

The Effect of Police on Crime: Evidence from the 2014 World Cup in São Paulo

ABSTRACT I estimate the causal impact of police on crime, based on evidence from Brazil. To tackle reverse causality, I consider as a natural experiment the creation of a special police unit to intensify surveillance around a few tournament-related locations in São Paulo during the 2014 FIFA World Cup. To better isolate the specific impact of policing, I account for different ways in which the tournament may affect crime, namely, via fan concentration and voluntary incapacitation. Difference-in-differences estimates reveal that increased police presence leads to significant reductions in criminal activity. My estimate of the crime-police elasticity (-0.37) is close to figures obtained in previous studies, suggesting that this effect is robust across settings and remains stable even in a high-crime, weak-institutions context, as in the case of Brazil.

JEL Codes: O10, K42

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Theory predicts that increased police presence leads to fewer crimes through deterrence (whereby more policing implies higher chances of being caught; see Becker, 1968) and incapacitation (whereby more policing results in more offenders behind bars, leaving fewer on the streets; see Ehrlich, 1981). While theory is rather straightforward, empirically estimating the causal effect of police on crime has proved to be challenging because of a major endogeneity issue. While police presence is expected to negatively affect crime, crime has a positive impact on police presence, as more dangerous neighborhoods are usually allocated more officers.

Mainstream papers in this field address the endogeneity issue by exploiting natural experiments whereby an event triggers a shock in policing that is exogenous with respect to the underlying evolution of crime. The literature typically

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considers terrorism-related triggering events. Di Tella and Schargrodsky (2004) examine a terrorist attack on an important Jewish center in Buenos Aires in 1994 that led to increased police protection around selected targets. Using a difference-in-differences (DID) estimator, the authors calculate an elasticity of crime to police presence of -0.33 . Klick and Tabarrok (2005) exploit the exogenous shocks in police presence in Washington, D.C., following changes in the terror alert level, and estimate a -0.30 elasticity. Draca, Machin, and Witt (2011) also get a -0.30 to -0.40 elasticity measure studying the policing adjustments in the aftermath of London's 2005 terror attacks.

A problematic aspect in this line of studies is that they generally fail to acknowledge and control for correlated shocks. In other words, the event that triggers the policing change may simultaneously affect criminal activity in other ways. For instance, a heightened terror threat level could make potential victims and criminals fear for their own safety, so that they avoid areas or times in which there is an increased perceived risk of being harmed. Absent a framework to consider correlated shocks, the estimated coefficients may ultimately be biased, as they reflect the overall impact of the triggering event on crime, rather than the specific effect of increased policing.

Ideally, one would examine a policing change whose triggering event is unlikely to affect crime through channels other than the change in policing. This is the case studied by Poutvaara and Priks (2009). The authors find a substantial negative impact of police on hooligan violence by analyzing the sudden reallocation of the hooliganism-fighting police unit following non-hooligan-related events.

An alternative way to deal with the correlated-shock issue is to account as much as possible for the complex relationship between the triggering event and crime. This paper follows that approach. This research contributes to the literature by considering an innovative natural experiment and accounting for different ways in which the triggering event may affect crime, to better isolate the specific impact of policing. I exploit the creation of a special police unit to monitor specific tournament-related targets in the city of São Paulo during the 2014 Fédération Internationale de Football Association (FIFA) World Cup. My crucial assumption is that the selective (across neighborhoods) police increase is exogenous with respect to the underlying evolution of crime, thus representing a natural experiment that breaks the endogeneity circle.

This study provides a good basis for comparing results with previous papers as it does not consider a terrorism-related event. The effect on crime of an exogenous police increase should not depend on the kind of event that triggered it. Thus, while moderate dissimilarities in estimated effects can be

explained by reason of the different settings, large differences may raise some concerns.

In addition, this paper contributes to the literature by evaluating for the first time the policing-crime relationship in the Brazilian context. Owing to its elevated delinquency and police brutality rates, the country provides an especially interesting ground to study whether and to what extent increased police presence is an effective tool in a high-crime, weak-institutions context. While São Paulo is an especially virtuous case within Brazil as far as homicide rates are concerned (less than 25 percent the national average in 2017), the incidence of police brutality and other offenses remains aligned with the national averages.¹ In addition, because São Paulo accounts for almost 6 percent of the nation's population, data about the city can provide some perspective on criminal behavior in Brazil at large.

This research also contributes to the literature by exploiting a nonpublic, granular crime database obtained from São Paulo's public authorities, which has never before been used in this stream of studies.

I look at reported offenses that were committed in the city of São Paulo in 2006–14 and aggregate data daily and by police district. Daily data are less subject to endogeneity problems from crime to police, and they allow for a more in-depth control of seasonality issues. I focus on the total number of crimes, robberies, and thefts. I link these data to information on the World Cup and the deployment of the special police unit.

A DID analysis to compare criminal outcomes in districts with increased protection relative to other districts would likely provide an estimate of the overall effect of the World Cup on crime. To better isolate the specific impact of policing, I develop a framework to account for different ways in which the tournament likely affects crime. Drawing on Marie (2016), I identify three: (1) an increased police presence reduces crime; (2) a higher concentration positively affects the incidence of occurrences; and (3) the voluntary incapacitation of a substantial number of individuals who are watching the games reduces criminal interaction. I adopt a research strategy that allows me to remove the voluntary incapacitation and concentration effects, so that the DID estimates better capture the specific impact of police on crime. A limitation of this study, however, is that I cannot rule out the possibility that further correlated shocks may be occurring on top of concentration and voluntary incapacitation.

1. Anuário Brasileiro de Segurança Pública (www.forumseguranca.org.br/publicacoes/anuario-brasileiro-de-seguranca-publica-2018). Accessed March 4, 2019.

My results show that the police have a negative and significant impact on crime: the total number of offenses per day decreases by 18 percent in the neighborhoods that receive extra protection, while the number of robberies drops by 34 percent. Results show that this effect is rather local, as adjacent districts do not experience crime reductions. In addition, I find no evidence that offenders from the treated districts are displacing their illegal activities to surrounding areas, with the exception of thieves, who seem to be spatially diverting offenses to some extent. Additional tests suggest that there is no significant temporal displacement, so that the observed crime reductions actually represent prevented—rather than temporally displaced—offenses. To enhance confidence that I am actually capturing the causal effect of police on crime, I calculate, as placebo treatments, the DID estimates for the period before the treatment period in 2014 and for the periods corresponding to the treatment period in previous years. Results validate my exercise in that they reveal no special crime dynamics affecting the treated districts in these pseudo-treatment periods.

My results are best interpreted as exclusively capturing deterrence (rather than incapacitation). In fact, the natural experiment considered in this paper (based on more police on the streets) involves the deployment of a clear deterrence strategy. Moreover, the policy period was short (two months), and it is unlikely that increased incarceration could be made effective and produce a significant impact so quickly.

