The effect of police on crime:

Evidence from the 2014 World Cup in São Paulo

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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-institution context such as the Brazilian one.

Key-words: Police • Crime • Brazil • Natural experiment.
JEL codes: O10; K42.

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1 Introduction

Theory predicts that increased police presence leads to fewer crimes through deterrence (more policing implies higher chances of being caught for a criminal – Becker, 1968) and incapacitation (more policing results in more offenders behind bars and fewer on the streets – Ehrlich, 1981).

While theory is rather straightforward, empirically estimating the causal effect of police on crime has proven to be challenging because of a major endogeneity issue. While police presence is expected to negatively affect crime, crime positively impacts 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 considers terrorism-related triggering events. Di Tella and Schargrodsky (2004) examine a terrorist attack to an important Jewish center in Buenos Aires in 1994, which led to increased police protection around selected targets. Using a difference-in-differences 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., pursuant to changes in the terror alert level, and estimate a -0.3 elasticity. Draca, Machin and Witt (2011) also get to a -0.3 to -0.4 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 most of them fail to acknowledge and control for correlated shocks. In other words, the event which 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, and thus avoid areas or times in which there is an increased perceived risk of being harmed. Absent a framework to consider this (and any other) 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 of Poutvaara and Priks (2009). The authors find a negative a substantial 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 shocks issue is to account as much as possible for the complex relationship between the triggering event and crime. This paper follows such 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 terror-related event (which, as mentioned, was the standard in previous literature). 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 (to the best of my knowledge) the policing-crime relationship in the Brazilian context. Displaying elevated delinquency and police brutality rates, the country provides an especially interesting

ground to study whether and to which 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% the national average in 2017 – Anuário Brasileiro de Segurança Pública 2018), the incidence of police brutality and other offenses remains aligned to the national averages. In addition, hosting almost 6% of the nation's population, data about the city of São Paulo can provide some perspective about criminal behavior in Brazil at large.

This research also contributes to the literature by exploiting a non-public, granular crime database which I obtained from São Paulo's Public Authorities and 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 over years 2006-2014 and aggregate data daily and by police district ("district"). Daily data are less subject to endogeneity problems from crime to police, and 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 difference-in-differences analysis to compare criminal outcomes in districts with increased protection with respect 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 can identify three of them: (a) increased police presence reduces crime; (b) higher concentration positively affects the incidence of occurrences; and (c) the voluntary incapacitation of a substantial number of individuals who are watching the games reduces criminal interaction. I adopt a research strategy which allows me to remove the voluntary incapacitation and concentration effects, so that the difference-in-differences estimates better capture the specific impact of police on crime. A limitation of this study,

however, is that I cannot rule out that further correlated shocks may be at place on top of concentration and voluntary incapacitation.

My results show that the police have a negative and significant impact on crime: the total number of offenses per day decreases by 18% in the neighborhoods that receive extra protection, while the number of robberies drops by 34%. 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 difference-in-differences estimates for the period before the policy-on one in 2014 and for the periods corresponding to the policy-on one in previous years. Results validate my exercise in that they reveal no special crime dynamics affecting the treated districts in these pseudo-treatment periods.

I believe 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 start producing a significant impact so quickly.

The remainder of this paper is organized as follows. Section 2 describes the World Cup-related police increase in São Paulo. Section 3 provides a conceptual framework to understand the World Cup-crime relationship. I introduce the data and describe my empirical strategy in Section 4. Section 5 presents my baseline results as well as several sensitivity and robustness checks. Section 6 concludes.

2 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 from June 12th 2014 to July 13th 2014, and ended with Germany's victory. Thirty-two national teams played a total of 64 games in 12 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 on the occasion of the World Cup. The unit counted with three battalions for a total of 4,265 policemen, inflating the police presence in the city by about 25%. The CPCopa was not distributed evenly around the city. On the contrary, it was exclusively assigned to specific spots located in 11 out of São Paulo's 93 police districts, as shown in Table 1. I refer to these 11 areas as "target districts". The monitored spots comprised:

