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Name: Marcio Alex Marcelino

Supervisor: Demetrio Muñoz Gielen

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How investments in urban services can be financed by the land value capture instrument "Sale of Development Rights" – the case of Curitiba

Marcio Alex Marcelino

Brazil

Supervisor: Demetrio Muñoz Gielen

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Summary

This research studies the use of the land value capture (LVC) tool *Sale of Development Rights (SDR)* to finance infrastructure and services that allow urban development to happen. Local governments work under pressure of tight budgets to manage the urban environment and provide needed services for citizens. In this context, LVC tools appear as an additional source of revenues still underutilized and with great potential to rebalance inequalities in urban development. LVC is the conversion of *increases in land value* – the unearned increment - into extra-budgetary public revenues available for investments in urban demands (Alterman, 2012; Furtado, 2012; Walters, 2016). Therefore, the main goal of this work is to explain how the way the instrument SDR is designed and operated impacts the amount of value captured from increases in value of private land to be invested in urban services.

The study was made with data from Curitiba, in south Brazil. This city uses the SDR to aid financing urban services for almost three decades. It was also one of the pioneer Brazilian cities to use the instrument in the 1990s. The tool was implemented in stages and suffered several modifications, outcoming three different models of SDR currently in operation: *Onerous Concession of the Right to Build* (OODC), *OODC sale through Shares* (OODC-S), and the *Certificates of Additional Potential Construction Bonds* (CEPACs). Each model of SDR is used for different purposes and since 2011 they coexist embedded in the municipal land use plan, raising an opportunity and a need to evaluate its operation in converting increments into public funds.

Based on a theoretical debate, a conceptual framework was elaborated to guide the empirical research made through the method of multiple case study. This methodology allowed observation of the impact of variations of the independent variable *the way SDR is used* in the dependent variable *amount of value captured*, also considering influence of context variables like culture and land markets. The time frame analyzed was between 2011 and 2016. The first investigation made was regarding the way the SDR is used, regarding what rights are charged, where they are charged, how they are charged, how much they cost, when they are charged, and what the revenues are used for. The second examination identified how much the SDR captures in relation to current and increments in value of land and generates revenues in Curitiba. Finally, the data analyzed allowed the drawing of conclusions inferring the causal relation between the studied variables.

The findings exposed that the design of the calculation of the charge affects hardly the amount of LVC. Calculating the price of building rights considering current market values of land or even auctioning the rights produce higher rates of capture than using flat rates. Besides that, the relation between the amount of basic rights that is already in the bundle of rights of the developer and the possible upgrade of these rights also affects how much value of land the tool will be able to capture. The fine tuning of this relation is more important than the adoption of unique FARs when considering LVC capacity. The higher is the result of this relation, the higher is the LVC rate. Moreover, measures to guarantee full purchase of the offered additional development and a long term vision plan embedded in the tool are necessary for higher efficiency. Instruments better planned captured more than the ones used for punctual demands. Finally, the results showed that the coexistence of the many models generates internal competition between the tools impairing their capacity to capture and redistribute resources.

The results also showed that the LVC mechanism of the SDR helped containing land prices' increase in Curitiba. Areas where the instrument operates expressed fewer value increase than areas where upgrade in development is not allowed. When the obligatory payment of charges

is known beforehand by the developer, he may pass this cost to the landowner (Muñoz Gielen, 2010, p.48, 201), converting the raises in public revenues.

The conclusions of this research help understanding how the adjustments of key variables in the use of the SDR impacts the efficiency of the instrument. The Sale of Development Rights is a powerful tool to recover plus values, generate and redistribute funds, aiding finance urban development. But its operation demands a very active market associated to a careful design and implementation. Therefore it should not be used indiscriminately. Constant monitoring of the context including the land and real estate markets, political and tax payer resistance and cultural ideological debates is crucial for the operation of the SDR and promotion of a more balanced urban development.

Keywords

Municipal finance; land value capture; property rights; land markets; sale of development rights; urban services; Curitiba.

