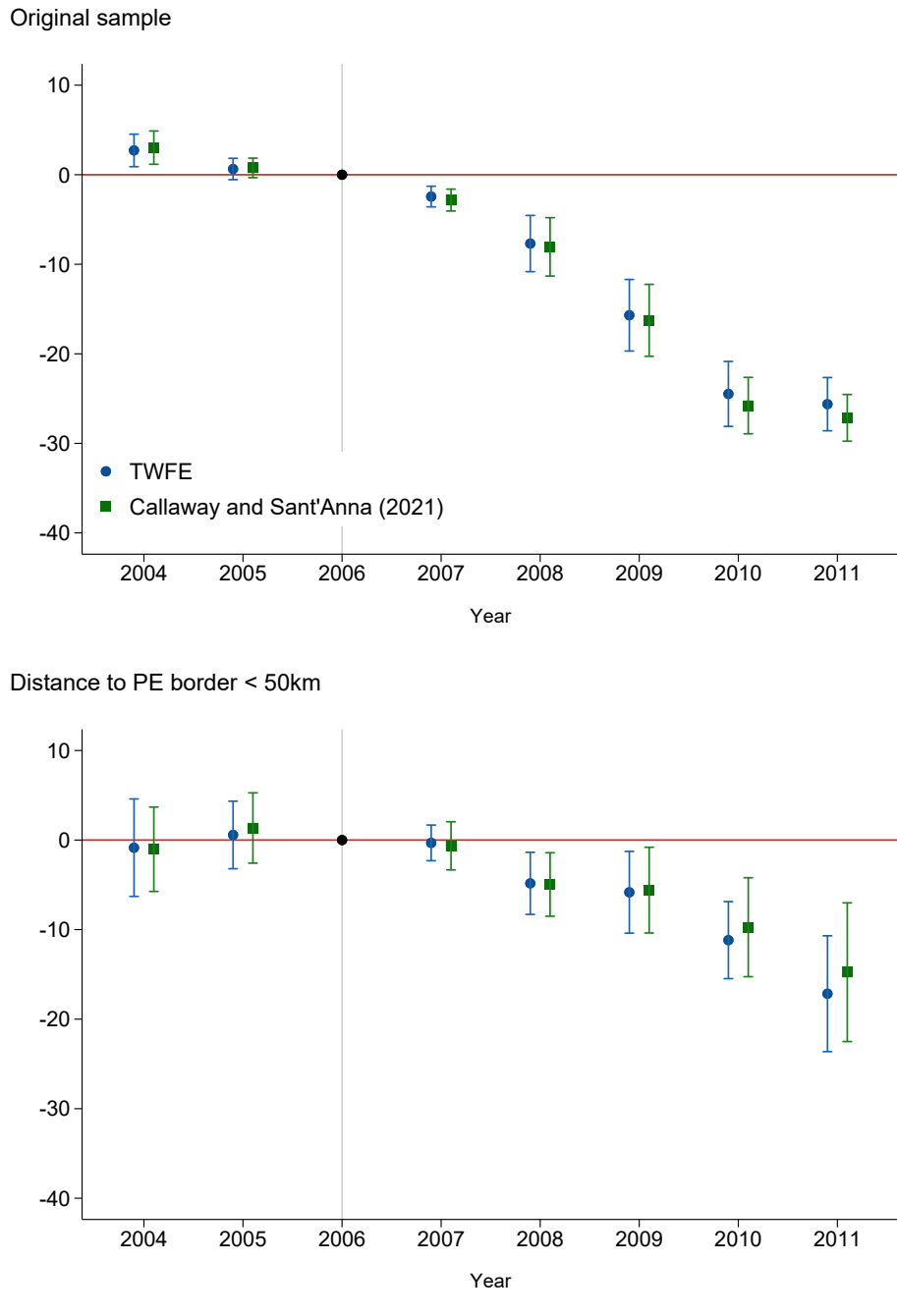


Figure 2: Dynamic Effects on Homicides

the documented effect on homicide rates.

First, we explore the effect that the PPV had on homicides of young males and on homicides that occurred in public places. Columns (1)-(3) of Table 2 show that the relative decrease in homicides seems to be much concentrated on young males and homicides occurring outside of the victims' homes. Specifically, more than 80% of the estimated effect on homicides comes from males aged 15-39 and from homicides occurring

on the streets. These results suggest that the PPV effect is unlikely related to reductions in domestic disputes; reducing conflicts associated with street crime constitutes a more likely mechanism.