- Venues of World Cup-related events: the locations of official celebrations and maxi-screens for public views of the games. The most popular by far of these venues was the FIFA Fanfest, which could accommodate up to forty thousand viewers. The FIFA Fanfest was located in the city center (*Vale do Anhangabaú*).
- Public transport and tourist spots: the main tourist attractions in the city (such as museums, theaters and high streets) and some crucial transportation spots.
- FIFA hotels: the eight hotels where the teams and FIFA representatives were hosted.
- Training centers: FIFA had pre-selected four training centers as suitable for guest teams within the city of São Paulo. However, only one of them was chosen as a base camp: the US squad used as its preparation site the São Paulo training center, 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 region, in the north-eastern part of the city (*Zona Leste*) and nearly 19 km away from the center. It can accommodate about 63 thousands viewers. The CPCopa was responsible for ensuring safety outside the stadium and in the surrounding area – while a private service was employed by FIFA to grant security inside the Arena.

In the deployment of the CPCopa, caution was paid so that the regular levels of police presence would be maintained unchanged 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 re-allocated) force. The unit was active from May 20th 2014 (24 days before the World Cup opening) until July 20th 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 re-allocated 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 of the São Paulo training center ("training center"). The special police unit supervised the proximities of the São Paulo Arena 24 hours per day on each day during the CPCopa period. On days in which a game was played at this stadium, 610 CPCopa policemen divided into three daily shifts watched over the area. On other days, 90 policemen (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 US team arrived in São Paulo on June 9th 2014 and was eliminated by Belgium in a round-of-16 game on July 1st 2014. An average of 25 CPCopa policemen (divided into two daily shifts) watched over the training center 24 hours per day during the period June 8th to July 2nd 2014. Figure 1 describes

the timeline of the CPCopa activity, with special regard to the surveillance at the São Paulo Arena and training center.

3 Conceptual framework: the World Cup-crime relationship

The World Cup is likely to affect crime in other ways than just through increased police presence. Marie (2016) studies 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: (a) the concentration of hostile fans increases the incidence of violent offences; (b) the displacement of police personnel sent to monitor the event positively impacts crime in the areas from which the police were displaced; and (c) 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* force. Then, the expected impact on delinquency of the CPCopa is negative. Concentration and voluntary incapacitation are relevant to the World Cup-crime setting, though with some dissimilarities with respect to Marie's framework. 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 month-long event Brazil received about 1 million foreign visitors from 203 countries (the corresponding figure for June 2012 was 0.3 million), as well as about 3 million domestic tourists. The city of São Paulo alone received about 540 thousands visitors, 220 thousands of whom were foreigners.

Higher concentration increases the likelihood of interactions between potential victims and offenders and may negatively impact the chance of being caught (Kelly, 2000). As a consequence, everything else being equal, concentration is expected to have a positive effect on criminal activity. This outcome is supported by empirical results. For instance, Campaniello (2013) studies 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 thousands per match on average in 2014) but also (mostly) of people who watch the match on TV or online. FIFA estimates that the 2014 competition reached 3.2 billion in-home viewers worldwide – little short of half the world population. The voluntary incapacitation effect has to do with the fact that, while so many people are busy watching the games, the potential for criminal interactions drops.

The term "incapacitation" has traditionally been used in the crime literature to express that those who are incarcerated cannot commit offenses (for instance, Ehrlich, 1981). More recently, some studies have introduced the concept of "voluntary incapacitation", pursuant to which potential offenders and victims voluntarily engage in some activities, thus substituting away from 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 on potential criminals. However, it is important to remark that there can also be a parallel effect on 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 proven the negative impact on crime of the voluntary incapacitation associated with numerous activities, including movie attendance (Dahl and Della Vigna, 2009), video game playing (Cunningham, Engelstätter and Ward, 2016) and television availability (Chong and Yañez-Pagans, 2017). More closely related to the World Cup context, 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. Table 2 portrays the expected direction of the impact of each mechanism.

4 Data and empirical strategy

4.1 Data

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*). The data portray the criminal incidents which occurred in the city of São Paulo in the period January 1st 2006 to December 31st 2014, and for which the police completed a case report. Data cover common offenses which I aggregated into six broader crime type categories, namely: murder (committed and attempted), robbery, rape, assault, theft and drugs-related offenses. All records provide information on the date of the occurrence as well as on the police district where it took place.[1] I organized crime records in a panel by day and district. Table 3 contains some descriptive

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

statistics about the data. As it is often the case with high-frequency criminal occurrences, the distributions are positively skewed.