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Abbreviations

BNH	Housing National Bank
CEPAC	Certificates of Additional Potential Construction Bonds
COHAB-CT	Affordable Housing Company of Curitiba
CVM	Commission of Mobile Values
DR	Development rights
FAR	Floor Area Ratio
FMH	Municipal Housing Fund
GDP	Gross Domestic Product
GIS	Geographic Information System
IGP-M	General Index of Market Prices
IHS	Institute for Housing and Urban Development
INPESPAR	Paraná Institute of Research and Development of the Real Estate and Condominium Market
IPPUC	Institute for Research and Urban Planning of Curitiba
IPTU	Urban Land Tax
LVC	Land Value Capture
OODC	Onerous Concession of the Right to Build
OODC-S	Onerous Concession of the Right to Build - Shares
OU	Urban Consortium Operation
OU-LV	Urban Operation Green Line
R$	Brazilian Real
SDR	Sale of Development Rights
SMF	Municipal Finance Secretary
SMMA	Municipal Secretary of Environment
SMU	Municipal Secretary of Urbanism
TDR	Transfer of Development Rights
UIEP	Unit of Special Interest for Preservation
US$	American Dollar

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Chapter 1: Introduction

As stated in most actual literature, the process called urbanization seems to be an irreversible trend. However, the current understanding of this phenomena is that it may not be restricted or avoided, but guided as more effective as possible in order to support a sustainable development (McGranahan, 2014). The more people are living in cities, the higher is the pressure over local governments for urban services ranging from hard infrastructure such as water supply, roads and housing to soft services including parks and amenities (Slack, 2009). Adding the global movement of *fiscal decentralization*, which distributes responsibilities for expenditures and revenue generation among different levels of governments (Muwonge, 2014), a complex framework emerges in which local municipalities need to manage the urban tissue and provide services for the citizens.

1.1 Background: Sale of development rights to finance Brazilian cities – the case of Curitiba

1.1.1 Brazil: decentralization and the finance of cities

In Brazil, the decentralization process started to take a greater body with the promulgation of the 1988 Constitution, which stated the division of responsibilities and expenses regarding social services and infrastructure among the three levels of government of the federation: the Union (federal), the states and the municipalities (local).

According to Afonso (2000), however, in reality the distribution is seen as unclear and often generates overlapping in spending and unfair provision of resources between different parts of the country. Despite that, what is very clear in the national law is that the delivery of services which have local character must be done by local governments, such as garbage collection, parks, local roads and housing. In order to pay for these urban services, municipalities are able to collect tax on services of any nature and, the most important one, tax on land property (Afonso, 2000).

Brazil has a system to address fiscal imbalances between regions and different levels of government, which guarantees regular transfers from the Union to the cities (Monteiro, 2014). Nevertheless, this process can make cities very dependent on the national government and, as the approval of transfers involves some political decision, cities can also be hostages of political disagreements. Therefore, several municipalities started to use another form of revenue generation to become stronger and independent: *land value capture*.

1.1.2 The development of land value capture in Brazil

Land value capture is a financial process operated through a set of policies and instruments used by local governments to convert capitalized values of land in public revenues to be used for investments in infrastructure and delivery of urban services. These tools can guide urban development and turn possible sharing benefits of this process in an equitable way among society. The sharing is made through the capture of increments in value of land that would be absorbed by few landowners and investment of these values in pro of the community (Peterson, 2009; Furtado, 2012; Smolka, 2013; Walters, 2016).

The Brazilian national law *Estatuto da Cidade* (City Statute), established in 2001, regulated the articles 182 and 183 of the 1988 Constitution which legislate about urban policy. The *Estatuto* provided the municipalities with powerful tools to manage their territory and use land value capture tools to promote equitable urban development (Sandroni, 2010). One of the most

important concepts consolidated by the regulation is the separation of the right to build from the collection of land ownership rights. This idea, added to another concept established - the *social function of land*, which is the accomplishment of the requirements of the city`s land use planning laws by the land property - were responsible for the implementation of innovative and creative policies by different municipalities to promote and finance their development (Sandroni, 2010).

1.1.3 Charging development to finance development

One of the instruments present in the 2001 *Estatuto* and being currently largely used in Brazil is the *Sale of Development Rights (SDR)*. Due to the Brazilian context of cultural and legal strength in separating the development rights from property ownership, this policy allows public recovery of land value increment derived from public actions by charging extra building rights above predetermined basic limits (Smolka, 2013). This instrument has its roots in the French urban reform *Plafond Légal de Densité*, of 1975, which influenced in 1976 discussions among Brazilian urban experts culminating in the release of the *Letter of Embu*. This document argued in favor of the adoption of an unique floor area ratio (FAR) for all urban land and densification of specific areas through sale of development rights – instrument named then *Solo Criado* (Created Land) (Grau, 1983). The Brazilian concept of the SDR included in the *Letter* stated that when the basic floor area ratio is one, every constructed area above this ratio would need a virtual new land, new plot, to accommodate this extra development. Therefore, the developer would pay society for this new virtual land in money or in kind, with another plot with the same area.

