

ABSTRACT

A Differences-in-Differences Approach to the UPP Policy and Crime Displacement
in the City Neighborhoods and Metropolitan Area of Rio de Janeiro

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This thesis uses differences-in-differences causal inference method to study the impact of the UPP policy in the surrounding neighborhoods of the city of Rio and also the spillover effects potentially caused by it. Five types of crimes were taken into account: Violent death, rape, robbery, drug related and death caused by police intervention, each of them with a certain degree of relationship with the "drug trading cycle" Rio suffers. The model reveals statistically significant results for all types of crime, with the exception of rape, potentially revealing how UPP in fact only swept crime to other cities and the reduction of it perceived along the years was a general trend. An event study using leads was also used to increase robustness of the research, showing parallel trends assumption cannot be discarded for UPP regions.

A Differences-in-Differences Approach to the UPP Policy and Crime Displacement
in the City Neighborhoods and Metropolitan Area of Rio de Janeiro

by

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DEDICATION

To my family, friends and my beloved city, Rio

CHAPTER ONE

Introduction

Rio de Janeiro suffers from violence related to Drug Trafficking Organizations, or Factions, as they are called in the city. Since the 80s, such criminal organizations took shelter in the favelas of Rio and from there they do their operations like selling drugs or vying for control of other territories through violence. Favelas, in vast majority, are separated from the main city, since they are located in the hills that feature in the landscape of Rio. Hence, the police rarely would go to enforce the law in such locations. If violence would escalate, a precise incursion would happen to neutralize the threat, without the police creating a permanent presence.

Because Rio would host the Olympics and at some extent also the World Cup, both in 2016 and 2014 respectively, the Government of the State of Rio created the Favela Pacification Program (Programa de Pacificação das Favelas, in Portuguese), which consisted in two phases, first the expulsion of the criminal faction from the selected favelas and then a permanent occupation by the police in those areas. This provided a natural experiment to measure the impact on crime in the neighborhoods that surrounds the favelas of Rio with police interventions and permanent allocation of assets in the selected slums. Potentially, good causal inference is made possible because select slums from a pool were selected to be occupied.

The amount of data could be sufficient to provide good modeling and further the understanding of crime displacement in the metropolitan area of Rio. This paper uses a difference-in-difference approach to assess such phenomenon and later address robustness by using an event study.

CHAPTER TWO

Political, Geographical and Historical Context

Every single day, a sucker and a scoundrel get out of their respective homes. If they bump into each other, business happens.

- Brazilian Popular Saying

Brief History of Rio

It is necessary beforehand to establish the historical background and explaining why the dynamics of the city of Rio is as such.

Rio de Janeiro, simply "Rio" and often nicknamed as "The Marvelous City", is the second-most populous city (municipality) of Brazil, being São Paulo the first. According to the Brazilian Institute of Geography and Statistics (2018) (IBGE), it has almost 7 millions inhabitants, with 12 millions in its metropolitan area. The demonym of Rio is "Carioca".

Rio was born as a strategic military base of operations. During the Age of Discovery, the Portuguese crown had to secure the southern parts of its newly found colony. The landscape of Rio is special because it is mainly composed of valleys, rivers and mountains, right next to the sea, representing a natural aptitude for being a commercial and military port or a bastion of Portuguese dominance in that area.

During the 1550s and the 1560s, the French increased pressure in the region, securing a foothold for further exploration. They constructed a fort in the Villegagnon Island and allied themselves with the Tamoio natives.

The Portuguese answer to the menace was to send the Governor's nephew to the region and prepare for the impending conflict. Estácio de Sá arrived in the valley between the Pão de Açúcar (Sugar Loaf Mountain) and the Cara de Cão (Dog's Face Mountain) and there founded the city of Saint Sebastian of Rio de Janeiro (River of January, because they thought the Guanabara Bay was a river at the time and because

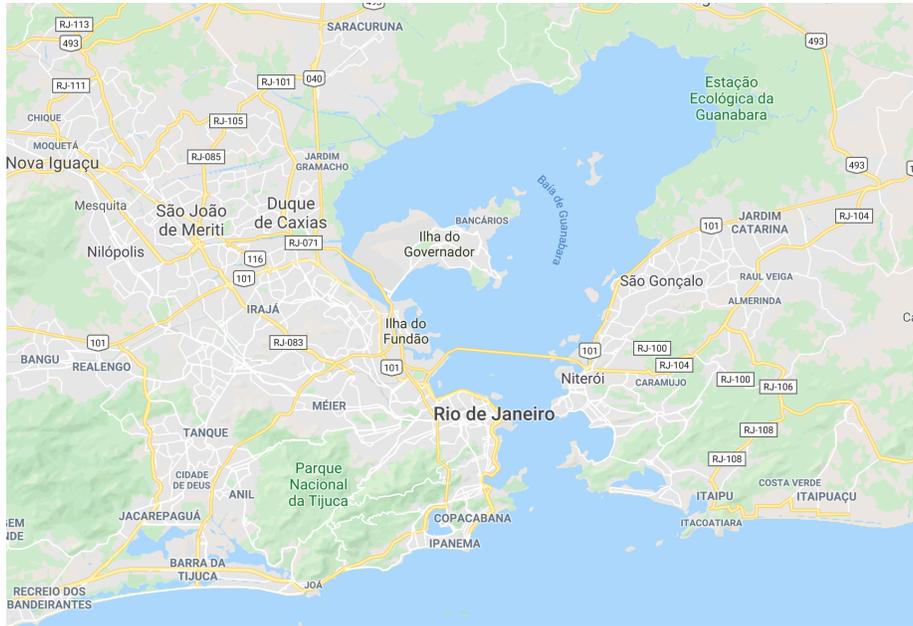


Figure 2.1. Guanabara Bay, the city of Rio and Niterói. Source: Google Maps

January is the month of Saint Sebastian). Arariboia, a native chieftain rival to the Tamoios, pledge allegiance to the Portuguese crown. Arariboia was fundamental in the expulsion of the French in Rio, latter converting himself to christianity and founding Niterói, the largest city of the state after Rio.

This complex symbiosis between the two people would provide in the future, alongside with the slaves from Africa, the foundation of Brazilian identity.

In 1763, the capital of the colony was transferred from Salvador to Rio, making it a major hub for trade. But it was in 1808, when the royal family of Portugal moved from Europe to Brazil, due to the Napoleonic Wars, that the city gained momentum. Until today, Rio has the unique status of ever being a European capital in the Americas.

In 1822, Brazil seceded from the United Kingdom of Portugal, with Rio maintained as the capital of the Brazilian Empire. Only in 1960 Brasília would be built and assigned as the country's capital.

Still, Rio is a powerhouse in Brazil's economy, having the second-largest GDP in the country. It is the seat of major Brazilian companies including Organizações Globo (in the entertainment) and Petrobrás (oil industry).

Origins of the Favelas (Slums)

The technical name of a favela is *subnormal occupation*, according to IBGE. A subnormal occupation is a group made by 51 or more units of habitation featured by the lack of property title and by at least one of the following features:

- Irregularities of the streets (usually made of dirt, no size standard and/or
- lack of public services (such as garbage management, sewage, water distribution, electrical energy and public illumination).

Subnormal occupations have local names across Brazil. The most popular comes from Rio de Janeiro, *favela*.

The origin of the favelas is intrinsically related to the problem of housing in Rio during the late 19th century. As Vaz (1994) says, the eve of the 20th century was marked by a social transformation in the then capital of the country. From a colonial town, Rio was becoming an industrial city. It is possible to highlight the main driving forces behind this transformation:

- The end of slavery in Brazil, a peaceful and slow process which culminated in 1888 with Princess Isabel signing the "Golden Bill", which eradicated the slave institution for good. Markets emerged and paid labor took the place of forced labor;
- The decadence of the agriculture in the surrounding areas of Rio, with the protagonism of this activity being taken by São Paulo's coffee business;
- The economic boom occurring in Rio, which attracted people from all over the country and the world.

The heavy influx of immigrants, added with the newly freed slaves and a lack of opportunities in the countryside of the capital, provoked a shock in the housing prices in the city, hence the start of the "tenements" era of Rio, huge popular mansions packed with small rooms to accommodate the population surge.

Still according to Vaz (1994), the tenements soon became a major issue. Packed with low class individuals, having common areas such as bathrooms and kitchens, no proper water or sewage, this type of location would transform in no time in a breeding ground for diseases.

The alternative to the tenement scenario was to seek the immediate outskirts of downtown. Given the geographical features of the city, composed of a complex chain of valleys, mountains and coastal areas, and taking into consideration that the urbanized areas of the city is at the vast majority in the valleys and beaches, the most suitable resolution for poor habitations would be going for the hills and building shacks. It is possible to affirm this process was way in course as early as the 1870s.

Although, as said before, already in course, the mythos of the creation of the favelas would not appear until 1897, right after the war of Canudos. Canudos was a region in the northeast state of Bahia where a cult was organized and rebelled against the newly established republic (in 1889, the Brazilian Empire became a republic). At first they seemed harmless, but the rebellion proved to be a heavy burden on the central government, forcing huge investments and conscripting a large expedition to deal with the problem.

In that region, a common plant can be found. *Cnidocolus quercifolius*, popularly known as favela. After the war, the victorious veterans went back to the capital asking for compensation (promised by the federal government in recognition of their efforts). Apparently betrayed by their superiors, the veterans chose a hill to settle near the ministry of defense building and wait for the reward. This never came to be. And

the hill started being called "the Hill of the Favela", in an obvious reference of the campaign performed by the settlers.