The remainder of this paper is organized as follows. The next section describes the World Cup–related police increase in São Paulo. After that, I provide a conceptual framework for understanding the relationship between the World Cup and crime. I then introduce the data and describe my empirical strategy, followed by a discussion of my baseline results, as well as several sensitivity and robustness checks. The final section concludes.

The World Cup–Related Police Increase in São Paulo

The 2014 edition of the FIFA World Cup—the quadrennial world championship for men’s national football teams organized by FIFA—took place in Brazil on June 12 to July 13, 2014, and ended with Germany’s victory. Thirty-two national teams played a total of sixty-four games in twelve venues located in as many host cities across the country, including São Paulo.

The state of São Paulo created a special police unit, the *Comando de Policiamento Copa* (CPCopa), to provide additional surveillance in the city

during the World Cup. The unit had three battalions comprising a total of 4,265 policemen, which inflated the police presence in the city by about 25 percent. The CPCopa was not distributed evenly around the city. Rather, it was exclusively assigned to specific spots located in eleven of São Paulo's ninety-three police districts. I refer to these eleven areas as target districts. The monitored spots were the following:

—*World Cup–related venues*: There were three locations for official celebrations and maxi-screens for public viewing of the games. The most popular by far of these venues was the FIFA Fanfest, which could accommodate up to 40,000 viewers. The FIFA Fanfest was located in the city center (*Vale do Anhangabaú*).

—*Public transport and tourist spots*: The CPCopa monitored the main tourist attractions (such as museums, theaters, and high streets) and some crucial transportation spots located in six districts across the city.

—*FIFA hotels*: The eight hotels that hosted the teams and FIFA representatives were located in three districts.

—*Training centers*: FIFA had preselected four training centers (located in three districts) as suitable for guest teams within the city of São Paulo. However, only one of them was chosen as a base camp: the U.S. squad used the São Paulo training center as its preparation site. This site is located in the northern part of the city (*Barra Funda*).

—*The stadium*: The São Paulo Arena was built between 2011 and 2014 to host the World Cup matches in São Paulo. It is located in a peripheral area in the northeastern part of the city (*Zona Leste*), nearly nineteen kilometers from the center. It can accommodate about 63,000 viewers. The CPCopa was responsible for ensuring safety outside the stadium and in the surrounding area, while a private service was employed by FIFA for security inside the arena.

In the deployment of the CPCopa, care was taken to maintain the regular levels of police presence in the rest of the city. To this end, the government hired more than 2,000 new recruits and managed the holidays of the existing officers so that the CPCopa was actually made up of extra (rather than reallocated) force. The unit was active from May 20, 2014 (twenty-four days before the World Cup opening) until July 20, 2014 (one week after the end of the tournament)—but not all targets were monitored throughout the whole period. I refer to this time window as the CPCopa period. Following the dissolution of the CPCopa, the officers were reallocated across the whole state of São Paulo.

For the purposes of this analysis, it is important to describe some characteristics of the surveillance in the areas of the stadium and the São Paulo

FIGURE 1. Timeline of the World Cup and the CPCopa Program

training center. The special police unit supervised the area proximate to the São Paulo Arena twenty-four hours a day every day during the CPCopa period. On days in which a game was played at this stadium, 610 CPCopa police officers, divided into three daily shifts, watched over the area. On other days, ninety police officers (in three daily shifts) were employed. The training center did not receive increased policing throughout the CPCopa period but only over a shorter period. The U.S. team arrived in São Paulo on June 9, 2014, and was eliminated by Belgium in a round-of-sixteen game on July 1, 2014. An average of twenty-five CPCopa policemen (divided into two daily shifts) watched over the training center twenty-four hours a day during the period from June 8 to July 2, 2014. Figure 1 illustrates the timeline of the CPCopa activity.

Conceptual Framework: The Relationship between the World Cup and Crime

The World Cup is likely to affect crime in ways other than just through increased police presence in target districts. Marie (2016) studied the impact of football matches on crime patterns at the borough level, examining nine London teams. He introduces a framework to analyze the multiple effects of sporting events on crime and develops some simple assumptions to disentangle and estimate them. According to Marie's framework, large sporting events can be expected to affect local crime in three ways: (1) the concentration of hostile fans increases the incidence of violent offenses; (2) the displacement of police personnel sent to monitor the event positively affects crime in the areas from which the police were displaced; and (3) the voluntary incapacitation of a substantial number of individuals who are attending the event reduces criminal activity.

The police displacement effect does not apply to this case as the special unit was made up of extra forces. In the absence of a displacement effect, the expected impact on delinquency of the increased police presence through the CPCopa is negative. Concentration and voluntary incapacitation are relevant to the World Cup crime setting. I discuss each of these effects and their likely impact below.

Concentration

It is rather straightforward that a huge event such as the World Cup leads to concentration in the cities hosting the games. It was estimated that during the monthlong event, Brazil received about a million foreign visitors from 203 countries (the corresponding figure for June 2012 was 300,000), as well as about three million domestic tourists. The city of São Paulo alone received about 540,000 visitors, 220,000 of whom were foreigners.

Higher concentration increases the likelihood of interactions between potential victims and offenders and may negatively affect the chance of being caught (Kelly, 2000). Therefore, concentration is expected to have a positive effect on criminal activity. This outcome is supported by empirical results. For instance, Campaniello (2013) studied the overall effect of increased tourism on crime. She exploits the 1990 FIFA World Cup as a source of exogenous variation in the level of attractiveness of different Italian provinces and finds that hosting such an event leads to a significant increase in property crimes.

Voluntary Incapacitation

The World Cup games are one of the most followed sporting events in the world. Viewership is made up not only of stadium-goers (54,000 per match, on average, in 2014) but also (mostly) of people who watch the match on television or online. FIFA estimates that the 2014 competition reached 3.2 billion in-home viewers worldwide—a little short of half the world population.² The voluntary incapacitation effect has to do with the fact that while so many people are busy watching the games, the potential for criminal interaction drops.

The term *incapacitation* has traditionally been used in the crime literature to express that those who are incarcerated cannot commit offenses (for instance,

2. FIFA (Fédération Internationale de Football Association), “2014 FIFA World Cup™ Reached 3.2 Billion Viewers, One Billion Watched Final,” press release, December 16, 2015, (www.fifa.com/worldcup/news/y=2015/m=12/news=2014-fifa-world-cuptm-reached-3-2-billion-viewers-one-billion-watched—2745519.html).