As the debates around the *Letter of Embu* were acquiring bigger proportions, some municipalities started using the Sale of Development Rights partially based on the concepts of the *Solo Criado*. That is the case of São Bernardo do Campo in 1977, Florianopolis since 1989, Curitiba since 1990, and Natal and Porto Alegre from 1994 (Furtado and Maleronka, 2014). But it was only more than 20 years after the first discussions that the SDR was nationally regulated with the approval of the *Estatuto da Cidade* in 2001.

The *Solo Criado* was framed by the *Estatuto da Cidade* with a different name: *Outorga Onerosa do Direito de Construir (OODC)* - Onerous Concession of the Right to Build. The national law regulated two main purposes of the instrument: generate revenues for financing urban development through capturing value of land and steer private development (Walters, 2016; Rezende, 2006). This means that a municipality could use resources from the OODC to invest in delivery of urban services and infrastructure and also use the same tool to encourage development in certain areas and restrict in others. The land value capture mechanism behind the instrument is based on the principle that if society must provide infrastructure and services in order to foster land development over basic limits, society cannot favor one landowner over the others when conceding extra building rights. Therefore, when the additional development rights are charged, the land value increment resulting from improvement in infrastructure and authorization of development above the basic line can be captured and reverted to society in the form of services, sharing the capital benefits originated from the public permission to urban development (Smolka, 2013).

The *Estatuto da Cidade*, however, left the way of using the OODC attached to local governments individual urban policies. This fact resulted in diverse models of implementation of the instrument across the country (Teixeira and Moreira, 2011). As its use is strictly linked to high market demand for additional development (Walters, 2016), in the past years, application of the tool was observed mainly in cities with accelerated growth or which were

passing through huge structural modifications, like redevelopment for accommodating new transport modes or industries (Furtado, 2006).

1.1.4 Sale of Development Rights in Curitiba

The city of Curitiba was one of the pioneers in Brazil in the use of SDR and began to charge development rights in order to finance investment in social housing programs. When the *Housing National Bank* (BNH) was extinguished in 1986, the cities stopped receiving resources from the national government for financing affordable housing. Therefore, the charging for extra building rights was structured in 1990 in order to finance investments to attend the increasing housing demand by earmarking the revenues from the SDR to a specific fund exclusively for this purpose: the Municipal Housing Fund (FMH) (Teixeira and Moreira, 2011). The FMH was managed at the time by the *Affordable Housing Company of Curitiba* (COHAB-CT), which was then responsible for investments in delivery of social housing. In 1995, the local government started to use the same instrument to protect large green areas in private land, by allowing building in higher density under the condition of the preservation of an extensive part of the green field and the payment of the additional development concession. The revenues, in this case, were allocated in an Environmental Fund and in a Social Fund, to be used in capital expenditures for environmental management and programs related to improvement of quality of life. The form of calculation of the charge was made through assessment of the value of the land to be developed and application of a reduction index. The price then could be paid in money or in kind. This last possibility was only available if the rights were acquired through the COHAB-CT, by transferring another plot for free to the Municipality to be used for affordable housing. During the 1990's, these two ways of using SDR were being operated disconnected from the land use planning laws, incurring the risk of encouraging development over the density desired by the original land use plans. So, an integration of the SDR in the Curitiba's masterplan was necessary to secure sustainable use of the tool and control of urban development.

In the year 2000, the review of Curitiba`s Land Use Plan delivered a package of local laws (law 9800 until 9808/2000 and other decrees) regulating several urban policy instruments, and among them, the *Sale of Development Rights*. The Municipal Law 9801/2000 stated the urban instruments to be used in the city and the goals of urban services provision to be financed by these tools, including construction of amenities, creation of public spaces and investments in social housing. The Municipal Law 9800/2000 was the legal framework of the land use plan, giving the directives of zoning, uses and land occupation parameters . This law reviewed and stated new basic Floor Area Ratios (FAR) for each zone which, on the contrary of the logic of the instrument SDR (the principles of the *Solo Criado* stated by the *Letter of Embu*), were not unique to all land in the city, but differentiated according to each zone.