This passage of Brazilian history was immortalized by the engineer, journalist and historian Euclides da Cunha, in his *magnus opus* *Sertões*, where he documents the Campaign of Canudos.

Because of his popularity, the name favela would soon mean any poor community of this kind away from the main urban areas.

The process of *favelization* increased heavily during the campaign against the aforementioned tenements. Famous mayors like Barata Ribeiro and Pereira Passos (also known as "Bota Abaixo", a Portuguese pun with his name, meaning in rough translation "the demolisher") would put down huge areas of the poor habitations, specially the tenements, pushing even more the poor away from the urbanized, modern valleys and forcing them to live in the hills. Pereira Passos is regarded as one of the most important mayors of Rio, a main contributor in modernizing Rio's landscape, permitting the city to endure through the changes of the next decades, but he is also criticized by his way of reformation in lieu of promoting alternatives for the poor.

Before the 1903 reforms, the nickname of the city was not "Marvelous" or "Wonderful" city, but "City of Death" or "The Filthy Port", because of the ridiculous sanitary conditions it provided and the diseases associated with it.

Geographical Dynamics of Rio

Much like the United States, Brazil has sub national entities called states, federative units which, by constitution, has certain autonomy. In total, 26 states and one federal district (like Washington) exist. Understanding the political spheres of the country is straightforward. First there is the Union (that is, federal government), the state government and the municipal government.



Figure 2.2: The states of Brazil. Rio de Janeiro is the capital of the homonymous state in the Southeast Region. Source: Google Maps

The municipal sphere should be, for the sake of simplicity, analogous to the American counties. A municipality generally is a political and geographical entity. There one finds a main city (where the prefecture is located) and its rural area. Some municipalities have the urban fabric so big that the entire city coincides with the geographical limits of the municipality (in other words, its rural portion is insignificant). Such is the case of São Paulo, other Brazilian state capitals and, of course, Rio.

All of Brazilian spheres of power has the three classical government branches: Executive (president, governor and mayor, respectively), legislative (only at the federal sphere there is bicameral legislature), and judicial. According to the Brazilian constitution, here are the responsibilities of each sphere related to crime management:

(1) Federal Government

Responsible for promoting strategies and milestones to reach. Also, to create prevention and control policies across the nation. The federal government has the Federal Police, with overlapping features with the FBI in the USA.

(2) State Government

The main actor against crime in Brazil is the states. They execute the plans and have huge autonomy regarding this issue. The state has two branches of police. The military police and the civil police. The military police are the force of public safety which has the function of overt policing and the maintenance of public order in an active fashion. They answer to the governor and may, in case of extreme conditions, be the reserve of the Brazilian armed forces. Their funding is state-level. The civil police is the branch of investigation, much related to the judicial system.

Table 2.1. US-BR Entity Equivalence

United States	Brazil
Federal States	Union (Federal) States
Counties	Municipalities

Although the name implies otherwise, the military police has nothing to do with armed forces. For the sake of avoiding confusion, we should use PMERJ, the Portuguese acronym, when talking about the military police of Rio. The name military derives from the imperial era, because of the nature of active patrolling and the hierarchical structure mimicking that of the armed forces.

The municipal government, in principle, has no direct attributions regarding safety. They have the municipal guard responsible for maintaining the urban landscape order, but it is very simplistic when compared to the military police.

The smallest urban "area" one can divide the city of Rio is the neighborhoods. Each neighborhood has its own identity, being an important reference in a Carioca's day-to-day life. Even though neighborhoods are recognized, it does not have administrative autonomy. This belongs to the administrative regions, the upper level of the city organization, basically aggregated neighborhoods with one neighborhoods being the "seat" of the region.

Officially, Rio has 162 neighborhoods, which make up the 33 Administrative Regions.

The Pereira Passos Institute has more general information about diverse aspects of the city¹.

A popular (not quite official) upper level of the administrative regions is the zones. This is the macro regions of the city, named in reference of its position from

¹ The website is in Portuguese but there is an English version in this following link: http://apps.data.rio/datarioresources/arquivos/RIOemSINTESE_2017_ingles.pdf

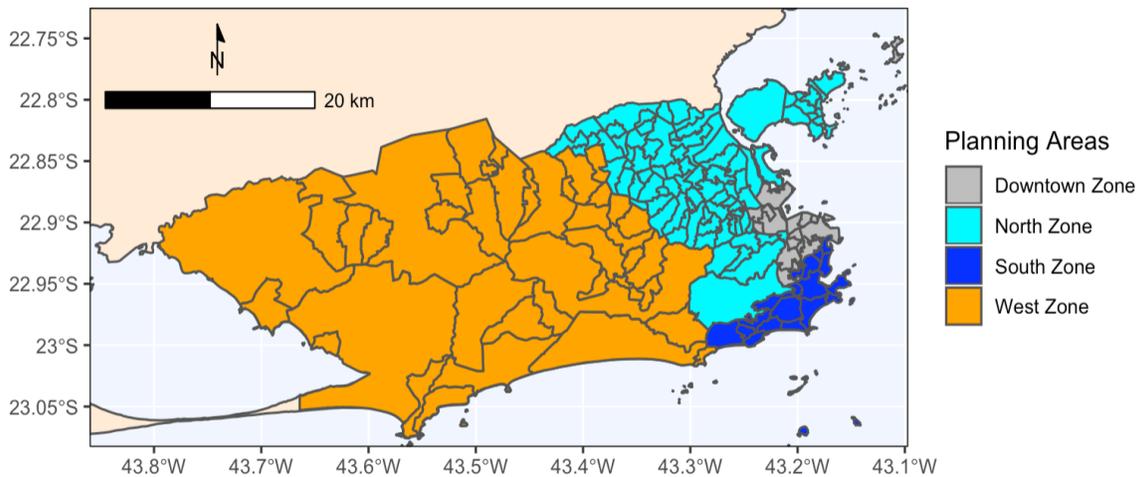


Figure 2.3. The Zones of Rio. Source: IBGE/Pereira Passos Institute

downtown. Rio has 4 regions, West Zone, North Zone, South Zone and Downtown. Obviously there is no East Zone since Rio's downtown is in the eastern coastal area.

The South Zone is the most popular area and richer area of the city. Here one encounters the Christ the Redeemer Statue, the Sugar Loaf Mountain and other tourist attraction internationally famous. Ipanema, Copacabana and other famous neighborhoods belong to this zone.

The West Zone is the largest zone and hence the most heterogeneous. It has the natural parks, poorer areas and also upper class areas such Barra da Tijuca and Recreio dos Bandeirantes, examples of coastal tourist neighborhoods.

The North Zone is another contrast zone, with Tijuca as a middle to upper class neighborhood and Pavuna, one of the poorest neighborhoods of the city. It is featured by a more industry oriented landscape.

Downtown is the center of the city economy. Large enterprises are located here (including Petrobrás). Every day a circular migration occurs inside the city mainly between the zones and downtown.

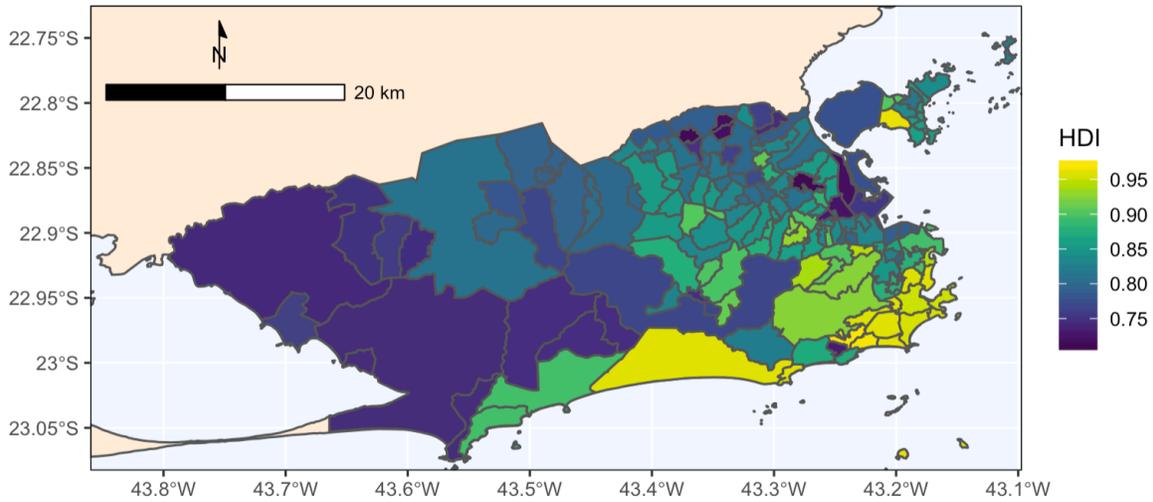


Figure 2.4: Human Development Index. Neighborhoods close to the coast are more likely to have higher HDI. Source: IBGE/Pereira Passos Institute

Rio has currently approximately one thousand favelas. Since this type of occupation is not regulated officially, this number is hard to track. Considering the 162 neighborhoods Rio has, it is easy to realize each neighborhood will have at least one favela, some having more than 20.