Ehrlich, 1981). More recently, some studies (for instance, Dahl and Della Vigna, 2009) have introduced the concept of voluntary incapacitation, whereby potential offenders and victims voluntarily engage in some activities instead of alternative occupations that would more likely lead to crime. The expected effect of World Cup games on crime through voluntary incapacitation is negative. The literature mostly emphasizes the role of voluntary incapacitation of potential criminals. However, there can also be a parallel effect for potential victims, who may become more or less susceptible to attacks while they engage in a certain activity with respect to their alternative occupation. Although it is often hard to distinguish between the impacts on the two sides of criminal interaction, the interpretation of results and the policy implications remain essentially unchanged.

Studies have empirically proved the negative impact on crime of the voluntary incapacitation associated with numerous activities, including going to a movie (Dahl and Della Vigna, 2009), playing video games (Cunningham, Engelstätter, and Ward, 2016), and watching television (Chong and Yañez-Pagans, 2017). Copus and Laqueur (2019) find substantial reductions in Chicago crime rates during the hours in which important sporting events are broadcast on television.

To sum up, the World Cup is expected to affect local crime rates through three channels: police increase, voluntary incapacitation, and concentration. In terms of the expected direction of the impact of each mechanism, police increase and voluntary incapacitation should decrease crime, while concentration should increase it.

Data and Empirical Strategy

I obtained crime data from the Public Safety Department of the state of São Paulo (*Secretaria de Estado da Segurança Pública do Governo de São Paulo*, SSP). The data portray the criminal incidents that occurred in the city of São Paulo between January 1, 2006, and December 31, 2014, for which the police completed a case report. Data cover common offenses, which I aggregated into six broader crime categories: murder (committed and attempted), robbery, rape, assault, theft, and drug-related offenses. All records provide information on the date of the occurrence and the police district where it took place.³

3. When requesting data from the SSP, I asked for the exact location of the occurrences, but it was not possible to obtain this level of detail.

TABLE 1 . Descriptive Statistics: Daily Crime Data by District, 2006–14

| <i>Statistic</i> | <i>Total crime</i> | <i>Robbery</i> | <i>Theft</i> | <i>Assault</i> | <i>Murder</i> | <i>Rape</i> | <i>Drugs</i> |
|-----------------------|--------------------|----------------|--------------|----------------|---------------|-------------|--------------|
| Mean | 11.1 | 4.5 | 5.2 | 1.1 | 0.1 | 0.1 | 0.2 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Zero observations (%) | 0.2 | 2.8 | 5.3 | 37.6 | 92.4 | 94.5 | 86.2 |
| Maximum | 211 | 132 | 147 | 15 | 5 | 5 | 10 |
| Variance | 37.2 | 10.0 | 15.4 | 1.5 | 0.1 | 0.1 | 0.2 |
| Skewness | 1.7 | 1.4 | 2.6 | 1.4 | 3.9 | 4.5 | 3.3 |
| No. observations | 305,505 | 305,505 | 305,505 | 305,505 | 305,505 | 305,505 | 305,505 |

Notes: Summary statistics are generated from the crimes reported daily in each of São Paulo's ninety-three districts over the period 2006–14. Murder includes committed and attempted murders. An observation is a daylong period for one of the considered districts in São Paulo over the period 2006–14, excluding days on which a 2014 FIFA World Cup game was played.

I organized crime records in a panel by day and district. Table 1 contains some descriptive statistics about the data. As is often the case with high-frequency criminal occurrences, the distributions are positively skewed.

Research Design

As explained earlier, the CPCopa operated over a longer period than the tournament itself and was exclusively assigned to the monitoring of specific World Cup–related spots, located in eleven target districts. For the sake of clarity, my conceptual starting point is the definition of the treatment group as including all target districts and the treatment period as the whole period over which the CPCopa was active. This approach would, at best, provide an estimate of the overall effect of the World Cup on crime—rather than the specific impact of increased policing. I thus refine the treatment group and period definitions to build a design that makes it possible to isolate the effect of interest. To this end, I discuss the temporal and geographic reach of the voluntary incapacitation and concentration effects.

Voluntary incapacitation negatively affects crime. If this effect were not filtered out, the impact of policing would be overestimated. I expect voluntary incapacitation to be in play only during matches and throughout the city, as most people watch the game on television (or online). Then, I can easily remove this mechanism by excluding from the sample the twenty-five days on which 2014 World Cup matches were played. There remain thirty-seven days on which no tournament games were played and the CPCopa was operational.

Concentration is expected to positively affect crime. If this factor were not cleared out, the impact of policing would be underestimated. Tourists

may arrive before the official beginning of the tournament and leave after its conclusion. Also, although concentration is likely to be higher around tourist and World Cup–related spots, it is not obvious how exactly to draw a line. Luckily, I can rely on the CPCopa setup itself to get reasonable approximations. In fact, the policymaker arguably studied which areas were likely to be affected the most by the event, and over which period, and arranged the CPCopa’s setup accordingly. I can soundly expect the concentration effect to be more relevant in target districts and over the CPCopa period.

Filtering out this effect requires some consideration of the likely timing of the increased concentration across different types of CPCopa target spots. I consider, for each kind of target, the likelihood of attracting larger than normal crowds on nongame days (which are the only ones I use in my analysis) during the CPCopa period.

—World Cup venues, public transport, tourist spots, and FIFA hotels are likely to attract tourists and curious bystanders even on nongame days.

—The São Paulo Arena obviously attracted big crowds on days on which a game was played at that venue (six matches took place in São Paulo, including the opening one). However, the location of the stadium makes it unlikely that concentration would be higher than normal on other days. The arena is located in a peripheral region, and there are no significant tourist attractions in the vicinity. In fact, the choice of the stadium’s location was mainly driven by the policymaker’s desire to stimulate economic activity in a highly populated and underdeveloped area of the city (Accenture, 2011). It is thus reasonable to expect that the concentration effect did not apply to the stadium area on nongame days.

—The São Paulo training center is located in a region that does not offer tourist attractions and is commonly perceived as dangerous. The squad bus brought the players directly into the center, where only accredited journalists were allowed. Thus the area was unlikely to attract larger than normal crowds.

I can remove the concentration effect by dropping from the sample all target districts but the stadium and training center. This way, the treatment group is made up of only two districts, while the control group includes the eighty-two nontarget districts.

To sum up, starting from a naïve delineation of the treatment group and period as including, respectively, all target districts and the whole CPCopa period, I remove the voluntary incapacitation effect by restricting the treatment period to include only those days during the CPCopa period when no World Cup matches were played; and I remove the concentration effect by restricting the treatment group to include only those target districts where

TABLE 2 . Expected Effects of the World Cup on Local Crime

| Expected effect on crime | Target districts | | | | | |
|--------------------------|---------------------|---------|-----------------------------|---------|-------|---------|
| | Nontarget districts | | Stadium and training center | | Other | |
| | Game | No game | Game | No game | Game | No game |
| Police increase | — | — | ↓ | ↓ | ↓ | ↓ |
| Concentration | — | — | ↑ | — | ↑ | ↑ |
| Voluntary incapacitation | ↓ | — | ↓ | — | ↓ | — |

Notes: Upward- and downward-pointing arrows represent, respectively, a positive and negative effect from each of the three mechanisms—police increase, concentration, and voluntary incapacitation—through which crime in target or nontarget districts may be affected on game and nongame days during the World Cup. Dashes mean that no effect is expected.

no concentration effect is expected on nongame days. Table 2 graphically summarizes my research design and highlights the relevant groups for comparison.