The Municipal Law 9802/2000 regulated the SDR for financing social housing and defined which zones were able to acquire extra building rights. The upgrades could increase both the basic FAR and the number of floors to be constructed, or only one of these building rights. The form of calculation of the concession is different depending on the right acquired. The Law 9802/2000 also opened more possibilities of the use of the FMH funds – which receives the revenues from the SDR and earlier could until then only finance affordable housing construction, allowing since then investments in infrastructure and amenities which were linked to social housing areas. Following the same parameters of the law 9802, the Municipal Decree 194/2000 regulated the SDR for financing environmental protection and social programs, but did not change the earmarking of the revenues (which remained the same as in 1995).

In the development of these regulations until the year 2000, Curitiba was pioneer and somewhat did not need to comply with any national urban legislation (except for a national law regulating minimal urban parameters and the Constitution). However, after the *Estatuto da Cidade* was implemented in the year 2001, it was necessary to adapt the local legislation to the new national law. Therefore, Curitiba employed in 2004 a new local law (11266/2004) suiting the land use planning regulations of the year 2000 to the *Estatuto da Cidade*. The law 11266/2004 integrated the OODC instrument as stated in the *Estatuto* into the municipal land use planning law and specified the revenues from it to be used in investments in urban services such as social housing, heritage and environmental conservation, development steering, creation of public and recreational spaces, and construction of community facilities (Teixeira and Moreira, 2011). From 2004 on, the Curitiba's version of the SDR first baptized as *Solo Criado* changed the name and started to be called OODC.

1.1.5 Variations in the way of using SDR in Curitiba: shares and the CEPACs

Additionally to the OODC, Curitiba developed two more models of SDR to attend other demands of urban development.

1.1.5.1 Historical buildings conservation through shares of development rights (OODC-S)

While facing difficulties to finance the restoration and conservation of huge and institutional historical buildings of the city, the Municipality created in 1993 a new mechanism to collect revenues for this purpose by selling to the real estate market *shares* of development rights. The historical building that would be restored would first be classified by decree as an *Unit of Special Interest for Preservation (UIEP)*, and then would have a certain amount of shares associated to it, earmarking the revenues for the restoration works. Every share corresponds to 1 square meter, and the price is fixed according to the expected costs of restoration. This tool was originally developed over the basis of the instrument *Transfer of Development Rights (TDR)*, and not the SDR (Ciffoni, 2011; Polucha, 2017a). TDR is an urban tool used to allow landowners to sell unused development rights to other property. The amount of rights to be transferred is limited to the availability of unused potential development from the property which cede the rights. Once the potential is transferred, the original land cannot be developed with the ceded parameters anymore. Differently from the SDR which is used by the government to sell building rights to upgrade developments and generate resources, TDR is a private transaction which happens between landowners. It does not produce financial income to the government and is normally managed to allocate density and compensate landowners that have legal limitations to develop their properties, like environment sensitive areas (Walters, 2016). However, in this case of Curitiba, the creation of stocks of shares independent of the potential development of the historical buildings, as well as the possibility of renewing the potential every ten years set this tool more in the logic of a SDR *earmarked* for historical buildings conservation, and not a TDR from them.

1.1.5.2 Public facilities and services provision through shares of development rights (OODC-S)

In the year of 2003, in order to push slum upgrading programs in Curitiba, the Municipality developed a variation of the SDR, using the basis of the OODC but with a mechanism of creating by decree limited quantities of extra buildable square meters rights to be sold to the real estate market. Those square meters rights were also named "*shares*", they had a fixed price,

and their amount was created according to the resources needed to be applied in programs of slums reurbanization. This SDR variation works equals to the model used to restore historical buildings (UIEP). From 2009, the municipality started to use the OODC *Shares* model to finance investments in community facilities, specifically schools and child care centers. That way, for each urban service investment the city wished to finance through the OODC with shares, a specific decree was necessary to create a limited quantity of extra buildable square meters, earmarking the funds for that specific urban service. Several decrees were released since 2009 for financing construction of schools, childcare centers, communitarian facilities, road works and creation of public green spaces. In 2010, one stock of OODC shares was created in order to capture resources for investment in a private stadium through a controversial public-private partnership to host the 2014 World Cup in the city (Polucha, 2017a).