4.2 Research design

As explained in Section 2, The CPCopa operated over a period longer than the tournament itself and was exclusively assigned to the monitoring of specific World Cup-related spots, located in 11 target districts.

For the sake of clarity, my conceptual starting point is a definition of the treatment group as including all target districts. Let us also for now characterize the treatment period as comprising, for each target district, the whole period over which the CPCopa was active in monitoring it. This approach could 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 geographical reach of the voluntary incapacitation and concentration effects.

The voluntary incapacitation effect negatively affects crime. In case this effect was not filtered out, the impact of policing would be overestimated. I expect voluntary incapacitation to be at play only during matches and throughout the city, as most people watch the game on TV (or online). Then, I can easily remove this mechanism out by excluding from the sample those 25 days on which 2014 World Cup matches were played. There remain 37 days over which no tournament game was played and the CPCopa was operational.

Concentration is expected to positively affect crime. In case this factor was 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 policy-maker 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. Then, 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 considerations on the likely timing of the increased concentration across different types of CPCopa target spots. I consider, for each kind of target, its likelihood of attracting higher-than-normal crowds on non-game days (which are the only ones I will look at in my analysis), during the CPCopa period.

- Venues of World Cup-related events; public transport and tourist spots; FIFA hotels: These are likely to attract tourists and curious by-standers even on non-game days.
- The stadium: 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 its proximities. In fact, the choice of the stadium's location was mainly driven by the policy-maker's desire to stimulate economic activity in a highly-populated and under-developed area of the city. Then, it is reasonable to expect that the concentration effect did not apply to the stadium area on non-game days.
- The São Paulo training center: The center is located in a region that does not offer tourist attractions and is commonly perceived as dangerous. The squad bus led 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 ones. This way, the treatment group is made up of only two districts, while the control group includes the 82 non-target districts.

Summing 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 only include those days over the CPCopa period when no World Cup matches were played; and
- Remove the concentration effect: by restricting the treatment group to only include those target districts where no concentration effect is expected on non-game days.

Table 4 elaborates in more detail the contents of Table 2 to graphically summarize my research design and highlight the relevant groups for comparison.

4.3 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 93 districts in the city of São Paulo over the period January 1st 2013 to December 31st 2014, and combine them with information on the CPCopa deployment and World Cup matches.

According to the research design set out above, I drop from the sample observations for the 25 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 ones. 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 non-target 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 that in districts that did not. My difference-in-differences ("DID") approach is summarized in the following model:

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

Where the subscripts s and t denote district and date (from January 1st 2006 to December 31st 2014), respectively. $\text{Crime}_{s,t}$ is the natural logarithm of crimes reported in district s on date t. CPCopa_t is a dummy equal to one on days when the special police unit was active (May 20th 2014 to July 20th 2014); $Stadium_s$ is a dummy equal to one for the stadium district; CPCopaTC_t is a dummy equal to one during the days over which the CPCopa monitored the training center (June 8th 2014 to July 2nd 2014); TC_s is a dummy 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 equal to one during the days over which the 2014 World Cup took place (June 12th 2014 to July 13th 2014); $ArenaSP_t$ is a dummy that equals one on the days after the Arena São Paulo's inauguration (which occurred on May 18th 2014). Holiday_t is a dummy variable equal to one on holidays and OnlineRob_t is a dummy variable equal to one on days from December 1st 2013 onwards, when it became possible to file for 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 are 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 3). My analysis only focuses on total crime, robberies and thefts because these offenses display few instances of zero reported crimes (0.2% of cases for total crime, 2.8% for robbery and 5.3% for theft – see Table 3), and zero-value observations are dropped when taking the log-transformation.

The identification strategy relies on two key assumptions. The first one 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 were recognized as material to big sporting events by previous literature (Marie, 2016; Copus and Laqueur, 2019). A limitation of this study, however, is that I cannot altogether rule out 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 improvements in the region, which is why I control for that in my estimations. Other than this, 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 that of 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 non-target 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 and motivates that such 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 non-target districts converge back together. It is not surprising that delinquency in the stadium and training center areas would go back up after the policy-on period. On the other hand, one may wonder why crime decreases in the non-treated 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 non-treated districts. As will be shown (section 5.2.1), I find evidence that thefts are indeed displaced during the policy-on period. Secondly, there has been an overall declining trend in crime in the years until 2014. The decrease may in part reflect this tendency. Indeed, even in treated districts, after the CPCopa period crimes does not rise back to the pre-policy level.