Empirical Model

My purpose is to estimate the causal effect of increased police presence on crime. I start from a panel of daily data on criminal occurrences in each of the ninety-three districts in the city of São Paulo over the period of January 1, 2013, to December 31, 2014, which I combine with information on the CPCopa deployment and World Cup matches.

According to the research design set out above, I drop from the sample all observations for the twenty-five days on which 2014 World Cup games were played, as well as observations for all target districts but the stadium and the São Paulo training center districts. Using N_1 to denote the number of treatment units and N_0 to denote the number of control units, I have $N_1 = 2$ (the stadium and training center districts) and $N_0 = 82$ (all nontarget districts).

I exploit the selective (across districts) and exogenous variation in police presence to compare the crime change in districts that received increased protection with respect to districts that did not. My difference-in-differences (DID) approach is summarized in the following model:

$$\begin{aligned}
 (1) \quad Crime_{s,t} = & \beta_0 + \beta_1 (CPCopa_t * Stadium_s + CPCopaTC_t * TC_s) \\
 & + \beta_2 CPCopa_t + \beta_3 CPCopaTC_t + \beta_3 WC_t + \beta_5 ArenaSP_t \\
 & + Holiday_t + OnlineRob_t + Y_t + M_t + MDay_t + WDay_t \\
 & + \theta_s + \varepsilon_{s,t},
 \end{aligned}$$

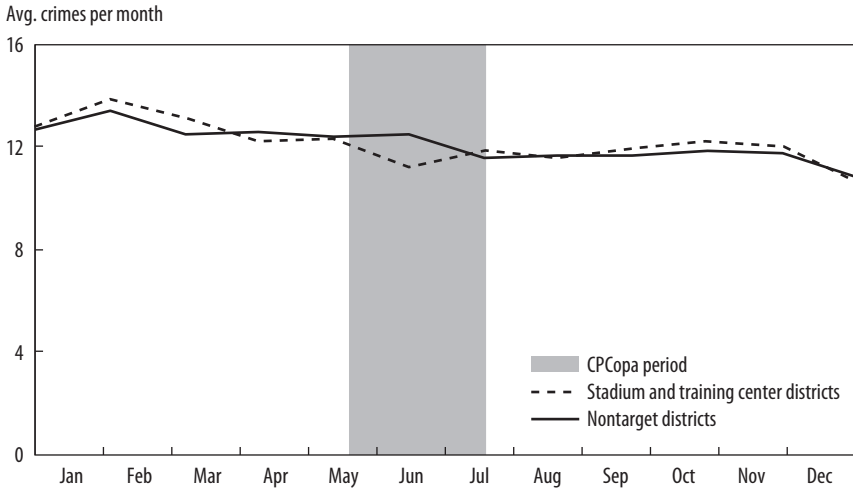
where the subscripts s and t denote district and date (from January 1, 2006, to December 31, 2014), respectively. $Crime_{s,t}$ is the natural logarithm of crimes reported in district s on date t . $CPCopa_t$ is a dummy variable equal to one on days when the special police unit was active (May 20, 2014 to July 20, 2014); $Stadium_s$ is a dummy variable equal to one for the stadium district; $CPCopaTC_t$ is a dummy variable equal to one on the days over which the CPCopa monitored the training center (June 8, 2014 to July 2, 2014); TC_s is a dummy variable equal to one for the training center district. β_1 is my coefficient of interest, capturing the specific evolution of criminal activity in the districts that received increased police protection as compared to those that did not. WC_t is a dummy variable equal to one during the days over which the 2014 World Cup took place (June 12, 2014, to July 13, 2014); $ArenaSP_t$ is a dummy variable that equals one on the days after the São Paulo Arena's inauguration (which occurred on May 18, 2014). $Holiday_t$ is a dummy variable equal to one on national holidays, and $OnlineRob_t$ is a dummy variable equal to one on days from December 1, 2013, onward, when it became possible to file robbery reports online. Finally, Y_t , M_t , $MDay_t$, and $WDay_t$ are fixed effects indicators for the year, month, day of the month, and day of the week, respectively, and θ_s captures district fixed effects. I include this rich set of fixed effects to account for common shocks in the evolution of crime across districts, as well as unobservable determinants of crime that are invariant at the district level.

I take the logarithmic transformation of the dependent variable because crime distributions are skewed (see table 1). My analysis focuses only on total crime, robberies, and thefts because these offenses display few instances of zero reported crimes (0.2 percent of cases for total crime, 2.8 percent for robbery and 5.3 percent for theft—see table 1), and zero-value observations are dropped when taking the log transformation.

The identification strategy relies on two key assumptions. The first is that the allocation of the CPCopa to the stadium and training center districts (the treatment group) is exogenous with respect to the underlying evolution of crime. Officers were placed in those areas in view of the World Cup rather than in response to a change in local criminal activity. In this sense, the CPCopa deployment provides a natural experiment that breaks the simultaneous determination of crime and police presence.

The second crucial assumption is that my research design effectively accounts for correlated shocks and thus allows me to isolate the specific impact of increased police presence on crime. I control for the impacts of voluntary incapacitation and concentration, which are recognized as material to big sporting events in previous literature (Copus and Laqueur, 2019; Marie

FIGURE 2 . Average Number of Crimes per Month: Stadium and Training Center Districts versus Nontarget Districts, 2014



Note: The averages are generated from the crimes reported monthly in the specified districts in 2014, excluding days on which a FIFA World Cup game was played.

2016). A limitation of this study, however, is that I cannot altogether rule out the possibility that there are further channels through which the World Cup affected crime dynamics. For instance, the tournament may have led to the installation of better street lights or clean-ups that increased the safety perception. The inauguration of the São Paulo Arena likely brought about this sort of improvement in the region, which is why I control for that in my estimations. Otherwise, I found no evidence that significant changes were made. Overall, this would constitute a problem for my estimation if the timing of these changes coincided with the CPCopa deployment.

Figure 2 graphically summarizes my DID approach. The dynamic of criminal activity in the stadium and training center districts is reasonably close to that in nontarget districts. However, there is some visual evidence that during the CPCopa period the former districts underwent a crime reduction that appears specific and more extreme with respect to the other districts. This paper argues that this deviation can be attributed to the increased police presence in the stadium and training center districts.