1.1.5.3 Infrastructure through CEPACs

In 2003, the local government started an urban redevelopment project consisting in integrating into the urban tissue a federal road that crosses the city. As the funds available were not enough to complete the intervention and more improvements were necessary, in 2011 this project was shaped as an "Urban Consortium Operation" (OU) (Soffiatti, interview 2017), which is another urban instrument stated in the *Estatuto da Cidade*. This instrument allows cities to improve urban areas through a detailed plan of intervention, changing the zoning, upgrading development rights and charging for them. The intervention was named *Urban Operation Green Line (OU-LV Operação Urbana Linha Verde)* and it is the fourth Brazilian case of OU, offering 4,830,000 square meters of additional development rights. All the development rights and other urban benefits inside the *operation* are released to the developer or landowner when he pays for these development concessions, in a SDR (Neto, 2013). The revenues from this SDR can only be invested in urban development inside the OU. The development rights in the OU-LV were sold by the Municipality using another variation of the SDR: by auctioning special bonds in the stock market corresponding to the extra building rights. These bonds are named Certificates of Additional Potential Construction Bonds (CEPACs) and, theoretically, their operation mechanism through auctions allows the building rights to be sold by the market value (Smolka, 2013).

The following table summarize the variations of the SDR in Curitiba in the past three decades:

Table 1: Summary of variations of SDR in Curitiba.

Model of SDR	Public facility & services *purpose*	Year of introduction
OODC (*Solo Criado*) *Calculation: market value*	Social Housing	1990
	Environmental Protection / Life quality	1995
OODC-S (Shares) *Calculation: price + index*	Historical Buildings conservation (UIEP)	1993
	Slum upgrading	2003
	Public facilities	2009
	World Cup Stadium	2010
CEPACs *Stock market*	Infra and public spaces	2011

1.2 Problem Statement

1.2.1 The use of SDR in Curitiba and its limitations

The different ways SDR is used in Curitiba have some apparent disfunctionalities which limit the capacity of value capture and revenue generation of the instrument (see also next section 1.2.2). The base line of development - the basic *Floor Area Ration* (FAR) – established by the land use plan is not unique and equal to one for all urban land – one of the main basic logics of the SDR (see section 2.5). Depending on the zoning where a piece of land is located, the landowner might own the building rights equivalent sometimes to five times the area of the land (FAR=5). This fact may reduce drastically the capacity of land value capture of the instrument, since not only the revenues obtained from few additional development rights sale might represent a little part of the land value but also their acquisition may often not be necessary. Only some extra FAR, density or extra floors are charged, which represents a little part of the total potential development.

The value charged for the building rights of the OODC-Shares since 1993 (second variation of the SDR) is being simply tagged without any apparent linkage with real estate property values. Every *share* represents one square meter and its price is fixed, varying only depending on the time and purpose of the decree. So, in a first look, the instrument could be capturing distorted and disproportional amounts of land value, since the upgrade's cost is the same in any area of the city able to receive extra building rights, independent of their current use value. The price of land in Curitiba in 2016 varied from around R$ 600 to R$ 4,000 per square meter (INPESPAR, 2017). Therefore, charging around R$ 700 for the both extremes is disproportional. When fixing the SDR price, the values being captured by the instrument might be too high or symbolic and much lower than the real market value of the serviced land. In this last case, as stated by Furtado (2014), the bigger part of profit from the urban regulations and public investments is being privately absorbed by the property owners and not by society.

The upgrade of development rights made through many different models might be generating a predatory competition between the instruments. The CEPAC operates in a closed boundary and the OODC and OODC-S operates usually in the same areas. As they usually sell the same upgrade for different prices, the LVC might be being impaired. Besides the SDR, the additional building rights in Curitiba are also negotiated through other kinds of transactions, like transfer of development rights (TDR) from historical buildings aimed at preservation and transfer of development rights (TDR) from green areas stated as conservation reserves. It is important to note that the *TDR*, although managed and regulated by the local government, it is a private transaction and not a public revenue tool (Walters, 2016). So even though there are in this process benefits shared with society through historical buildings and environmental conservation, there is no revenue generation in money for new public investment. The coexistence of these modalities of transaction of extra development rights could possibly be generating competition between them (Furtado, 2006), impairing the achievement of the policies` goals in land value capture. Price differences, cultural aspects including perception of the SDR as a tax and resistance of developers to pay for it may lead the acquisition of the extra potential through these private transfers (TDR).

1.2.2 Limitations of the use of SDR in Brazil: the broader problem

A study developed in 2006 by Furtado in 12 Brazilian cities showed that the resources captured by the SDR are frequently inexpressive and very low comparing to other revenue sources. Nevertheless, according to that research, municipalities see potential in the instrument to aid

finance their expenses and improve urban development. Therefore, Brazilian cities seek for ways to enhance the efficiency of the tool.