The vast majority of favelas are not considered neighborhoods, but segregated areas *inside* a neighborhood, generally on hills. Favelas generally does not respect boundaries and are very heterogenous as suggested by its official definition. This means a favela can be small enough to be encompassed by its parent neighborhood or be large enough to span through several neighborhoods, like Rocinha, Vidigal and the complexes in the North Zone. When such thing happens, the research will treat all the neighborhoods involved as treated. Having such stark contrast, it is easy to spot a favela on the landscape of Rio. During the 90s, the elected mayors took some effort to improve the life conditions in some of the favelas, even emancipating the largest ones into their own neighborhoods (e.g. Rocinha used to belong to São Conrado neighborhood, but now it is its own.). This process of urbanizing the favelas is slow

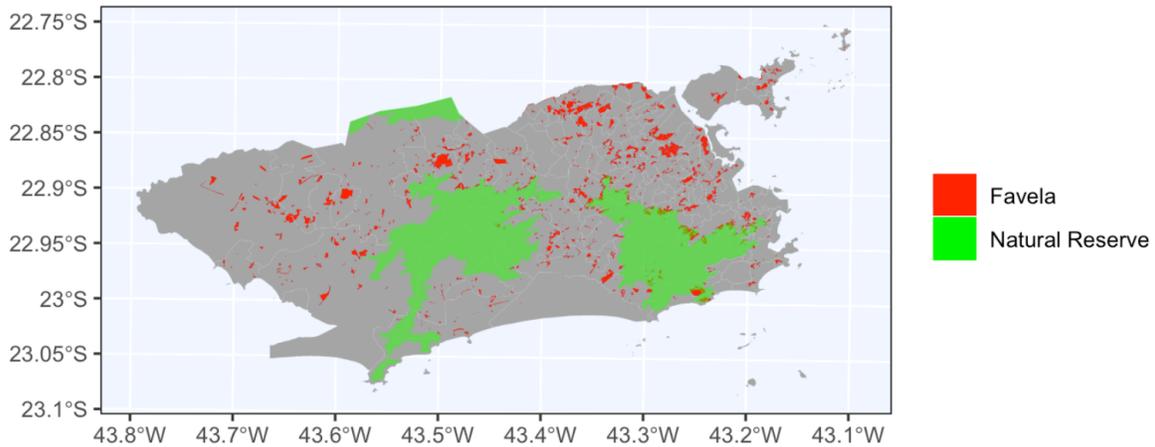


Figure 2.5: A rough demonstration of the distribution of slums around the city of Rio. The size of the favelas are exaggerated Source: IBGE/Pereira Passos Institute

and controversial since it is accused of simply doing cosmetics, as pointed by Mendes (2006).

Still, the contrast between the favela and the "proper" city is so important in the life of a Carioca that often we use the metonymy "Hill" to designate a Favela and "Asphalt" to designate the proper urbanized areas. This research will be using the same nomenclature for the sake of simplicity.

A Sociogeographical Model of Rio

It is possible to model Rio after its social and spatial dynamics. Let's assume a neighborhood is a rectangle, like in Figure 2.6. The small light blue square represents the existence of a favela inside that neighborhood. A neighborhood can have none, or multiple favelas. The entire city then can be represented as a grid such in Figure 2.7. When we discuss the crime activity in Rio, this model will play an important role since favelas play a major part in territorial dominance for the drug factions.

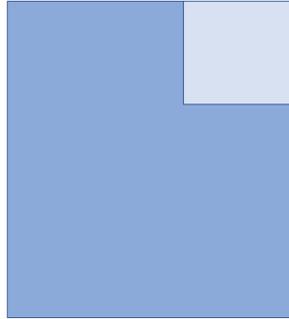


Figure 2.6: A simple representation of a neighborhood of Rio. The light square represents the existence of a slum.

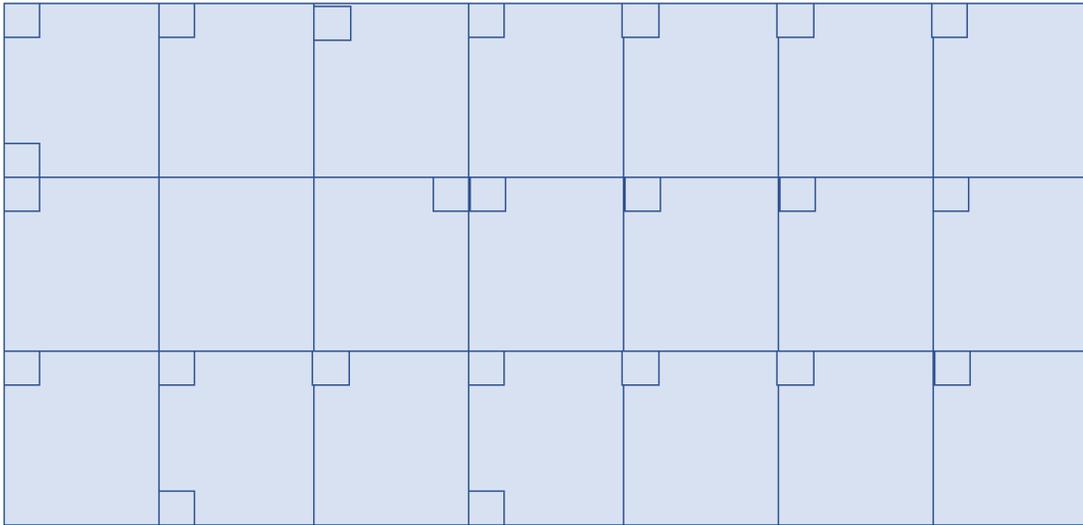


Figure 2.7. The complete simple spatial model of Rio.

Criminal Organizations

The process of *favelization* didn't stop by the turn of the 20th century. It still goes on until this day, specially during economic crisis and due to the fact the local government in the past decades struggled finding an optimal solution to it. Nowadays, the most important feature of a favela is the crime associated with it.

According to Friman and Andreas (1999), it is the gap between the ability of providing prohibition laws and the lack of actually enforcing it that governments create the fertile ground for illegal markets.

During the 80s, Brazil was under a military dictatorship prone to fight any communist-oriented guerrilla. It was successful fighting armed resistance but the very repressive modus operandi of the government spawned new opposition. Mainly because the military officers didn't have the expertise to separate criminals into the groups they actually belonged: Political opposition and common criminals.

In Rio, both types of inmates were held in Cândido Mendes prison, at Ilha Grande (an island in the western coast of the state of Rio, the prison is now deactivated). With common criminals being judged as hidden agents, not lone wolves, and being tortured and repressed, the government created the very enemy it was supposedly to be hunting down: both groups soon banded together for mutual protection. Political opposition taught the common criminals ideology and the offspring of this relationship soon became the Comando Vermelho (Red Command), an armed organization led by prisoners with ideological motives and drug as the main source of income. The leaders of this organization, and all other criminal organizations around the country, are still led by arrested individuals inside prisons scattered over Brazil.

One may say the drug organizations are the bastard child of the Brazilian dictatorship (Penglase, 2008).

This newborn organization found in the favelas the perfect place to settle and start operations, for two related reasons:

- (1) The government is not present in a favela not only in providing essential utilities like roads or sewage, but also in enforcing the law;
- (2) hence the favela population saw in the criminals a kind of parallel state which could provide the things the official State didn't. It is not uncommon to find inhabitants of the favelas looking fondly towards the criminal leaders of the community.

As pointed by Penglase (2008) and Filippetto (2016), each favela will have a local leader answering to a boss at a prison. This loose formation is the criminal organization main feature. Also, they are not gangs or mafia. Although mafia and criminal organizations have the characteristic capacity of expanding in new activities and geographical areas, Brazilian criminal organizations appeal to the young lacking educational, economic and social development.

It is also not a gang. A gang can be defined as a youth association committing crime with a sense of leadership and formality, and great identity towards a place.

During the 80s and 90s, the Red Command expanded over a huge portion of the favelas in Rio. During the 90s and 2000s, two splits occurred. One created the Amigos dos Amigos (Friends of Friends, ADA) and the other, the Terceiro Comando Puro (Pure Third Command, TCP).

Militias

Parallel to the Drug Trade Organizations (DTOs), there is the militia, not a unified group, but a collection of small groups scattered across the city that share common features, with each dominating a specific slum. This type of criminal organization was born in Rio das Pedras community, Barra da Tijuca Neighborhood, out of the fear of instability brought by a DTO taking over the favela (Zaluar & Barcellos, 2013), since it generally brings drug trading and usage, conflicts with the police and others DTO. The militia is usually mainly composed of ex-police

officers, fire fighters and other types of corrupt public agents that pledge to protect the aforementioned territory.

From the 90s until the 2011, the militia expanded quickly, since this type of group rarely enters in conflict with the police and with each other (Zaluar & Barcellos, 2013), capitalizing in conflicts between the state and DTOs and DTOs against DTOs.

Militia are maintained via extortion and "tax" payment. They forbid the usage of guns, with the exception of notable individuals (in DTOs' favelas guns are widespread) and drugs are banished. Although these are a guide to define a militia, it is by no means canonical, with the militia in the end being a very heterogeneous group.

Since the nature of the militia is not to deal with DTO at first and rarely there is intervention by the state, this research will assume the regions controlled by them to be sufficient control group.