At the end of the treatment period, crime rates in target and nontarget districts converge again. It is not surprising that delinquency in the stadium

and training center areas would go back up after the police presence was lifted. On the other hand, one may wonder why crime decreases in the untreated districts. I can offer two explanations for that. First, the end of the CPCopa period stops the spatial displacement of some share of crime from treated to untreated districts. As shown below, I find evidence that thefts were indeed displaced during the treatment period. Second, crime tended to decline overall prior to 2014. The decrease may, in part, reflect this continuing trend. Indeed, even in treated districts, crime does not rise back to the pre-policy level after the CPCopa period.

A complication to my approach is the fact that I have only two treated districts. Standard inference methods used in DID models may not perform well in this case because they are based on the asymptotic approximation that both N_1 and N_0 are large. Conley and Taber (2011) show that if N_1 and the number of periods (T) are fixed, then the DID estimator is unbiased but inconsistent, as the estimated treatment coefficient tends in probability to the true parameter of interest plus a noise ($\hat{\beta}_1 \rightarrow \beta_1 + W$). In this case, using the standard inference methods would result in misleading standard errors. The authors develop an alternative approach to inference under the assumption that N_1 is small (finite), using asymptotic approximations that let N_0 grow large. The key idea is to use information on the residuals of the control group to estimate the distribution of the noise, W . This approach allows for the calculation of reliable confidence intervals for the treatment coefficient. In my baseline analysis, I use Conley and Taber's inference method to calculate confidence intervals for the coefficient of interest (β_1).

The Effect of Police on Crime

Panel A in table 3 reports the results from the estimation of equation 1 using my baseline dependent variables of interest (one for each row). Next to the DID point estimates for β_1 , I display the 95 percent confidence intervals obtained using Conley and Taber's inference method. In all regressions, I include fixed effects at the district level and further controls as displayed in equation 1.⁴

4. I drop February 29 in leap years. For completeness, I present estimation outcomes for total and specific crimes in levels in appendix table A2.

TABLE 3 . Effect of Police on Crime: Baseline Results

| <i>Treatment group and dependent variable</i> | $\hat{\beta}_1$ | <i>95% confidence interval</i> | | <i>Inference method</i> | <i>N</i> |
|---|-----------------|--------------------------------|--------------|-------------------------|----------|
| | | <i>Lower</i> | <i>Upper</i> | | |
| <i>A. Stadium and training center districts</i> | | | | | |
| ln(Total crime) | -0.18 | -0.32 | -0.06 | Conley-Taber | 273,402 |
| ln(Robbery) | -0.34 | -0.58 | -0.15 | Conley-Taber | 258,323 |
| ln(Theft) | -0.08 | -0.25 | 0.06 | Conley-Taber | 265,450 |
| <i>B. All target districts</i> | | | | | |
| ln(Total crime) | -0.08 | -0.16 | 0.01 | Clustered by district | 302,739 |
| ln(Robbery) | -0.18 | -0.29 | -0.07 | Clustered by district | 287,080 |
| ln(Theft) | 0.01 | -0.08 | 0.09 | Clustered by district | 294,678 |

Notes: An observation is a daylong period for one of the considered districts in São Paulo over the period 2006–14, excluding days on which a 2014 FIFA World Cup game was played. Panel A considers eighty-four districts (the stadium, training center, and nontarget districts). Panel B considers all ninety-three districts in São Paulo. The estimates are from ordinary least squares (OLS) regressions with district and time fixed effects. Time fixed effects include indicators for the year, month, day of the month, and day of the week. Other controls include a dummy variable for the CP Copa period, a dummy variable for the period over which the training center received extra monitoring, an indicator for the World Cup period, an indicator for the period after the inauguration of the São Paulo Arena, a holiday indicator, and a dummy variable for the period when it was possible to file robbery reports online.

The results show that increased police presence generates a significant reduction in total crime and robberies, while there is no detectable impact on thefts.⁵ The impact of increased police presence on total crime and robberies is quite large. The DID estimates show that the total number of crimes per day decreased by 18 percent and the number of robberies per day by 34 percent during the treatment period. During this period, nontarget districts had an average of 12.1 crimes a day, 5.3 of which were robberies. Thus a back-of-the-envelope calculation indicates that the increased police presence prevented 2.2 crimes per day, on average, including 1.8 robberies. Over the sixty-two days on which the CP Copa was active, about 136 crimes were averted, including 112 robberies. Interestingly, my analysis does not detect a significant effect on thefts, suggesting that the increased protection effectively deterred more manifest offenses, while it did not significantly prevent less visible ones.⁶

As mentioned, the literature acknowledges two channels through which police presence reduces crime: deterrence and incapacitation. Like Di Tella

5. Results do not change when I use fixed effects for the year, day of the year, and day of the week.

6. Robberies involve an interaction between the offender and the victim. In thefts, the victim typically is not present or does not notice the occurrence.

and Schargrodsky (2004), Klick and Tabarrok (2005), and Draca, Machin, and Witt (2011), I believe my results are best interpreted as exclusively capturing the police deterrence effect. The CPCopa policy involved the deployment of a clear deterrence strategy, and the treatment period was likely too short for the incapacitation effect to be triggered.

To calculate the elasticity of crime to police, I need to compute the percentage increase in police presence in the stadium and training center districts. Data on police presence per district are not available as they are considered sensitive and confidential. As an approximation, I assume that the 17,000 police officers active in São Paulo in 2014 were uniformly allocated across the ninety-three districts. Thus, before the CPCopa, each district had 183 officers. Assuming they work eight-hour shifts and an average of twenty-one days per month, there are approximately forty-three officers on patrol in each district at any given time—eighty-six in the stadium and training center districts jointly. The CPCopa force increased this number to 128 (thirty extra officers in the stadium district and twelve extra officers in the training center district at any given time). Thus the approximate percentage change in police presence in treated districts is 49 percent, yielding an elasticity of crime to police of -0.37 .

This number is remarkably close to previous estimates. Klick and Tabarrok (2005) calculate an elasticity of -0.3 in Washington, D.C.; Draca, Machin, and Witt (2011), 0.4 in London; and Di Tella and Schargrodsky (2004), -0.33 in Buenos Aires. The proximity of elasticity estimates suggests that the deterrent effect is rather robust across contexts: both in London (about one murder per 100,000 people in 2014) and in São Paulo (about 10 murders per 100,000 people in 2014), a 10 percent increase in police presence leads to a 3–4 percent reduction in crime. In addition—and quite reasonably—the impact of increased police presence seems not to depend on the nature of the event that triggered it: whether it was an act of terrorism or the World Cup, extra officers appeared to have the same effect on crime. Nonetheless, caution is in order regarding my calculation of the elasticity, as it is based on the strong assumption that, apart from the CPCopa officers, police officers in São Paulo are uniformly allocated across districts.