A complication to my approach is represented by the fact that I only have 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. In particular, 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 ($\widehat{\beta_1} \rightarrow \beta_1 + W$). 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 the Conley and Taber's inference method to calculate confidence intervals for the coefficient of interest (β_1).

5 The effect of police on crime

5.1 Results

Panels (A) in Table 5 report 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% confidence intervals obtained by using the 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).[2,3]

The results show that increased police presence generates a significant reduction in total crime and robberies, while there is no detectable impact on thefts.[4]

The impact of increased police presence on total crime and robberies is quite large. The DID estimates indicate that the total number of crimes per day went down by 18% and the number of robberies per day dropped by 34% during the treatment period. During such period, in non-target districts there were on average 12.1 crimes a day, 5.3 of which were robberies. Then, a back-of-the-envelope calculation indicates that the increased police presence prevented on average 2.2 crimes per day, including 1.8 robberies. Over the 62-day period in which the CPCopa was active, about 136 crimes were averted, including 112 robberies.

Interestingly, my analysis does not detect a significant effect of thefts alongside robberies, suggesting that the increased protection effectively deterred more manifest offenses (in robberies there needs be an interaction between the offender and the victim) while it did not significantly prevent less visible ones (in thefts the victim typically is not present or does not notice the occurrence).

As mentioned, the literature acknowledges two channels through which police presence reduces crime: deterrence and incapacitation. Like Di Tella 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 involves the deployment of a clear deterrence strategy and the treatment period was likely too short for the incapacitation effect to be triggered.

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2 I drop February 29th in leap years.

3 For completeness, I present estimation outcomes for total and specific crimes in levels in Appendix Table A- 2.

4 Results do not change using fixed effects for the year, day of the year and day of the week.

To calculate the elasticity of crime with respect 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 thousand policemen active in São Paulo in 2014 were uniformly allocated across the 93 districts. Then, before the CPCopa, each district counted with 183 officers. Assuming they work eight-hour shifts and an average of 21 days per month, there are approximately 43 officers on patrol in each district at any given time – 86 in the stadium and training center districts jointly. The CPCopa force increased this number to 128 (30 extra officers in the stadium district and 12 extra officers in the training center district at any given time). Thus, the approximate percentage change in police presence in treated districts is 49%, yielding an elasticity of crime with respect 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) estimate it at -0.3 to -0.4 in London, and Di Tella and Schargrodsky (2004) calculate it at -0.33 for 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% increase in police presence leads to a 3-4% reduction in crime. In addition – and quite reasonably – the impact of increased police presence seems not to depend on the nature of the even that triggered it – whether it was a terrorist act or the World Cup, extra officers appear to have the same effect on crime. Nonetheless, caution is in order as regards my calculation of the elasticity, as it is based on the strong assumption that, apart from the CPCopa officers, policemen in São Paulo are uniformly allocated across districts.

Panel (B) in Table 5 shows the estimation results from using a definition of the treatment group which comprises all (eleven) target districts. Notice that in this case $N_1=11$, so I rely on

standard, 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 non-game days. Then, this approach is naïve because it 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.

I report in panel (A) in Appendix Table A- 1 the results from estimating Equation (1) using data from all 93 districts while including a dummy for the interaction between non-treated target districts (all target districts but the stadium and training center ones) and the CPCopa period. In panel (B) in Appendix Table A- 1 I display the results from estimating Equation (1) using a sample that comprises all days in the period 2006-2014 and including additional indicators for game days, days when a match was played in São Paulo and a dummy for the interaction between the latter variable and the stadium district. Results are robust to these alternative specifications.

5.2 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.

5.2.1 Spatial issues: displacement and spill-over

The CPCopa was assigned to the monitoring of specific World Cup-related targets. Thus, one would expect the effect of the police unit to be rather local and well-delimited as regards its spatial reach. My empirical approach, indeed, uses all non-target 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 impacted 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 regions, thus causing crime to rise in such regions. On the other hand, the negative effect of police may have spilled over to other districts, causing crime to fall in such regions. Either way, it is reasonable to assume that the affected areas (if any) would be the districts adjacent to the treated ones. I examine the two possible effects separately.