The same study exposed the diversities in the way the instrument is used across the country. The form of calculation varies as using the virtual land area necessary to accommodate additional development, a percentage of the estimated construction cost and the simple multiplication of the additional right per the square meter value of land. The assessment of land values is done in some cities through fiscal cadaster plans, frequently not updated, and in others through market value appraisal. The assignment of the basic and maximum FAR varies from some municipalities stating basic FAR as 1 while in others the baseline can be 5. The land uses that can acquire additional development rights are also not uniform. The earmarking of the revenues of the SDR diverges from very specific, like social housing and infrastructure, to complete absence of earmarking (Furtado, 2006).

All these varieties generate different results of LVC and consequently diverse possibilities of financing urban development. The national law *Estatuto da Cidade* encompasses concepts and theories that might have been disregarded or misunderstood and applied in a questionable way when incorporated in the municipal level regulations. Therefore there is a need to enlarge the knowledge about the use of SDR in Brazilian cities.

1.2.3 The opportunity of Curitiba

Curitiba was one of the pioneers to use the instrument SDR and holds more than 27 years of experience with it. The implementation of the SDR in Curitiba happened in stages passing through different periods of time, therefore different political phases, different land markets dynamics, different approaches and demands of public administration. The three different ways the SDR has been used in the past decades – OODC, OODC Shares and CEPACS - reflect different understandings and implementation methods of the tool. Since 2011, the three models of SDR coexist embedded in the land use planning of the city. These factors make this city a good example to be studied. There is an opportunity and a need to evaluate whether the ways the instrument *Sale of Development Rights* is used in Curitiba are working well or not.

1.3 Research Objective

The objective of this research to explain how does the design, implementation and operation of the instrument *Sale of Development Rights* (in its three variations OODC, OODC through shares (OODC-S) and CEPACs) impacts the amount of value captured from increases in value of private land in Curitiba when used to finance investments in public services and facilities.

1.4 Research Questions

In order to achieve the objective above, this research will be steered to answer the following main question:

How does *the way Sale of Development Rights is used* to finance public services and facilities in Curitiba impacts *the amount of value increase captured* from privately owned land?

In order to address the main question, the following sub questions will be answered:

1. How was the SDR designed and implemented in Curitiba and how is it operated to finance public services and facilities?

2. What is the amount of value increase captured to finance public services and facilities from privately owned land by the SDR?

1.5 Significance of the study

1.5.1 Social relevance

The findings of the study will help to better understand how the instrument SDR works in different approaches and evaluate the feasibility of its use as a financing tool in the Brazilian context. It is important in the context of a country like Brazil, where wealth and land ownership concentration leads to social injustices, that advanced tools which allow sharing of urban benefits as the SDR be promoted and improved. The lessons to be raised by this work can be possibly replicated to other Brazilian cities which also deals with the problematic of how to improve efficiency in the use of the SDR (see section 3.7 about external validity).

1.5.2 Academic relevance

As mentioned in section 1.2, Curitiba has a large history in the implementation of urban instruments, specially the charging for building rights to finance urban development. This study will enlarge knowledge regarding when and how a land value capture mechanism can be effective or not, and raise the debate about its feasibility as a financial tool of urban development. It will fill the theoretical gaps regarding the influence of the SDR in land values, the mechanisms and rationales of the SDR, the debate around SDR and property rights, the functional principles of the SDR and the amount of LVC to be promoted, and the impact of the land and real estate markets behavior in the amount of LVC. A theoretical framework will be constructed which can be used to analyze other cities.

1.6 Scope and limitations of this research

This work will examine policies designed for provision of *public services and facilities* which were financed by the SDR, such as social housing, public facilities, historical buildings conservation and hard infrastructure, and identify several measurable aspects that varies in the different designs of the tool in order to explain their causal relationship with land value capture. Specific timeframes will be analyzed following criteria explained in detail in the method of selection of cases in section 3.3.

The major limitations in the development of this study are concerning some collection of available data (like prices of land), the certainty of the causality identification and the generalizations of the findings. Explanations and measures to contour these limitations will be treated in the *reflections on validity and reliability* in section 3.7.