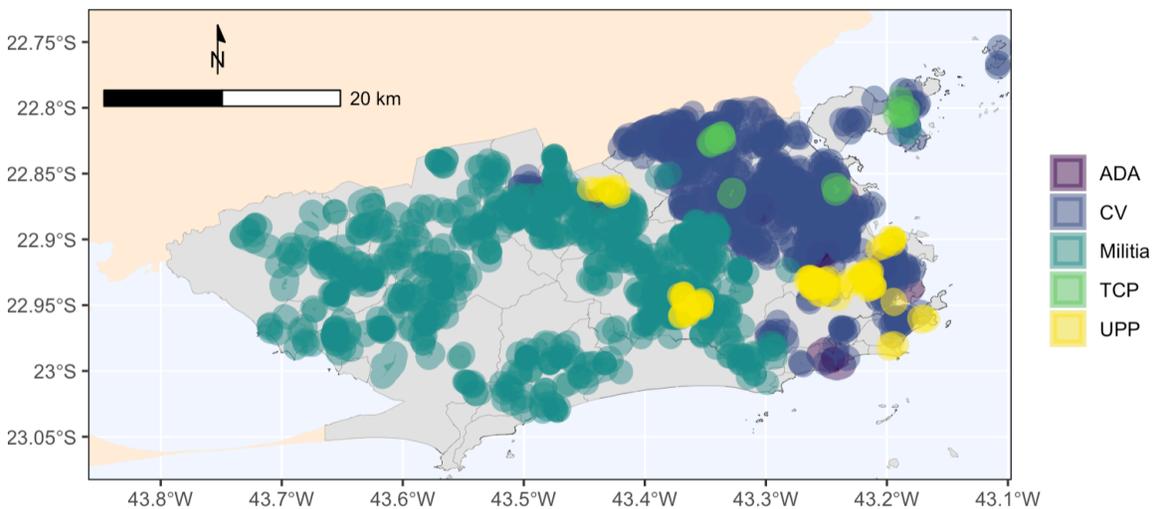


Figure 2.8: This map shows the favelas and the factions controlling them. For visualization purposes, an "area of influence" was created around the location of slums. This map accounts for the situation in 2011. Militia gained momentum and secured almost the entire west zone of the city, while CV, TCP and ADA control the rest of it. ADA main location used to be Rocinha (southeastern purple area) before the UPP in 2012. The yellow areas are UPPs implemented so far until 2011. Although more would be created until 2015, some of them went extinct by 2018 and the program is virtually defunct. Source: Zaluar and Barcellos (2013)

World Cup, Olympics and the Natural Experiment

With the success of the 2007 Pan American Games in Rio combined with the stability of the Brazilian economy amidst the global recession, it was only inevitable for the city to be the host of the 2016 Olympics, announced October 2nd, 2009. Before that, the World Cup Host position was secured in 2007.

From now on, Rio's government, jointly with federal government, had to come up with several policies to mitigate the social issues and challenges ahead. Rio de Janeiro state government launched a program in 2008 called Unidades de Polícia Pacificadora (UPP, Pacifying Police Units). Since Rio, specially the capital, was dealing with the severe problem of drug trafficking and factions controlling the slums, the main objective now was to occupy those communities, expel the criminals and invest on social infrastructure to mitigate crime and provide in the long run a safe environment for tourists in the following years. It is different from previous programs because of the proposition of permanently maintaining a police force stationed inside a slum, where traditionally, the police resolution would be only to stop further bloodshed between criminals temporarily (Tealde, 2015) and (Magaloni, Franco, & Melo, 2015).

In theory, an UPP would have two stages. The first stage is the purge of criminals in the slum through surgical operations, intentionally causing minimum collateral damage to the community. Drug dealers operate as a parallel states in slums. After the power vacuum due to the first stage, the second stage objective was to provide the community infrastructure, support and integration with the rest of the city, thus the pacifying aspect of the policy. This is a consistent departure from previous public safety policies. In past attempts, the government would order an incursion inside a community with search, destroy and apprehension orders and the arrest of key individuals. After that, the police special forces leave the slum, leaving it to another criminal to take place as leader.

The focus of a UPP, at least during the heydays, was exactly to break the cycle. The total number of UPP implemented was 38 units, with 37 at the capital, and 1 installed in the neighboring city Duque de Caxias.

How The Police Would Choose a Favela to Occupy?

This question is important for the experiment because the underlying purpose of the policy could generate bias depending on the criteria. Magaloni et al. (2015) defines 3 motives for deciding where to pacify.

- The first motive of a pacification is the economic aspect behind the parent neighborhood of a favela. Favelas from poor neighborhood were not a priority, since it does not provide a show case for tourism and protection for the middle and high classes. Copacabana, Botafogo, Leblon and Ipanema are all internationally famous neighborhoods, with rich inhabitants in the asphalt providing services to tourists, with their business at stake due to criminal activity. Securing these areas became paramount for the events' success. The target was slums in the end would be the ones alongside the axis between the considered tourist areas of Rio and the international Airport, with a priority in communities closer to the areas. Another important aspect of this first motive is the fact that the favelas around the South Zone are small, easy to take over and prosperous in the drug sell, due to its proximity to their clientele: The very middle and high class people asking for protection from them.
- The second motive was tactical. The main target of the first phase of the UPP was clearly the CV's controlled slums. José Mariano Beltrame, the then Secretary of Public Safety during the operations, explains in his memoirs that

the Red Command is the most violent of all DTOs and controlled a lot of the South Zone's favelas ² .

- The third, complementing the others, is political. As revealed by Figure 2.8, militia is concentrated in the West Zone. Rarely police make incursions in favela controlled by such type of criminals, since they are corrupt officers. ADA is less belligerent and more prone to bribing key agents to leave their activities alone.

The first UPP was installed in Botafogo, Rio's south zone neighborhood, at the Santa Marta favela, located on the slope of Dona Marta's hill, in December 19th, 2008. The operation received lots of media attention, due to it being the first attempt of the policy and because Santa Marta community is a relatively famous location (for instance, Michael Jackson filmed a videoclip there in the 90s), with somewhat low violence occurrences compared to other portions of the city, a main factor contribution for the community to be chosen as the prototype of the policy. Until the day of this thesis writing (2020), this UPP still existed.

Table A.1 has a list of all the UPPs implemented, the corresponding favela, their parent neighborhood(s), date of occupation and date of extinction.

The quasi-natural aspect of the experiment comes from the fact only selected slums from the city were chosen to be secured by the government. With the proper mechanism, it is possible to assume the rest of the city as controls to measure the impact of such police activity and permanent presence in the treated slums. As Tealde (2015) and Magaloni et al. (2015) used the same phenomenon to understand its impact inside of a favela territory, the goal here is to reach a conclusion about the aggregate

² The notable exception is Rocinha and Vidigal. They are considered key favelas of the city but, interestingly enough, although CV is the most powerful faction, these were controlled by ADA before the UPPs.

effects *outside and inside* a favela, including the neighborhood (or precinct, explained further ahead) in which it belongs, as a spillover effect.

Figures A.1, A.2 and A.3 showcases some example of neighborhood/slum dynamics, with the favela circled in yellow.

CHAPTER THREE

Empirical Strategy

Like Card and Krueger (1993) and further discussed in Bertrand, Duflo, and Mullainathan (Feb/2004), the research will use a differences-in-differences approach, assuming a parallel trend between the west zone, the rest of the city, and the metropolitan area. This parallel trend will be discussed further in the robustness check section.

Natural Experiment

The UPP policy is a quasi natural experiment which permits comparing precincts with Favela treated in it with precincts without treated favelas. In this research, a raw differences-in-differences model is used to test the efficacy of the policy and then we discuss how the model could be improved in this case.

At first it is possible to utilize the method because of the nature of the experiment and how Rio is structured. Since we can divide the city into zones and the west zone is predominantly controlled by the militia, it serves as a control of the UPP experiment because of the following reasons:

- (1) First, the spillover effect is controlled since neighborhoods with favelas predominantly controlled by militia are not involved in the dynamics of the UPPs and DTOs, which means that DTO agents avoid areas with the militia and that the militia has the furtive support of the police, thus they are relatively more peaceful (Zaluar & Conceição, 2007).
- (2) Second, the expected effect would be the militia acting as a barrier for the flux of criminals running away from the UPP intervention. This flow would hit the rest of the state of Rio. The DTO expelled went to other Rio's metropolitan area cities (Nova Iguaçu, Duque de Caxias, Belford Roxo e etc, all of them

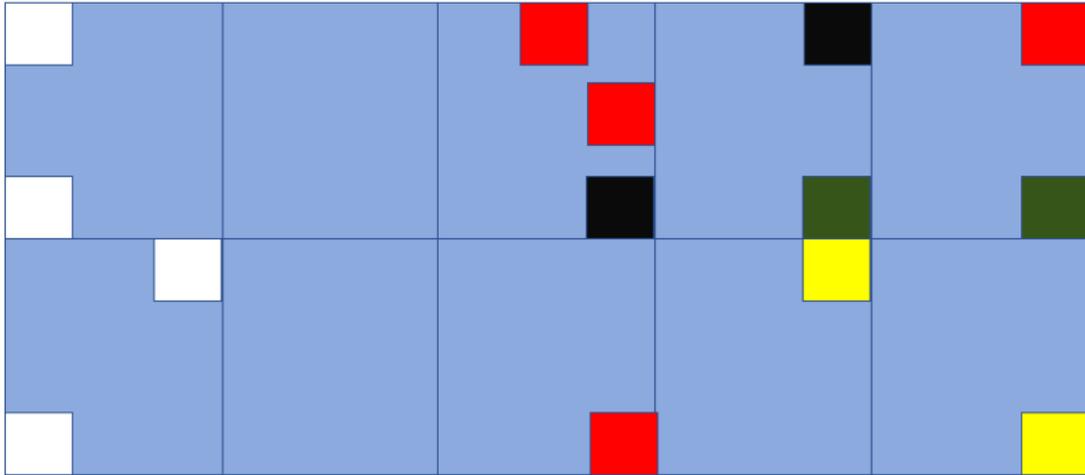


Figure 3.1. The complete simple spatial model of Rio.

north right above the city of Rio, region called Baixada Fluminense), the Green Coast (west of the state) and the Lakes Region (east of the state). These mentioned areas, therefore, are not suitable for a control.