Panel B in table 3 shows the estimation results when all eleven target districts are included in the treatment group. In this case $N_1 = 11$, so I rely on regular cluster-robust standard errors. As explained, in all target districts but the stadium and training center ones, World Cup–related concentration is likely to affect criminal activity even on nongame days. Thus this approach does not allow netting out the impact of concentration. Based on

my conceptual framework, I expect this to set back the (negative) impact of increased police presence on crime.

Results are consistent with this prediction. Estimated coefficients for total crime and robbery are negative but smaller in absolute value, and only the latter is significant. The coefficient for theft becomes positive, though not precisely estimated.

Appendix table A1, panel A, shows the results from estimating equation 1 using data from all ninety-three districts while including a dummy variable for the interaction between untreated target districts (all target districts but the stadium and training center) and the CPCopa period. Panel B displays the results from estimating equation 1 using a sample that comprises all days in the 2006–14 period and including additional indicators for game days, days when a match was played in São Paulo, and a dummy variable for the interaction between the latter variable and the stadium district. Results are robust to these alternative specifications.

Robustness and Specification Checks

In this section, I present additional tests to assess the validity of my results, exploiting the spatial and temporal characteristics of the CPCopa operation.

SPATIAL ISSUES: DISPLACEMENT AND SPILLOVER. The CPCopa was assigned to monitor specific World Cup–related targets. Therefore, one would expect the effect of the police unit to be rather local and well delimited. My empirical approach uses all nontarget districts as control regions, implicitly assuming they were unaffected by the increased police presence in the treated districts during the CPCopa. If this was not the case, my DID estimates would be biased.

Increased police presence in the treated districts may have affected criminal activities in other areas in two opposite ways. On the one hand, the change in relative police presence across districts may have pushed criminals to displace their illegal activities from treated districts to other areas, thus causing crime to rise in those areas. On the other hand, the negative effect of police may have spilled over to other districts, causing crime to fall in those areas. Either way, it is reasonable to assume that the additional affected areas (if any) would be adjacent to the treated districts. I examine the two possible effects separately.

If spatial displacement was in play, my DID approach would overestimate the real impact of police on crime. This effect would translate into increased criminal activity in the untreated districts, resulting in a larger DID baseline

TABLE 4. Spatial Displacement and Spillover Effect

| <i>Analysis and dependent variable</i> | $\hat{\beta}_1$ | <i>95% confidence interval</i> | | <i>Inference method</i> | <i>N</i> |
|--|-----------------|--------------------------------|--------------|-------------------------|----------|
| | | <i>Lower</i> | <i>Upper</i> | | |
| <i>A. Spatial displacement</i> | | | | | |
| <i>ln(Total crime)</i> | -0.19 | -0.23 | -0.13 | Conley-Taber | 42,355 |
| <i>ln(Robbery)</i> | -0.33 | -0.42 | -0.21 | Conley-Taber | 40,720 |
| <i>ln(Theft)</i> | -0.12 | -0.18 | -0.08 | Conley-Taber | 41,786 |
| <i>B. Spillovers</i> | | | | | |
| <i>ln(Total crime)</i> | 0.04 | -0.05 | 0.13 | Clustered by district | 266,887 |
| <i>ln(Robbery)</i> | -0.02 | -0.18 | 0.14 | Clustered by district | 252,129 |
| <i>ln(Theft)</i> | 0.10 | 0.02 | 0.18 | Clustered by district | 259,023 |

Notes: An observation is a daylong period for one of the considered districts in São Paulo over the 2006–14 period, excluding days on which a 2014 FIFA World Cup game was played. Panel A includes thirteen districts: the stadium and training center districts (treatment group) and the adjacent districts (control group). Panel B includes all eighty-two nontarget districts: eleven districts that surround the stadium and training center districts (pseudo-treatment group) and the remaining seventy-one nontarget districts (pseudo-control group). The estimates are from OLS regressions with district and time fixed effects. Time fixed effects include indicators for the year, month, day of the month, and day of the week. Other controls include a dummy variable for the CPCopa period, a dummy variable for the period over which the training center received extra monitoring, an indicator for the World Cup period, an indicator for the period after the inauguration of the São Paulo Arena, a holiday indicator, and a dummy variable for the period when it was possible to file robbery reports online.

estimate (in absolute value). Following Draca, Machin, and Witt (2010), I test for spatial displacement by running a robustness check in which the control group is restricted to the set of nontarget districts that are adjacent to the stadium and training center districts. This set consists of eleven districts. If crime were diverted to these areas, I would obtain bigger DID estimates (in absolute value) with respect to my baseline results.

As shown in table 4, spatial displacement does not seem to be an issue as far as total crime and robberies are concerned. The police effect estimated using only neighboring districts as a control group is very close to that in my baseline analysis. However, there is evidence that some share of thefts was diverted from the districts receiving extra monitoring to the surrounding ones. The estimated coefficient is significant and about one-third larger, in absolute value, than the corresponding figure in my baseline results. This suggests that localized police presence displaces theft to relatively less monitored districts.

In contrast, if the negative effect of police spills over to other districts, causing crime to fall, then my DID approach would underestimate the real impact of police on crime. This effect would translate into lower criminal activity in the untreated districts, resulting in a smaller DID baseline estimate

(in absolute value). I analyze this issue by using equation 1 to compare crime outcomes in the eleven districts that surround the stadium and training center districts (the pseudo-treatment group) against the remaining seventy-one nontarget districts (the pseudo-control group). In this case, $N_1 = 11$, so I rely on regular, cluster-robust standard errors. If the police effect was spilling over to neighboring districts, then I would obtain negative and significant DID estimates.