CHAPTER 2. Literature Review

2.1 Introduction

The literature review in the following sections addresses theories and concepts that supported the development of the conceptual framework used to answer the main research question of this work: *How does the way Sale of Development Rights is used to finance public facilities in Curitiba impacts the amount of value increase captured from privately owned land?*

First, the section 2.2 presents a contextualization of municipal finances and its challenges within the global trend of decentralization. The increasing demand for urban services in a reality of local governments lacking of resources calls for the use of alternative tools, being one largely discussed in literature *land value capture.*

Land value capture consists in sets of instruments local governments use to revert increases in value of private land in public revenues to invest in urban development. The use of these tools, though, have big implications in property rights and land use planning issues. The section 2.3 addresses the evolution of the concepts of property and property rights, and start discussing some implications of value capture application, for example, who is the owner of increases in value of land?

The following section 2.4 debates the conceptualization of land value capture, the justification of its use to finance urban infrastructure and facilities, and seeks to briefly differentiate its ways of application. In order to answer the first research sub-question (*How was the SDR designed and implemented in Curitiba and how is it operationalized to finance public facilities?*), section 2.5 will discuss specifically the LVC instrument *Sale of Development Rights,* covering the several forms of design, implementation and operation of the tool within land use planning regulations, cultural pressures, administrative capabilities of local governments and the condition of local land markets.

Section 2.6 examines the use of SDR in the specific context of Brazil, presenting the national efforts to first introduce and then uniform the implementation of the tool. It will briefly cover experiences in different cities to support the theoretical argumentation regarding the instrument and draft some analysis about the results of Curitiba's use of the SDR, stating the basis for answering the second research sub-question (*What is the amount of value increase captured to finance public facilities from privately owned land by the SDR?*).

Finally, section 2.7 combines all the concepts debated seeking for the relations between them in order to shape the conceptual framework and steer the development of the empirical research.

2.2 Municipal Finances and the provision of urban services

Public services and facilities, or urban services, consist of the infrastructure and services that allow urban development to happen. They range from water, electricity and mobility infrastructure, to housing and social services as health and education (Slack, 2009). The types and level of demand for urban services are directly affected by land development, consequently impacting municipal finance. Paulsen (2014) suggests a theoretical framework to explain the effect of land development in the municipal finances. Consider a system in equilibrium (city) which suffers a "shock" (land development). Expenditures, revenues, land values and level of urban services demanded change in response to *land development* achieving a new state of equilibrium. What can be understood here is that land development could, in theory, pay itself.

Urban development would attract more residents, raising the demand for public services, generating more expenditures, however also raising the tax base generating more revenues. The development push land values up, giving opportunity for more public revenues generation. At the end, a new state of equilibrium would be achieved with balance of this variables in an urban serviced area.

In this sense, land use planning has a crucial role in the management of the interaction between land development, municipal budgeting and infrastructure provision. Land use policies controlling the form of occupation of the territory may have huge impacts on municipal budgets. Urban plans leading to inefficient occupation of space and consequently urban sprawl, for example, lead local governments to struggle in order to provide infrastructure and services in higher amount than necessary comparing to a denser compact city development (Lynch, 2015). Some scholars, however, argue that when considering all government expenditures, policies increasing density trend to increase per capita public expenditures, and not reduce them (Holcombe, 2008).

In order to provide urban services, local governments may work in a similar way to any business. They deliver them in exchange for the appropriate payment (Bird, 2011). The way these payments are made manifests in different forms, some more obvious like user fees for electricity, for example, and others not so much, like benefit taxes regarding infrastructure improvement. There are also services that benefit the whole community and individuals shall not be excluded from them, independent of their willingness to pay for it, like police protection and street cleaning. These last services are named public goods (Freire, 2014). This business management of the revenues and decisions on expenditures, including financing infrastructure and operation of recurrent services is defined as *Municipal Finance* (Slack, 2009).

2.2.1 Municipal finance in decentralized governments

Around the world, democratic nations are undergoing a trend of fiscal decentralization. The rationale of this process follows the theory of the *Subsidiary Principle*, which states that public services should be provided by the lowest level of government at the same time that the collection of taxes should be assigned to the lowest level of administration which can perform this task better. The principle translates that the government level which is “closer to people” is the most capable of efficient service provision. The same theory encompasses a list of services which should be assigned to local governments including soft infrastructure as education, healthcare, garbage collection and land use planning, and hard infrastructure, such as roads, transportation, pavement, facilities, water and sewage systems (Alm, 2015).