Combining the schematics of Figure 2.7 with the map of Figure 2.8 produces a grid with small switches that has an allegiance according to the color. It can be Militia, CV, TCP, ADA or the police intervention (UPP). It is dynamic across time, changing as slums are invaded and new dominance takes place.

Figure 3.1 showcases the model previously proposed with the favela squares highlighted accordingly to the controlled factions. Because the west zone of the city is practically taken over by the militia, one could divide Rio into two parts and test a differences-in-differences model.

Data

The Instituto of Public Safety of Rio (ISP-RJ) provides monthly data regarding homicide, assault, rape, robbery and drug (both apprehension and trade) and many other types of crime not covered by the research.

CISP and Neighborhoods in Rio

One challenge encountered is the fact that the ISP does not take into account the neighborhoods but police precincts (Circunscrição Integrada de Polícia, in Portuguese, or the acronym CISP, more often used in the following text). Because of this, assuming simple correlation between favela and its neighborhood can be challenging when using crime data of Rio. For example, Vidigal and Rocinha are both from CISP 15, but they relate respectively to Ipanema/Leblon and São Conrado Neighborhoods, placed in different CISPs.

Slums does not respect CISPs or neighborhoods and can spread to multiple ones like Morro dos Macacos in CISP 20 and 25 (see Figure 3.2).

In this research, because of data availability and time constraints, CISP will be preferred instead of Neighborhoods. The Institute provides shapefiles for favelas and CISPs. Using Pebesma et al. (2019) R package, it is possible to use an adjacency function to determine the parent CISPs of each favela.

In general, if a favela gets occupied by the police, all surrounding neighborhoods are considered treated, even if bordered.

Crime Data

Table A.2 has a succinct description of the variables. Data for the entire state of Rio was gathered, but only some areas, such as the capital (city of Rio) was eventually taken into account. It is a panel data with monthly time variance. Crime related data was gathered from ISP-RJ (Institute of Public Safety of Rio, <http://www.isp.rj.gov>).

Population was gathered from the Brazilian Institute of Geography and Statistics (<http://www.ibge.gov.br>). This is the public organization behind geosciences and social statistics in Brazil, responsible for the decennial census and organize all sorts of information from it, besides other periodic researches such GDP calculation, inflation, employment rate and demographics. The headquarters is in Rio. The population

acquired from the institute utilizes an interpolation to get the approximate value of the population per month.

The Pereira Passos Institute works alongside with IBGE, but it is solely focused on the city of Rio. It has a collection of shapefiles, maps and the information for region identification.

The description given by the ISP-RJ for the crime data gathered is as follows:

- *cisp* is the police precinct where the crime occurred. It sometimes corresponds to a neighborhood but this is by no means a rule. CISPs changed over time, with some of them being divided into two. This had to be dealt with during data wrangling, merging back together data from parent and child CIPSS along the years.
- *month* corresponds to the month (and year) when the crime was reported.
- *violent death* means combination of willful murder, aggression followed by death, robbery followed by homicide.
- *robbery* stands for all the data regarding this type of property crime combined together. ISP-RJ gathers crime reported from bicycle and cellphone stealing to grand theft auto. Robbery in Brazil is similar to the definition of the United States: Take something by force.
- *rape* stands for rape and indecent assault (there used to be a distinction until 2009 of both types of crime but since then all of it is considered simply rape).
- *drug crime* stands for any type of drug related crime. Apprehension, trafficking and possession are all within this data.
- *death by police* corresponds to a special case of homicide that occurs when police invades a slum to take control or expel DTO or shooting between police and criminals in the asphalt.

Also, Pereira Passos Institute alongside with ISP-RJ provides information about the starting date of UPP occupation, list of all UPPs and day of its extinction by UPP. Also, it provides spatial data for CISPs, slums and UPP treated slums.

Combining the CISP (neighborhood) information with the spatial data, it is possible to determine the adjacency of each area relating to each slum.

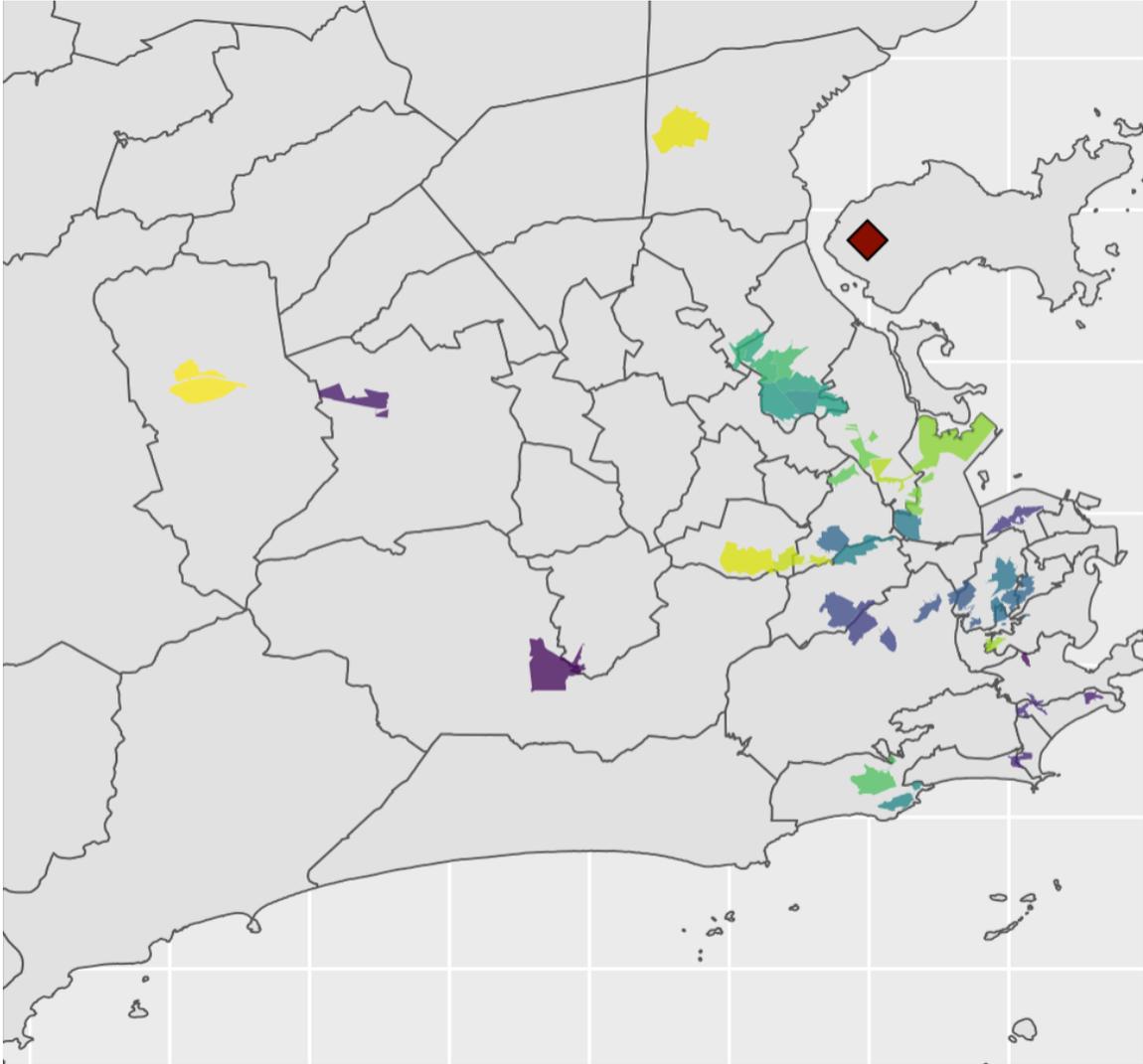


Figure 3.2: All the favelas that got eventually treated by the UPP policy. The red diamond at the island represents the Antonio Carlos Jobim International Airport. The main map borders are not neighborhoods, but CISPs. Some favelas spread to other regions. Source: Public Safety Institute of Rio de Janeiro.

Model

The model used here is a differences-in-differences approach to determine the impact on the neighborhoods (CISPs) of the UPP policy. We will use the west zone of the city, in vast majority controlled by the militia, as a control group in opposition to the north and south zone controlled by DTOs and eventually by the UPPs.

The model proposed is based on Tealde (2015) model. There, the model is used to measure the impact on favelas. Here we will be using it to measure entire areas regardless if it is asphalt or hill, therefore proper adaptations must be done. Equation 3.1 is the adapted model from Tealde (2015).

$$Y_{im} = \beta C_{im} + I_i + M_m + \epsilon_{im} \quad (3.1)$$

Where Y_{im} is a crime rate outcome (per 100,000 inhabitants) per month m per CISP i . I_i and M_m are fixed effects of CISPs and month, respectively. The C_{im}^t (equation 3.2) parameter is an indicator function which produces a series of dummies indicating when a CISP contains a territory pacified (a UPP).

$$C_{im} = I[m - e_i = t] \quad (3.2)$$

Where e_i is the month where the pacification occurred. As a boolean function, if the subtraction is negative, the function produces a 0, if it is positive, produces 1.

Finally, β_t coefficients are differences between the crime of a non-UPP CISP and a UPP CISP. The null hypothesis is $\beta_t = 0$ for anytime and any CISP, which means the UPP policy didn't had any impact on the crime in the city of Rio.