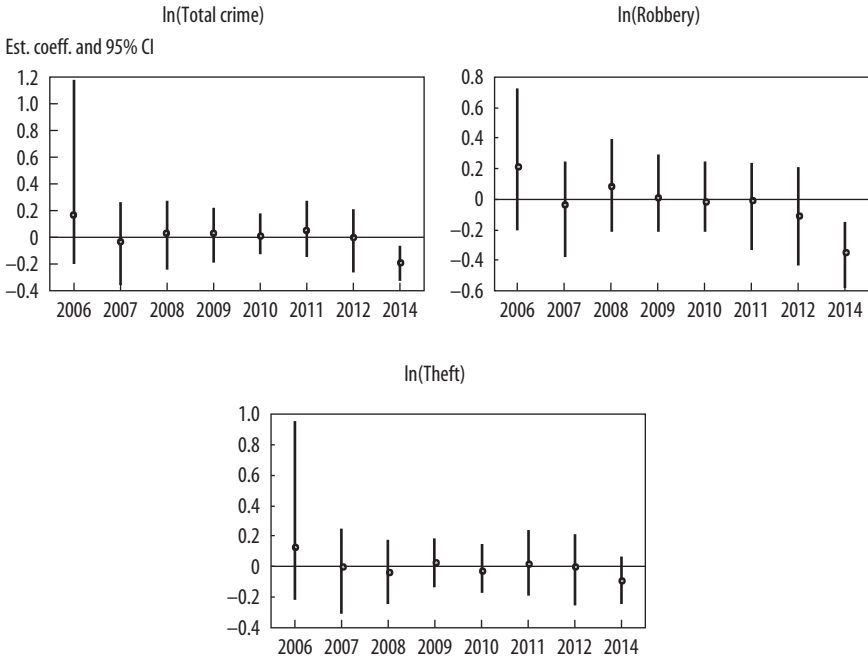
As displayed in table 4, spillover effects do not seem to be at play. Increased police presence in the stadium and training center districts has no significant impact on total crime and robberies in the neighboring districts. The positive and significant effect on thefts does not reflect a spillover dynamic (it would be negative in that case), but rather shows that some portion of thefts was diverted from the monitored districts to the surrounding ones, in line with results from the spatial displacement analysis.

TEMPORAL ISSUES: PLACEBOS AND DISPLACEMENT. My baseline results indicate that during the CPCopa period, criminal activity in the treated districts decreased significantly more than in nontarget ones. Although my research design is aimed at capturing the impact of increased police, I cannot explicitly rule out that the crime reduction is actually driven by a contemporaneous shift in some unobservable factors that I am not properly taking into account. In that case, my DID estimates would be capturing a spurious correlation. I perform some placebo checks to alleviate this concern, exploiting the temporal characteristics of the CPCopa program.

To begin with, I check whether the treatment group displays some special crime dynamics over the pseudo-treatment period in the years before 2014. To this end, I drop 2014 and, for each year y from 2006 to 2012, I run equation 1 as if the World Cup and CPCopa program had taken place in that year. I do not perform this test for 2013 because the FIFA Confederations Cup (a smaller football tournament acting as a rehearsal for the World Cup) took place in Brazil that year roughly over the pseudo-treatment period, and this may affect the results. I plot the pseudo-treatment coefficients with their 95 percent Conley-Taber confidence intervals in figure 3, together with the actual treatment coefficients for year 2014. The results confirm that the special dynamic in total crime and robbery affecting the treatment group is specific to 2014.

As a second placebo test, I exploit the discontinuity represented by the start of the CPCopa program. I drop the period May 20, 2014, to July 20, 2014 (the CPCopa period), and reestimate my baseline regression using,

FIGURE 3 . Pseudo-treatment and Actual Treatment Coefficients



Notes: For each dependent variable (total crime, robbery, and theft) and for each year y over the period 2006–12, the figures report the estimated pseudo-treatment coefficients and 95 percent confidence intervals from running equation 1 as if the World Cup and CP Copa program had taken place in year y . The figures also report the actual treatment coefficients and confidence intervals (for year 2014) derived from the baseline analysis. I do not perform the test for year 2013 because the FIFA Confederations Cup took place in Brazil that year roughly over the pseudo-treatment period. All confidence intervals are calculated using the Conley-Taber inference approach.

as pseudo-treatment, the period before the CPCopa deployment. I modify equation 1 as follows:

$$\begin{aligned}
 (2) \quad Crime_{s,t} = & \beta_0 + \beta_1 [bf_CPCopa_t * (Stadium_s + TC_s)] + \beta_2 bf_CPCopa_t \\
 & + \beta_3 ArenaSP_t + Holiday_t + OnlineRob_t + Y_t + M_t + MDay_t \\
 & + WDay + \theta_s + \epsilon_{st},
 \end{aligned}$$

where bf_CPCopa_t is a dummy variable equal to one for days in 2014 before the extra monitoring at the stadium started (January 1 to May 19).

This placebo test allows me to check whether the stadium and training center districts were exhibiting a different crime dynamic relative to nontarget

TABLE 5 . Crime Dynamics in the Treated Districts in the Periods Surrounding the CPCopa Program

| <i>Analysis and dependent variable</i> | $\hat{\beta}_1$ | <i>95% confidence interval</i> | | <i>Inference method</i> | <i>N</i> |
|---|-----------------|--------------------------------|--------------|-------------------------|----------|
| | | <i>Lower</i> | <i>Upper</i> | | |
| <i>A. Placebo: January 1 to May 19, 2014</i> | | | | | |
| <i>ln(Total crime)</i> | -0.16 | -0.35 | 0.02 | Conley-Taber | 270,295 |
| <i>ln(Robbery)</i> | -0.25 | -0.52 | 0.07 | Conley-Taber | 255,298 |
| <i>ln(Theft)</i> | -0.07 | -0.24 | 0.07 | Conley-Taber | 262,407 |
| <i>B. Temporal displacement: July 21 to December 31, 2014</i> | | | | | |
| <i>ln(Total crime)</i> | -0.18 | -0.41 | 0.04 | Conley-Taber | 270,295 |
| <i>ln(Robbery)</i> | -0.15 | -0.46 | 0.19 | Conley-Taber | 255,298 |
| <i>ln(Theft)</i> | -0.16 | -0.35 | -0.01 | Conley-Taber | 262,407 |

Notes: An observation is a daylong period for one of the considered districts in São Paulo over the 2006–14 period, excluding the CPCopa period. Eighty-four districts are considered (the stadium, training center, and nontarget districts). The estimates are from OLS regressions with district and time fixed effects. Time fixed effects include indicators for the year, month, day of the month, and day of the week. Other controls include a dummy variable for the pseudo-treatment period, an indicator for the period after the inauguration of the São Paulo Arena, a holiday indicator, and a dummy variable for the period when it was possible to file robbery reports online.

districts before the police increase. If so, I may be capturing a spurious correlation rather than a causal impact. The results are displayed in table 5. Using my preferred inference approach (Conley-Taber), the outcomes validate my exercise in that they reveal no special crime dynamic affecting the treatment group before the treatment period.

The increase in police presence may have pushed criminals to postpone their illegal activities, causing crime to rise in the treated districts after the end of the CPCopa period. To check for medium-term temporal displacement, I perform an exercise analogous to the one above using, as pseudo-treatment, the period after the CPCopa activity (July 21, 2014, to December 31, 2014). The results shown in table 5 suggest that there was no medium-term temporal displacement. This, in turn, implies that the crimes prevented by increased police presence represent averted—rather than displaced—offenses.