Table 2: Potential Mechanisms

	Homicide rate decomposition			Policing intensity, drugs and guns availability			Placebo and spillovers	
	All homicides (1)	Young male homicides (2)	Outside of home homicides (3)	Deaths by police intervention (4)	Fraction of suicides by firearm (5)	Drug overdose deaths (6)	Suicides (7)	Traffic accident deaths (8)
TWFE Model	-16.301*** [1.855]	-13.355*** [1.563]	-14.171*** [1.726]	-0.042 [0.046]	-0.018*** [0.004]	-0.001 [0.032]	-0.209 [0.133]	-0.038 [0.030]
Callaway and Sant'Anna (2021)	-16.014*** [1.525]	-12.986*** [1.252]	-13.460*** [1.450]	-0.078 [0.079]	-0.022*** [0.006]	-0.089 [0.068]	0.114 [0.151]	-0.013 [0.023]
Observations	14,288	14,288	14,288	14,288	14,288	14,288	14,288	14,288

Notes: All regressions are weighted by the municipality population in 2000. In brackets, standard errors are clustered at the state level. Callaway and Sant'Anna (2021) estimator is implemented through the *csdid* Stata command. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

Columns (4)-(6) of Table 2 explore the effect on outcomes associated with policing intensity, illegal market activity, and firearms availability. While no significant effects are observed on deaths by police intervention or drug overdose, we show that the fraction of suicides by firearms, a proxy for local gun availability, experienced a relative decrease of 2 pp. While an explicit formal bonus for police officers who seized illegal firearms took place in 2017 (Barros et al., 2022), our results suggest that in the initial years of the PPV program, a reduction in firearm availability was also an important channel through which homicides were reduced (Gius, 2020). Additionally, columns (7)-(8) show that the program did not affect the suicide or traffic accident death rates.

For completeness, Figure 3 shows the dynamic effects on outcomes of Table 2. Results corroborate the static estimations and suggest that a lower gun availability and a reduction in disputes that occur on the streets and among young males are indeed the most likely channels behind the PPV program's effect on homicides.

5 Conclusion

Evidence on the causal link between public security reforms and crime is limited. In this paper, we use a deep reform implemented in 2007 in the Brazilian state of Pernambuco to fill this gap. First, we show that Pernambuco experienced a robust relative decrease