If spatial displacement was at play, my DID approach would overestimate the real impact of police on crime. In fact, this effect translates into increased criminal activity in the non-treated districts, resulting into a larger (in absolute value) DID baseline estimate. Following Draca, Machin, and Witt (2011), I test for spatial displacement by running a robustness check where the control group is restricted to the set of non-target districts that are adjacent to the stadium and training center districts. This comprises 11 districts. If crime were diverted to these areas, I would obtain bigger (in absolute value) DID estimates with respect to my baseline results.

As displayed in Table 6, spatial displacement does not seem to be an issue as far as total crime and robberies are concerned. In fact, the police effect estimated using only neighboring districts as a control group is very close to that in my baseline analysis. On the other hand, there is evidence that some share of thefts is being diverted from the districts receiving extra monitoring to the surrounding ones. The estimated coefficient is significant and about one third bigger, in absolute value, than the corresponding figure in my baseline results. This suggests that localized police presence displaces theft to relatively less monitored districts.

The negative effect of police may be spilling over to districts other than the treated ones, causing crime to fall. In this case, my DID approach would underestimate the real impact of police on crime. In fact, this effect translates into lower criminal activity in the non-treated districts, resulting into a smaller (in absolute value) DID baseline estimate. I analyze this issue by using Equation (1) to compare crime outcomes in the 11 districts that surround the stadium and training center districts (the pseudo-treatment group) against the remaining 71 non-target districts (the pseudo-control group). Notice that in this case N_1=11, so I rely on the standard, 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 6, spill-over 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 spill-over dynamic (it would be negative in that case), but rather shows that some portion of thefts is being diverted from the monitored districts to the surrounding ones, in line with results from the spatial displacement analysis.

5.2.2 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 non-target 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 which I am not properly accounting for. In such case, my DID estimates would be capturing a spurious correlation. I perform some placebo checks exploiting the temporal characteristics of the CPCopa program to alleviate this concern.

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 such 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 test's results. I plot the pseudo-treatment coefficients with their 95% Conley and 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 20th 2014 to July 20th 2014 (the CPCopa period) and re-estimate my baseline regression using, as pseudo-treatment, the period before the CPCopa deployment. To this end, I modify equation (1) as follows:

$$(2) \quad Crime_{s,t} = \beta_0 + \beta_1(bf\_CPCopa_t * (Stadium_s + TC_s)) + \beta_2 bf\_CPCopa_t + \beta_5 ArenaSP_t + \\ + Holiday_t + OnlineRob_t + Y_t + M_t + MDay_t + WDay_t + \theta_s + \varepsilon_{st}$$

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

This placebo test allows me to check whether the stadium and training center districts were exhibiting a different crime dynamic with respect to non-target districts before the police increase. In such case, perhaps I am capturing a spurious correlation rather than a causal impact. Results are displayed in Table 7. Using my preferred inference approach (Conley and Taber), outcomes validate my exercise in that they reveal no special crime dynamic affecting the treatment group before the policy-on period.

The increase in police presence may have pushed criminals to put off their illegal activities to later times, 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 21st 2014 to December 31st 2014). The results shown in Table 7 suggest that there was no medium-term temporal displacement. This in turn implies that the crimes prevented by increased police presence represent averted – rather 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. I show in Panel (B) in Appendix Table A- 1 that 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, one may worry that if a short-term temporal displacement effect was at play, whereby criminals diverted their illegal activities to game days, then my results may be biased. Neglecting such effect would generate overly large (in absolute value) estimates, as it would inflate the crime reduction in treated districts. To assess this concern, Table 8 reports the average number of crimes in game days, non-game days during the CPCopa period and remaining days in 2014 in the stadium, training center and non-target districts. In line with the previsions for the voluntary incapacitation effect, the average number of crimes during game days was slightly lower with respect to the rest of the CPCopa period. This descriptive evidence suggests that crime was not diverted to game days.

6 Conclusions

In this paper I provide novel evidence on the causal impact of police on crime in a high-crime, weak-institution 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%, and the daily number of robberies drops by 34%. There is no evidence of spatial (except for thefts) or temporal displacement, so that the measured crime reductions in treated districts represent prevented – rather than shifted – offenses. My results can be best interpreted as reflecting deterrence, by which 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 the control groups.