In my baseline analysis, I exclude from the sample all game days during the CPCopa period, in order to neutralize the voluntary incapacitation effect. As shown in appendix table A1, panel B, my baseline findings on the effect of police on crime are robust to an alternative specification where I include and control for World Cup game days. Still, if a short-term temporal displacement effect was in play, whereby criminals diverted their illegal activities to game days, then my results may be biased. Neglecting this effect would generate overly large estimates (in absolute value), as it would inflate the crime reduction in treated districts. To assess this concern, table 6 reports the

TABLE 6 . Average Number of Crimes on Game Days, Nongame Days, and All Other Days in 2014

| <i>Period</i> | <i>Nontarget districts (average)</i> | <i>Stadium district</i> | <i>Training center district</i> |
|-------------------------------|--|-------------------------|---------------------------------|
| 2014 excl. CPCopa period | 12.1 | 7.4 | 17.1 |
| CPCopa period excl. game days | 12.1 | 7.0 | 14.8 |
| Game days | 11.3 | 5.9 | 14.6 |

Notes: Means are generated from the crimes reported daily in the specified districts over the specified days. For nontarget and stadium districts, the CPCopa period is defined as May 20, 2014, to July 20, 2014. For the training center district, the CPCopa period is defined as June 8, 2014, to July 2, 2014. In the stadium district case, I exclude the six days on which a World Cup game was played at the São Paulo Arena, as criminal activity was exceptionally high (likely due to concentration).

average number of crimes on game days, nongame days during the CPCopa period, and the remaining days in 2014 in the stadium, training center, and nontarget districts. As expected for the voluntary incapacitation effect, the average number of crimes during game days was slightly lower than the rest of the CPCopa period. This descriptive evidence suggests that crime was not diverted to game days.

Conclusion

In this paper I provide novel evidence on the causal impact of police on crime in a high-crime, weak-institutions context such as Brazil. I use the natural experiment represented by the creation of a special policing unit to monitor a few tournament-related areas in São Paulo during the 2014 FIFA World Cup. I account for two important mechanisms through which the World Cup affects local crime in addition to increased policing. This allows me to better isolate the specific impact of interest. A limitation of my approach, however, is that I cannot rule out the possibility that further parallel mechanisms are in place.

The DID estimates show that a police increase leads to a significant reduction in criminal activity. The total number of offenses per day decreases by 18 percent, and the daily number of robberies drops by 34 percent. There is no evidence of spatial displacement (except for thefts) or temporal displacement, so that the measured crime reductions in treated districts represent prevented—rather than shifted—offenses. My results can best be interpreted as reflecting deterrence, whereby increased police presence reduces crime by making it more costly for potential offenders. I test the robustness of my

empirical strategy by performing several placebo regressions. Outcomes suggest that I am indeed capturing the causal impact of police on crime rather than some spurious correlation deriving from different crime dynamics in the treatment and control groups.

My estimate of the elasticity of crime to policing is remarkably close to estimates reported in previous studies, which look at different natural experiments in different contexts. This suggests that the deterrent effect of policing is robust across settings.

Appendix: Supplemental Tables

TABLE A 1. Effect of Police on Crime: Alternative Models

| <i>Model and dependent variable</i> | $\hat{\beta}_1$ | <i>95% confidence interval</i> | | <i>Inference method</i> | <i>N</i> |
|--|-----------------|--------------------------------|--------------|-------------------------|----------|
| | | <i>Lower</i> | <i>Upper</i> | | |
| <i>A. Controlling for untreated target districts</i> | | | | | |
| <i>ln(Total crime)</i> | -0.18 | -0.33 | -0.06 | Conley-Taber | 302,739 |
| <i>ln(Robbery)</i> | -0.34 | -0.58 | -0.15 | Conley-Taber | 287,080 |
| <i>ln(Theft)</i> | -0.08 | -0.29 | 0.06 | Conley-Taber | 294,678 |
| <i>B. Controlling for game days</i> | | | | | |
| <i>ln(Total crime)</i> | -0.23 | -0.29 | -0.18 | Conley-Taber | 275,499 |
| <i>ln(Robbery)</i> | -0.39 | -0.44 | -0.34 | Conley-Taber | 260,359 |
| <i>ln(Theft)</i> | -0.10 | -0.15 | -0.06 | Conley-Taber | 267,497 |

Notes: An observation is a daylong period for one of the considered districts in São Paulo over the considered period. Panel A considers all ninety-three districts in São Paulo in 2006–14, excluding days on which a 2014 FIFA World Cup game was played. Panel B considers eighty-four districts (the stadium, training center, and nontarget districts) over the period 2006–14. The estimates are from OLS regressions with district and time fixed effects. Time fixed effects include indicators for the year, month, day of the month, and day of the week. All regressions include a dummy variable for the CPCopa period, a dummy variable for the period over which the training center received extra monitoring, an indicator for the World Cup period, an indicator for the period after the inauguration of the São Paulo Arena, a holiday indicator, and a dummy variable for the period when it was possible to file robbery reports online. In addition, regressions in panel A include a dummy variable for the interaction between untreated target districts and the CPCopa period; regressions in panel B include indicators for game days, days when a match was played in São Paulo, and a dummy variable for the interaction between the latter variable and the stadium district.

TABLE A 2 . Effect of Police on Crime: Dependent Variable in Levels

| <i>Dependent variable</i> | $\hat{\beta}_1$ | <i>95% confidence interval</i> | | <i>Inference method</i> | <i>N</i> |
|---------------------------|-----------------|--------------------------------|--------------|-------------------------|----------|
| | | <i>Lower</i> | <i>Upper</i> | | |
| Total crime | -2.08 | -3.90 | -0.81 | Conley-Taber | 273,840 |
| Robbery | -1.43 | -2.86 | -0.39 | Conley-Taber | 273,840 |
| Assault | -0.61 | -1.35 | 0.14 | Conley-Taber | 273,840 |
| Rape | -0.14 | -0.35 | 0.10 | Conley-Taber | 273,840 |
| Murder | -0.04 | -0.11 | 0.00 | Conley-Taber | 273,840 |
| Theft | -0.02 | -0.07 | 0.05 | Conley-Taber | 273,840 |
| Drugs | 0.16 | -0.04 | 0.24 | Conley-Taber | 273,840 |

Notes: An observation is a daylong period for one of the considered districts in São Paulo over the period 2006–2014, excluding days on which a 2014 FIFA World Cup game was played. Eighty-four districts are considered (the stadium, training center, and nontarget ones). The estimates are from OLS regressions with district and time fixed effects. Time fixed effects include indicators for the year, month, day of the month, and day of the week. Other controls include a dummy variable for the CPCopa period, a dummy variable for the period over which the training center received extra monitoring, an indicator for the World Cup period, an indicator for the period after the inauguration of the São Paulo Arena, a holiday indicator, and a dummy variable for the period when it was possible to file robbery reports online. Murder includes committed and attempted murders.

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