Beginning in 2008, the program would occupy new favelas until 2015. Because of the economic crisis Brazil faced in 2015 until 2017, the program was officially ended in 2018, but only for new favelas. The remaining ones would still maintain its police

presence. Rio, in 2017, asked for help from federal government to maintain peace and order due to a severe financial crisis. The federal intervention started in February 2018 and ended at the end of that year¹.

Because of this fact, the research will only take into consideration the time period spanning from mid-2007 until the end of 2017.

Controls for Spillover

To add further details to the model, we should expect a spillover effect. As one would observe in A.6, the incursion of police in the favelas, setting a permanent occupation in those locations, would just expel criminals to other areas of the metropolitan area. Because of that, the rest of the state of Rio alongside with the metropolitan area are not good controls for UPP. Assuming the militia blocks the entrance of criminals in the west zone of the capital, it is possible to use it to measure both the spillover effect in the metro area and the change in the crime rate of the CISPs having an UPP.

Having this in mind, a second econometric model can be created.

$$Y_{im} = \beta C_{im} + \delta S_{im} + I_i + M_m + \epsilon_{im} \quad (3.3)$$

The additional term $\beta_2 * S_{im}$ is a another indicator function for the metropolitan area of the city of Rio de Janeiro, becoming 1 after August 2010, the Alemão complex operation.

In summary, it is expected due to higher police presence a decrease in crime rate in areas with UPP and an increase in violence due to displacement in the metropolitan area. Other regions of the state of Rio were not included in the regression. The western

¹ For further information, newspaper articles, “Cerimônia marca fim da intervenção federal no RJ” (2018) (Globo, in Portuguese), “Brazil Army Takes Control of Rio Security” (2018) (BBC, in English).

portion of the city was used as control due to militia presence in the slums serving as a barrier to incoming criminal presence.

The challenge is to determine when UPP occupation started creating the spillover effects in other areas. For simplicity, this research will assume the spillover started after the 2010 generalized aggression made by the Red Command which resulted in the largest operation of UPP made so far (Globo, 2010) and (Globo, 2015). This is when Brazilian armed forces and the police of Rio jointly occupied the slum complex of Alemão, with dozens of criminals appearing on the TV escaping the invasion through the jungle.

CHAPTER FOUR

Results and Further Discussion

Table 4.1 is the result of a naive differences-in-differences taking into account only upp regions and the control west zone of the main city. Naive because we do not take into account the potential spillover effect. There are also weak assumptions that should be addressed using an event study. The first is assuming the city (and the metropolitan area) is homogeneous in trend across all regions, which of course it is highly not probable. The second is assuming the spillover effect started exactly after the 2010 intervention in Complexo do Alemão.

Table 4.1. Results only with upp outcome differences-in-differences

<i>outcome</i>	<i>Dependent variable:</i>				
	violent_death (1)	rape (2)	robbery (3)	drug_crime (4)	police (5)
upp	0.032 (0.102)	0.081 (0.092)	-30.576*** (2.478)	4.271*** (0.590)	-0.132* (0.070)
Observations	4,318	4,318	4,318	4,318	4,318
R ²	0.447	0.254	0.833	0.656	0.264
Adjusted R ²	0.425	0.226	0.827	0.642	0.236
Resid. SE (df = 4157)	1.700	1.533	41.185	9.800	1.159

Note:

*p<0.1; **p<0.05; ***p<0.01

The results are not significant with violent death, rape and police, with robbery and drug crime being the most significant results. After adding the spillover effect in Table 4.2, we can see the decrease on average of robbery, violent death (which basically is homicide) and death by police intervention being statistically significant. This can be explained by the police presence enforcing the law in areas not being

protected by the state in past times and by the expulsion of criminals, which would in a short term eliminate conflicts between factions and with the police, a main driving factor for death by police intervention. Conflicts in the west zone would still occur, but not change dramatically. It is important to understand such crimes are all part of the "drug cycle".

Table 4.2. Results using the differences-in-differences model with the spillover and upp

<i>outcome</i>	<i>Dependent variable:</i>				
	violent_death (1)	rape (2)	robbery (3)	drug_crime (4)	police (5)
upp	-0.230** (0.099)	0.034 (0.093)	-31.526*** (1.950)	3.303*** (0.435)	-0.211*** (0.056)
spillover	0.557*** (0.099)	-0.036 (0.093)	15.412*** (1.954)	1.068** (0.436)	0.291*** (0.056)
Observations	7,747	7,747	7,747	7,747	7,747
R ²	0.440	0.262	0.841	0.646	0.253
Adjusted R ²	0.426	0.243	0.837	0.637	0.235
Resid. SE (df = 7558)	1.773	1.667	34.969	7.795	0.996

Note:

*p<0.1; **p<0.05; ***p<0.01

Robbery can be associated with drugs trafficking particularly in Rio. If we assume the model used in Caruso (2010) and at some extent Misse (2011), the youth in a slum faces optimization problem which depends on the overall prosperity of their community.

Generally, DTOs enforce parallel law in the communities they control, decreasing crime rates in the favela, with a contrary effects in much cases in the surrounding neighborhoods (asphalt).

- It can suffer a surge in crime whenever there is conflict in the vicinity. Disorder stimulates individuals to commit crime due to the obvious apparent chaos and

lack of formal authority. DTOs in conflict with the police in the past years (where the police would not occupy but only search and destroy) created sufficient instability for high crime rates in the neighborhoods.

- Robbery in Rio can be related to addiction. Drug users would violently get property from victims to pay their debts, acquiring firearms from local drug dealers. Lower ranked criminals from DTO also carrying weapons would not only obey their leader inside the community but also go to the asphalt to commit robbery.

With a permanent police occupation, the weapons market is crippled at some extent, the conflicts inside the community ceasing to exist and more patrolling in a short term perspective happens on the asphalt.

The same logic could be applied to violent death, with conflicts between factions as a main driving force for this type of crime. Since the west zone is, in a broad sense, more secured than the rest of the city, not much of a change would occur.

The increase in drug crime can be explained by the way it is measured. It is both apprehension of drug material and individuals committing such activities. During the years of the UPP, the entire state was actively persecuting such criminal activity and employing search and apprehend strategy to eliminate the supply of cocaine and marijuana from the parallel market. In the west zone, nothing would change because of no formal state presence.

Rape is a relatively non-related crime, with the weakest results compared to the others. Rape in the context of Rio can come from a plethora of different backgrounds, specially that after 2009 the definition of rape was changed to a more broad definition of aggression (Cerqueira & Coelho, 2014).

Death by police intervention would decrease in areas controlled by UPP since police intervention in Rio is mainly due to conflicts in slums. With UPP present,

almost no conflict is expected to happen, thus, no death by police intervention. The west zone control was not impacted at all by UPP, maintaining a certain stability.

In summary, the simple model reveals a spillover effect on crime during the UPP policy, mainly crimes related to the DTO cycle (property and violent crime related to the drug market).

Event Study

Beyond the basic model, an event study is important to show how such different treated units behaved across time, since there must be also variation between not only control and treat but pre-treated and post-treated. A Differences-in-Differences approach is a comparison between the treated and never treated, an early treated compared to a late treated and a late treated compared to an early treated (Cunningham, 2020) (Goodman-Bacon, 2018).

The event study method is a way of showing leads and lags regression, thus showing that, regardless of absolute time, the change of an outcome is always relative to the time zero. It is expected that because of the parallel trends (which is crucial), the difference in the leads to be close to zero, while noticing a change in the lags.

In this research, we used event study to check the robustness of the assumption that before the interventions, control and UPP treated units were having a similar trend.

$$Y_{im} = \beta C_{im} + \delta S_{im} + I_i + M_m + \sum_{t=-13}^{-1} \gamma_t C_{tim} + \epsilon \quad (4.1)$$

Again, we are using the same model with spillover and the city regions, but additionally we are adding a new dummy term indicating when it is τ months prior to the event, in a UPP treated region. For example, when τ in the γ term assumes the value of -1, it indicates one month before the treatment day (an UPP intervention

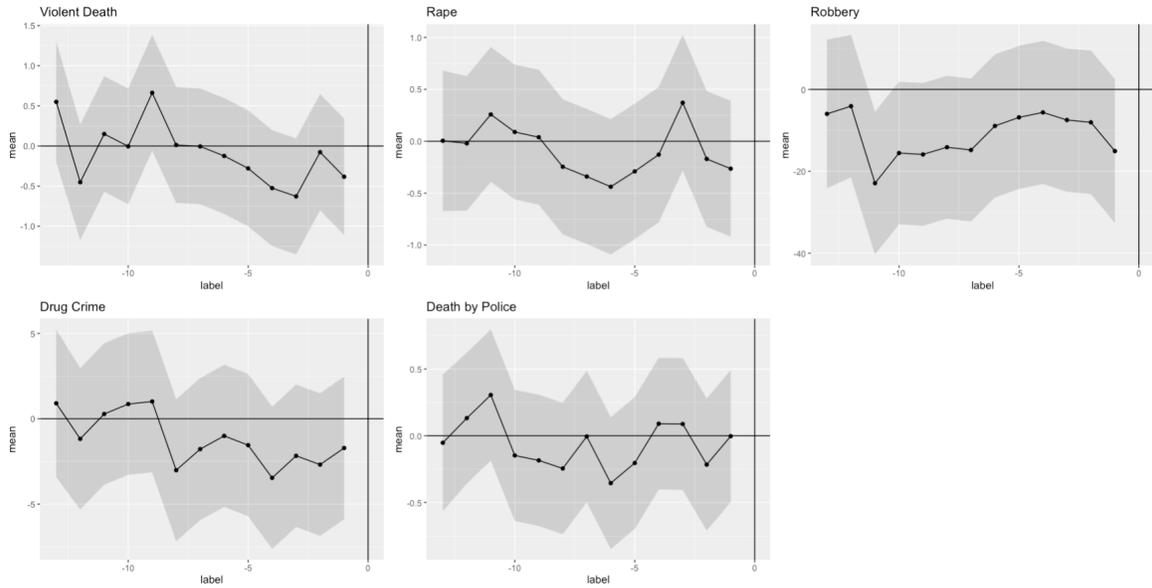


Figure 4.1: Graphs of the event studies, with the exception of some leads in robbery, it shows no significant results.

in the CISP). If it happens in a CISP with UPP treatment, the term assumes value of 1.