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

Figures and tables

TABLE 1: CPCOPA MONITORED SPOTS AND NUMBER OF DISTRICTS WHERE THEY ARE LOCATED

Monitored spots					districts		
Stadium	FIFA Hotels	Training centers	Venues of WC-related events	Transport and Tourism	Target	Non-target	Total
1	3	3	3	6	11	82	93

Notes: Different monitored spots may be located in the same district.

FIGURE 1: THE TIMELINE OF THE WORLD CUP AND OF THE CPCOPA PROGRAM

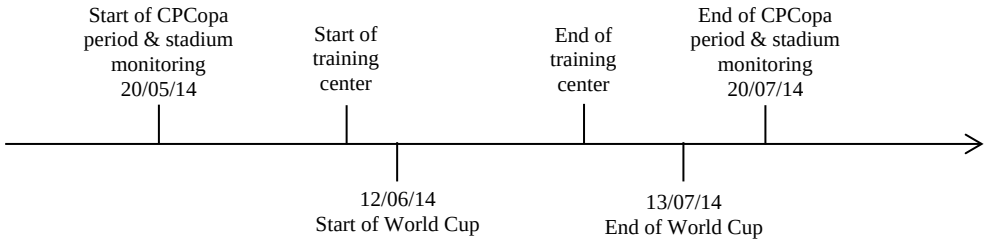


TABLE 2: THE EXPECTED EFFECTS OF THE WORLD CUP ON LOCAL CRIME

Mechanism	Expected impact on crime
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, incapacitation and concentration – through which the World Cup may impact local crime.

TABLE 3: CRIME DATA DAILY BY DISTRICT, 2006-2014 – DESCRIPTIVE STATISTICS

Statistic	Total crime	Robbery	Theft	Assault	Murder	Rape	Drugs
Mean	11.1	4.5	5.2	1.1	0.1	0.1	0.2
Min	0	0	0	0	0	0	0
Obs = 0 (%)	0.2	2.8	5.3	37.6	92.4	94.5	86.2
Max	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
N	305,505	305,505	305,505	305,505	305,505	305,505	305,505

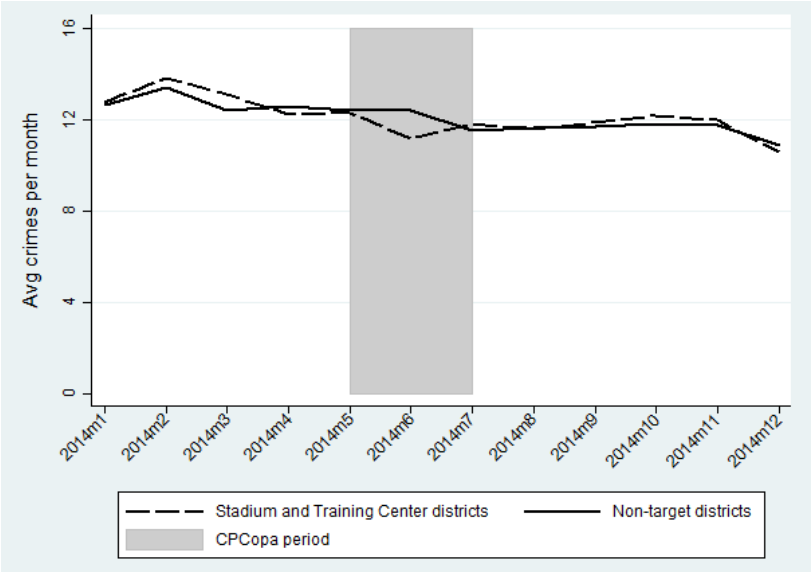
Notes: Summary statistics are generated from the crimes reported daily in each of São Paulo's 93 districts over the period 2006-2014. "Murder" comprises committed and attempted murders.

TABLE 4: THE EXPECTED EFFECTS OF THE WORLD CUP ON LOCAL CRIME – DETAILED

Expected effect on crime	Non-target districts		Target districts			
			Stadium and training center		Others	
Game day	Yes	No	Yes	No	Yes	No
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, incapacitation and concentration – through which crime in target or non-target districts may be impacted on game and non-game days during the World Cup. Dashes mean that no effect is expected.