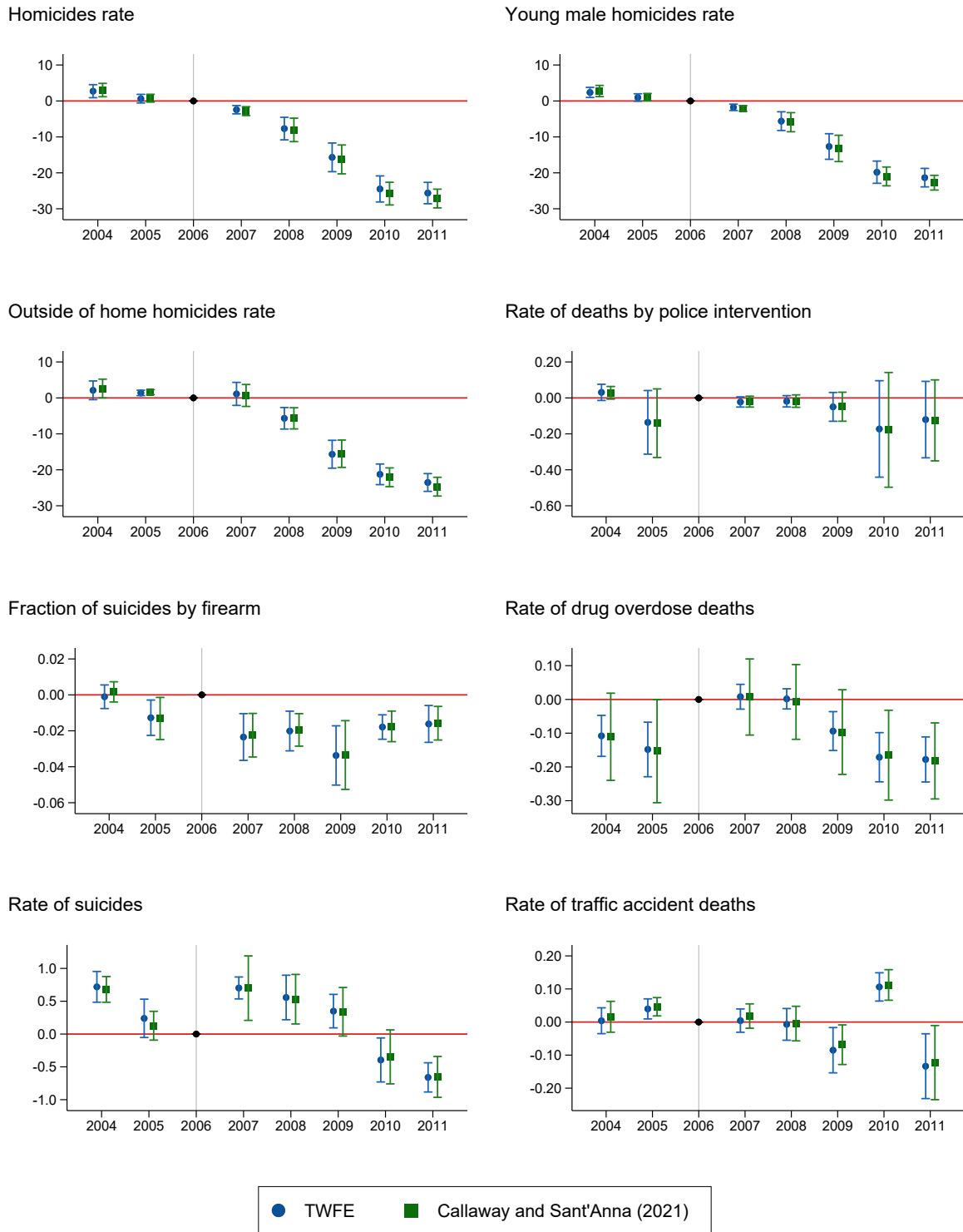


Figure 3: Dynamic Effects on Potential Mechanisms

in the homicide rate following the program implementation. Then, we explore potential mechanisms that might be behind the reduction in homicides. Despite not being able to pin down an exact mechanism, we show that more than 80% of the overall effect came

from a relative reduction in homicides of young males that occurred outside the victim's residence. We also present evidence that the program effect might be closely associated with a reduction in firearms availability.

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Online Appendix for “The Role of Public Security Reforms on Violent Crime Dynamics”

Danilo Souza and Mateus Maciel¹

A Additional Tables and Figures

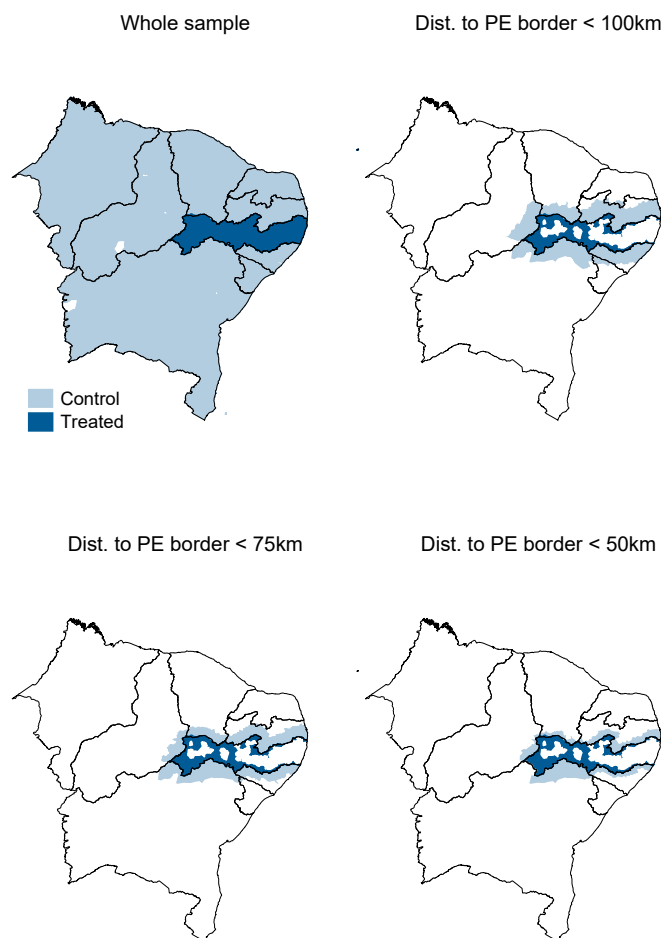


Figure A.1: Treated and control groups

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