Figure 4.1 reveals no significant differences in trends between control and treated in lead periods, revealing we cannot discard the hypothesis that there is no difference at all in the pre-treatment period.

Table 4.3.

	<i>Dependent variable:</i>				
	violent_death (1)	rape (2)	robbery (3)	drug_crime (4)	death_by_police (5)
lead1	-0.383 (0.369)	-0.265 (0.333)	-15.050* (8.942)	-1.712 (2.130)	-0.003 (0.252)
lead2	-0.077 (0.369)	-0.171 (0.333)	-8.030 (8.933)	-2.687 (2.128)	-0.216 (0.252)
lead3	-0.628* (0.368)	0.371 (0.333)	-7.475 (8.922)	-2.171 (2.125)	0.088 (0.251)
lead4	-0.525 (0.368)	-0.129 (0.332)	-5.610 (8.908)	-3.464 (2.122)	0.090 (0.251)
lead5	-0.279 (0.368)	-0.291 (0.332)	-6.831 (8.913)	-1.547 (2.123)	-0.204 (0.251)
lead6	-0.124 (0.368)	-0.439 (0.332)	-8.912 (8.906)	-1.003 (2.121)	-0.355 (0.251)
lead7	-0.005 (0.367)	-0.340 (0.332)	-14.801* (8.895)	-1.780 (2.119)	-0.006 (0.251)
lead8	0.012 (0.367)	-0.246 (0.331)	-14.112 (8.892)	-3.017 (2.118)	-0.245 (0.251)
lead9	0.663* (0.367)	0.039 (0.331)	-15.874* (8.888)	1.013 (2.117)	-0.184 (0.250)
lead10	-0.004 (0.366)	0.089 (0.331)	-15.536* (8.874)	0.860 (2.114)	-0.147 (0.250)
lead11	0.150 (0.366)	0.258 (0.331)	-22.898*** (8.867)	0.280 (2.112)	0.305 (0.250)
lead12	-0.451 (0.366)	-0.021 (0.330)	-4.081 (8.858)	-1.178 (2.110)	0.132 (0.250)
lead13	0.550 (0.382)	0.005 (0.345)	-5.974 (9.254)	0.907 (2.204)	-0.053 (0.261)
Observations	4,318	4,318	4,318	4,318	4,318
R ²	0.448	0.256	0.834	0.656	0.265
Adjusted R ²	0.425	0.225	0.827	0.642	0.234
Residual Std. Error (df = 4144)	1.700	1.535	41.163	9.805	1.160

Note:

*p<0.1; **p<0.05; ***p<0.01

CHAPTER FIVE

Conclusion

The objective of this research was to conclude how effective was the UPP policy in the city of Rio de Janeiro and its potential spillover effect in its metropolitan area. Using a difference-in-differences approach, we found a tendency of crime to go to the other cities of the metropolitan area after the implementation of the policy, using the west zone of Rio de Janeiro city as a control due to militia activity there, enemies of DTO, functioning as a practical barrier for criminal influx. We also found regions with existing UPP had a tendency to decrease its criminal activity, mainly the ones of the "Drug Cycle", which is robbery and violent death. Drug crime increased in this model, with the possible explanation being the massive operations made during that time in the city slums.

The model gave statistically significant results, and the event study of the model showed we cannot discard the null hypothesis, indicating robustness of the model.

In this interview, Globo (2017), the then secretary of public safety of Rio, Roberto Sá, said the UPPs were a too bold project, with a price too high: In 2012 it was created the Additional Work Shift Plan (Regime Adicional de Serviço in Portuguese, ¹ . Since the bulk of new police recruits were being transferred to UPPs, with more expensive training, the asphalt had to deal with a lack of officers. Considering the majority of the population living in the urbanized areas, this unbalance created in the long run instability. The "mandatory" work shift was a palliative care for the state, culminating in 2018 for the first time a state asking for help to the federal government due to bad administration and bankruptcy, losing its autonomy and having

¹ (*Decreto 43.538 - 03/04/12 - Regime Adicional de Serviços - Programa Mais Polícia*, 2012)

the Brazilian armed forces occupying the streets to maintain peace and order until the end of the year.

The UPP program was practically shut down by 2019, with Santa Marta UPP being a notable exception.

APPENDIX

APPENDIX

Neighborhoods, Favelas and UPPs

Table A.1: List of all UPPs

UPP	Favela	Neighborhood (CISP)	Occupation
1	Santa Marta	Botafogo (10)	Nov 2008
2	Cidade de Deus	Jacarepaguá (32)	Feb 2009
3	Batan	Realengo (33)	Feb 2009
4	Chapéu Mangueira	Leme (12)	Jun 2009
5	Pavão-Pavãozinho	Copacabana (13)	Dec 2009
6	Ladeira dos Tabajaras	Copacabana (13)	Jan 2010
7	Providência	Gamboa (4)	Apr 2010
8	Borel	Tijuca (19)	Jun 2010
9	Formiga	Tijuca (19)	Jul 2010
10	Andaraí	Andaraí (20)	Jul 2010
11	Salgueiro	Tijuca (18)	Sep 2010
12	Turano	Tijuca (18)	Sep 2010
13	Macacos	Vila Isabel (20)	Nov 2010
14	São João	Engenho Novo (25)	Jan 2011
15	Coroa	Rio Comprido (20)	Fev 2011
16	Escondidinho/Prazeres	Santa Teresa (7)	Fev 2011
17	São Carlos	Rio Comprido (20)	May 2011
18	Mangueira	São Cristóvão (17)	Nov 2011
19	Vidigal	Vidigal (15)	Jan 2012
20	Fazendinha	Inhaúma (44)	Apr 2012

(continued)

UPP	Favela	Neighborhood (CISP)	Occupation
21	Nova Brasília	Bonsucesso (21)	Apr 2012
22	Adeus/Baiana	Bonsucesso (21)	May 2012
23	Alemão	Complexo do Alemão (22)	May 2012
24	Fé/Sereno	Penha (22)	Jun 2012
25	Chatuba	Penha (22)	Jun 2012
26	Parque Proletário	Penha (22)	Aug 2012
27	Vila Cruzeiro	Penha (22)	Aug 2012
28	Rocinha	Rocinha (15)	Sep 2012
29	Manguinhos	Penha (21)	Jan 2013
30	Jacarezinho	Jacarezinho (25)	Jan 2013
31	Caju	Caju (17)	Apr 2013
32	Barreira do Vasco/Tuiuti	São Cristóvão (17)	Apr 2013
33	Cerro-Corá	Cosme Velho (9)	May 2013
34	Arará/Mandela	Benfica (21)	Sep 2013
35	Lins	Lins de Vasconcelos (26)	Dec 2013
36	Camarista Méier	Méier (23)	Dec 2013
37	Mangueirinha	Duque de Caxias (59)	Fev 2014 ¹
38	Vila Kennedy	Bangu (34)	May 2014

¹ Duque de Caxias is a city of the metropolitan area of Rio, not a neighborhood. Mangueirinha is the only slum outside of the city of Rio to be ever treated by a UPP.

Table A.2. Variable dictionary for the dataset used in the research

Variable	Description
cisp	code for police precinct
region	part of the state of Rio
westzone	dummy variable for the west zone (control)
month	month variable
pop	population of each cisp
morte_violenta	absolute value for violent death
estupro	absolute value for rape
total_roubos	absolute value for robbery
apreensao_drogas	drug related crime
hom_por_interv_policial	police intervention related deaths
violent_death	violent death rate
rape	rape rate
robbery	robbery rate
drug_crime	drug related crime rate
death_by_police	police intervention related death rate

Note. The variables with Brazilian Portuguese names are related to the absolute values of the crime. The English counterpart is the rate. *Estupro* stands for rape, *morte violenta* stands for violent death, *roubo* stands for robbery and *drogas* stands as the name suggests for drugs.