FIGURE 2: GRAPHIC REPRESENTATION OF THE DID APPROACH – AVERAGE NUMBER OF CRIMES PER MONTH ON NON-GAME DAYS IN THE STADIUM AND TRAINING CENTER DISTRICTS *VS* NON-TARGET DISTRICTS, 2014



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

TABLE 5: THE EFFECT OF POLICE ON CRIME – BASELINE RESULTS

DV	$\widehat{\beta_1}$	95% Confidence interval		Inference method	N
		Lower	Upper		
(A) Treatment group = stadium and training center districts					
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
(B) Treatment group = all target districts					
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

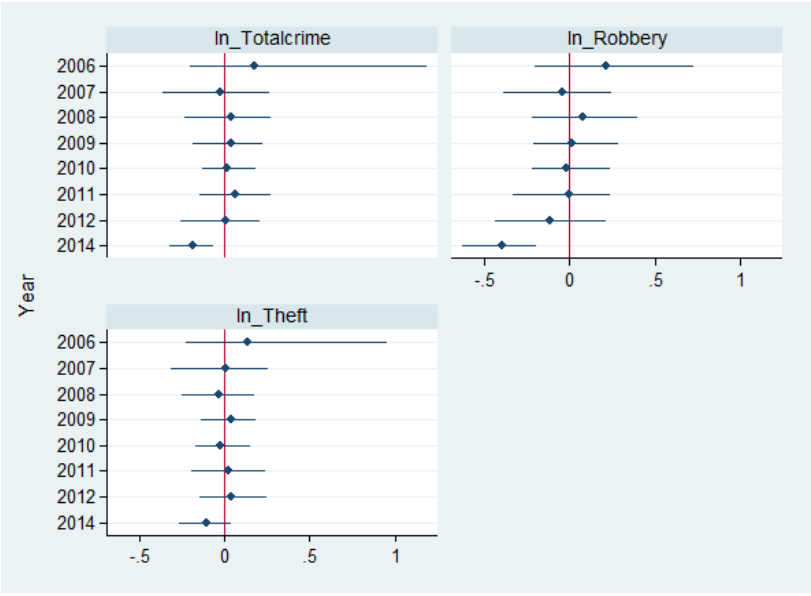
Notes: An observation is a day-long period for one of the considered districts in São Paulo over the period 2006-2014, excluding days in which a 2014 FIFA World Cup game was played. Considered districts in panels (A) comprise 84 districts (the stadium, training center, and non-target ones). Considered districts in panel (B) comprise all 93 districts in São Paulo. The estimates come from ordinary least squares 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 for the CPCopa period, a dummy 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 for the period when it was possible to file robbery reports online.

TABLE 6: SPATIAL DISPLACEMENT AND SPILL-OVER EFFECT

Analysis	Specification	DV	$\widehat{\beta_1}$	95% Confidence interval		Inference method	N
				Lower	Upper		
(A) Spatial displacement	T = stadium and training center districts C = adjacent districts	ln(Total crime)	-0.19	-0.23	-0.13	Conley-Taber	42,355
		ln(Robbery)	-0.33	-0.42	-0.21	Conley-Taber	40,720
		ln(Theft)	-0.12	-0.18	-0.08	Conley-Taber	41,786
(B) Spill-overs	T = adjacent districts C = other non-target districts	ln(Total crime)	0.04	-0.05	0.13	Clustered by district	266,887
		ln(Robbery)	-0.02	-0.18	0.14	Clustered by district	252,129
		ln(Theft)	0.10	0.02	0.18	Clustered by district	259,023

Notes: T = Treatment group; C = Control group. An observation is a day-long period for one of the considered districts in São Paulo over the period 2006-2014, excluding days in which a 2014 FIFA World Cup game was played. Considered districts in panel (A) comprise 13 districts. Considered districts in panel (B) comprise all 82 non-target districts. The estimates come from ordinary least squares 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 for the CPCopa period, a dummy 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 for the period when it was possible to file robbery reports online.

FIGURE 3: PSEUDO-TREATMENT COEFFICIENTS (2006-2012) AND ACTUAL TREATMENT COEFFICIENTS (2014)



Notes: For each DV (total crime, robbery and theft) and for each year y over the period 2006-2012, the figures report the estimated pseudo-treatment coefficients and 95% confidence intervals from running Equation (1) as if the World Cup and CPCopa 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 place in Brazil that year roughly over the pseudo-treatment period. All confidence intervals are calculated using the Conley and Taber inference approach.

TABLE 7: CRIME DYNAMICS IN THE TREATED DISTRICTS IN THE PERIODS SURROUNDING THE CPCOPA PROGRAM

Analysis	Pseudo-treatment period	DV	$\widehat{\beta_1}$	95% Confidence interval		Inference method	N
				Lower	Upper		
(A) Placebo	01/01/14-19/05/14	ln(Total crime)	-0.16	-0.35	0.02	Conley-Taber	270,295
		ln(Robbery)	-0.25	-0.52	0.07	Conley-Taber	255,298
		ln(Theft)	-0.07	-0.24	0.07	Conley-Taber	262,407
(B) Temporal displacement	21/07/14-31/12/14	ln(Total crime)	-0.18	-0.41	0.04	Conley-Taber	270,295
		ln(Robbery)	-0.15	-0.46	0.19	Conley-Taber	255,298
		ln(Theft)	-0.16	-0.35	-0.01	Conley-Taber	262,407

Notes: An observation is a day-long period for one of the considered districts in São Paulo over the period 2006-2014, excluding the CPCopa period. Considered districts comprise 84 districts (the stadium, training center, and non-target ones). The estimates come from ordinary least squares 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 for the pseudo-treatment period, an indicator for the period after the inauguration of the São Paulo Arena, a holiday indicator and a dummy for the period when it was possible to file robbery reports online.

TABLE 8: AVERAGE NUMBER OF CRIMES ON GAME DAYS, NON-GAME DAYS DURING THE CPCOPA PERIOD AND ALL OTHER DAYS IN 2014

Period	Non-target districts (average)	Stadium district	Training center district
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 non-target and stadium districts, the CPCopa period is defined as May 20th 2014 to July 20th 2014. For the training center district, the CPCopa period is defined as June 8th 2014 to July 2nd 2014. In the stadium district case, I exclude the six days in which a World Cup game was played at the São Paulo Arena, as criminal activity was exceptionally high (likely due to concentration).

Appendix A. Additional tables

TABLE A- 1: THE EFFECT OF POLICE ON CRIME – ALTERNATIVE MODELS

Model	DV	$\widehat{\beta_1}$	95% Confidence interval		Inference method	N
			Lower	Upper		
(A) Controlling for non-treated target districts	ln(Total crime)	-0.18	-0.33	-0.06	Conley-Taber	302,739
	ln(Robbery)	-0.34	-0.58	-0.15	Conley-Taber	287,080
	ln(Theft)	-0.08	-0.29	0.06	Conley-Taber	294,678
(B) Controlling for game days	ln(Total crime)	-0.23	-0.29	-0.18	Conley-Taber	275,499
	ln(Robbery)	-0.39	-0.44	-0.34	Conley-Taber	260,359
	ln(Theft)	-0.10	-0.15	-0.06	Conley-Taber	267,497

Notes: An observation is a day-long period for one of the considered districts in São Paulo over the considered period. The analysis in panel (A) considers all 93 districts in São Paulo over the period 2006-2014, excluding days in which a 2014 FIFA World Cup game was played. The analysis in panel (B) considers 84 districts (the stadium, training center, and non-target ones) over the period 2006-2014. The estimates come from ordinary least squares 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 for the CPCopa period, a dummy 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 for the period when it was possible to file robbery reports online. In addition, regression in panel (A) includes a dummy for the interaction between non-treated target districts and the CPCopa period; regression in panel (B) includes indicators for game days, days when a match was played in São Paulo and a dummy for the interaction between the latter variable and the stadium district.

TABLE A- 2: THE EFFECT OF POLICE ON CRIME – DEPENDENT VARIABLE IN LEVELS

DV	$\widehat{\beta_1}$	95% Confidence interval		Inference method	N
		Lower	Upper		
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 day-long period for one of the considered districts in São Paulo over the period 2006-2014, excluding days in which a 2014 FIFA World Cup game was played. Considered districts comprise 84 districts (the stadium, training center, and non-target ones). The estimates come from ordinary least squares 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 for the CPCopa period, a dummy 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 for the period when it was possible to file robbery reports online. "Murder" includes committed and attempted murders.

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