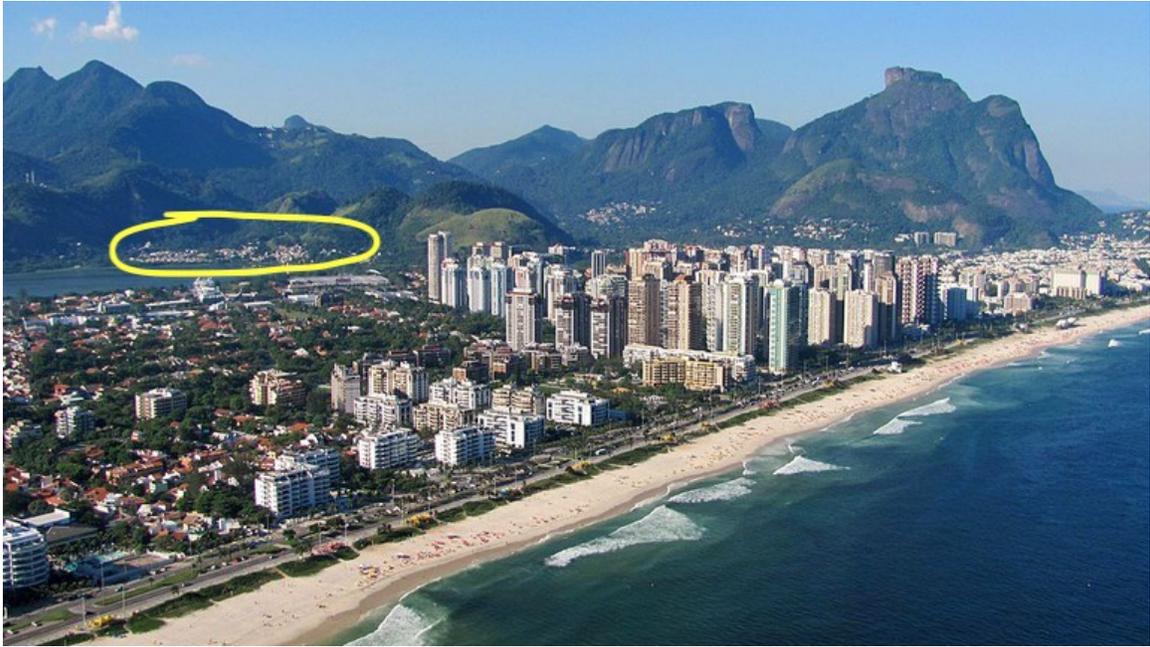


Figure A.1. Barra da Tijuca neighborhood with favela Rio das Pedras.



Figure A.2. Ipanema, Copacabana and Leblon neighborhood with their favelas circled.



Figure A.3. São Conrado Neighborhood and Rocinha.

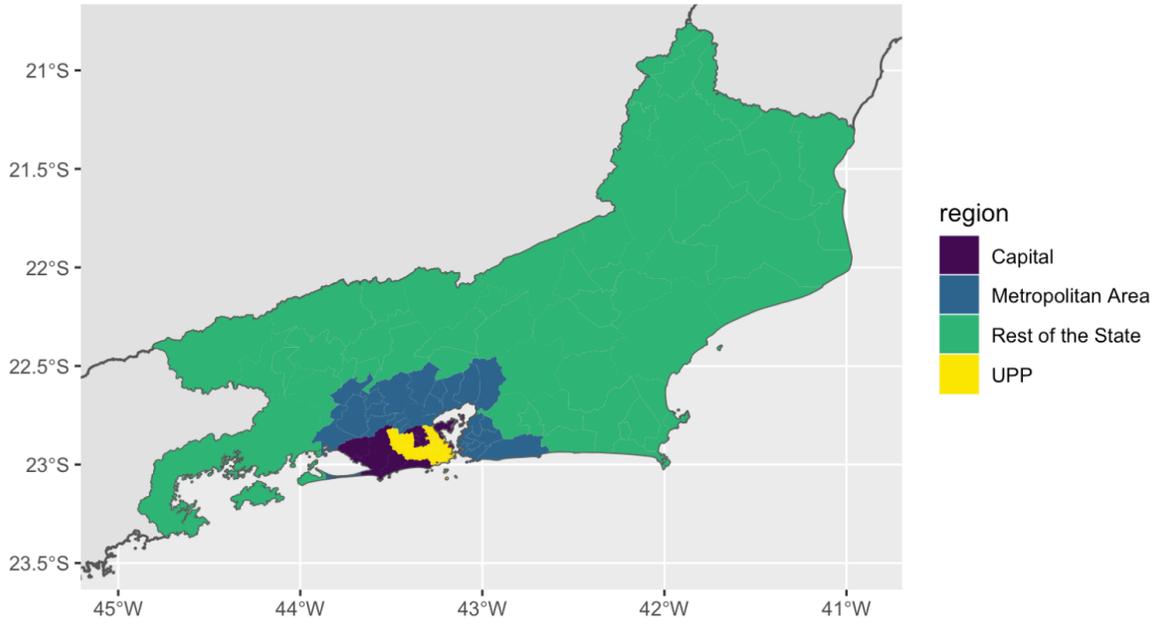


Figure A.4: The main regions of the state of Rio. The bright (yellow) area down south is the capital city CISP's which got UPP occupied favelas.

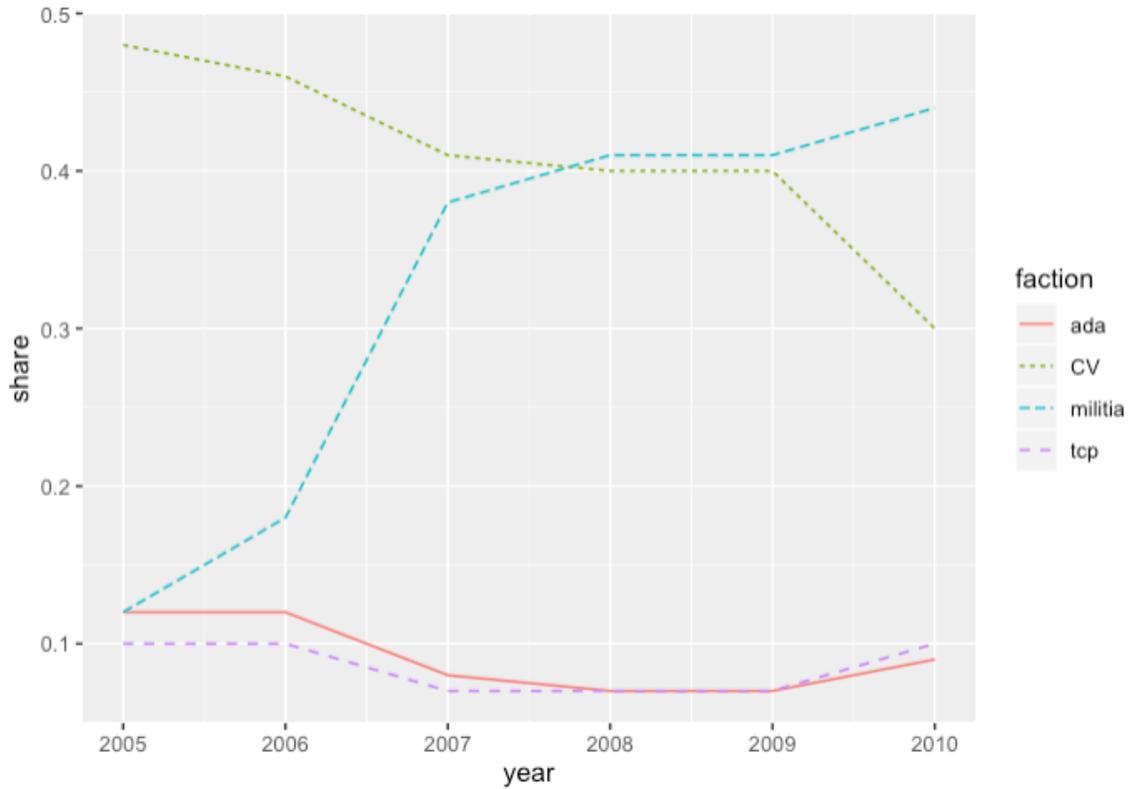


Figure A.5: An approximate proportion of favela dominance in the city of Rio. From 2006 onwards, militia quickly gained momentum. Source: Zaluar and Barcellos (2013)

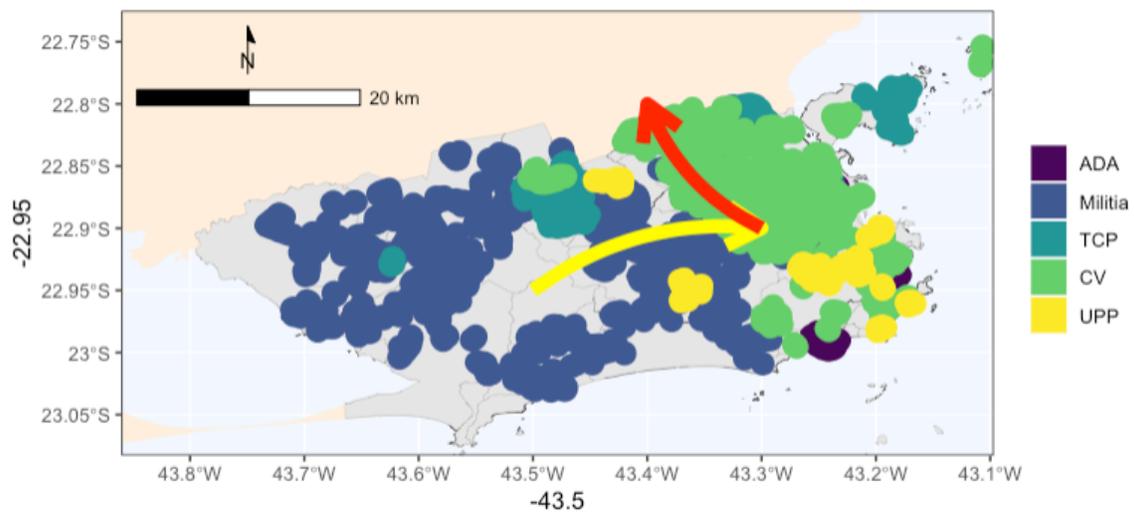


Figure A.6: Crime pressure. Bright/yellow arrow: Militia creates a barrier for DTOs to not enter in the western portion of Rio, while DTOs are expelled by the police in an upward direction (dark/red arrow). Source: Zaluar and Barcellos (2013)

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