Although an administration closer to people may be able to identify the needs of the citizens and, in theory, the decentralization process provides local governments autonomy and independence on the expenditure of resources, the perfect ideal and balanced scenario for financing infrastructure provision does not exists (Alm, 2015). Resources available are commonly insufficient to attend the demand, leading municipalities to vicious circles of national level transfers or borrowings that may lead to political control and lack of independency.

2.2.2 Expenditures and revenues

In a municipal context there are mainly two types of expenditures: capital and current expenditures. The last one refers to operation and maintenance assignments in the provision of urban services. Those are regular and recurring costs and are usually financed by current operating revenues, like user fees and taxes. Capital expenditures, on the other hand, refers to

usually one time investment in long-lived assets used to provide public services. This refers to facilities including schools, parks, health care centres and other hard infrastructures like sewage, power plants and public transportation systems. These assets normally demand high initial investments and are often left in a second place behind the more urgent current expenses (Alm, 2015; Slack, 2009).

Alm (2015) classifies the sources of revenues from local governments in three categories: borrowing, municipal own-source of revenues and intergovernmental transfers. Borrowing is typically used for financing only capital expenditures, while municipal sources and transfers might be used for both capital and current expenditures, depending on the nature of the resource. Municipal own-sources of revenues may come from fees over provision of different services, in a *cost recovery* logic, from taxes over private services profits, and from, probably the most representative source, the governance over land property. This last source refers to taxes, charges and fees local governments collect over the profits and property of land.

2.2.3 Collecting revenues from land: capture of value

Henry George, American thinker of the XIX century, developed in 1879 the idea of a "single tax" to be charged on land. He argued that land could not be hidden, a tax on it could be assertively calculated and its collection would be easy and inexpensive, making it "the perfect tax". Despite its tax shape, the land tax would be in nature a *rent*, collected over the use of values inherent to land that are actually created by the community. The value attached to land arises from community growth, so the land tax is a taking of this value back to the community. His theory stated that if charged on an ongoing basis, the land tax would be enough to pay for all community's expenses (George, 1879; Alterman 2012).

The taxation over land property is widespread around the world. This collection, however, is very far from the *Georgian* concept of value created by society and usually is able to capture only small parts of land values. George's ideas then are used to advocate the adoption of additional mechanisms besides the *land tax* to improve the recapping of land values and finance urban development. The problem is that while a *weak* tax on land property can be largely accepted, *stronger* taxes and more powerful land value capture mechanisms start a bigger ideological battle with the understanding of property and encounter more resistance to be implemented both in developing and developed countries (Alterman 2012).

The next section will debate the diverse understandings of the concept of property rights and lead to its relationship with land value capture policies adopted by local governments to finance urban development.

2.3 Property rights

> *You are lost if you forget that the fruits of the earth belong to all and that the earth itself belongs to no one! (Rousseau, 1775 apud Alterman, 2012, p. 757)*

The concept of private property is a social and legal creation, which means that it is subject to changes when those institutions evolve. Applying it to land, the concept discussed today has its roots in the French and American revolutions of the XVIII century. In the past hundred years, it was the center of debate between the political economic theories of socialism and capitalism,

communism and democracy (Jacobs, 2013). Considering the prevail of the second and fourth, private property is being treated as the basis of these economic and social frameworks, at the point that the degree of protection given to property can indicate the level of economic strength and freedom of a country (Alterman, 2012; Jackson, 2011 apud Jacobs, 2013).

The development of the theory of Economics added political and economic rationales to the central arguments of private property concept. The political rationale is linked to democracy, while the economic rationale is linked to market mechanisms. The concept of property is being sculptured according to the stages of economic, social and cultural development of society (Jacobs, 2013).

Access, rights over and possession of land, as well as forms of dealing with conflicts regarding it are the center of the current debate involving private property. Jacobs (2013), argues that as property is a creation of society, society defines what property is or is not, what is public, private or other form, and society may change this definition whenever it is necessary for the needs of the public. This discussion became more intense with the Garret Hardin's paper debating the conflicting relations between personal interests and social interests, what he called the "Tragedy of the Commons". It raised questions about "*resources owned by none but used by all"* (Jacobs, 2013 p.93), like the air and water. This debate culminated in a new rationale of the role of society and public management in protecting and seeking sustainable development, which transformed the concept of property (Jacobs, 2013; Jacobs, 2016).

The new understanding about property in order to solve the "tragedy of the commons" came in two ways: diminishment of individual property rights and reconceptualization of natural resources ownership. Therefore, new programs of environmental protection and application of regulations to uses of land started taking place so private property stopped having its legitimacy questioned and started to be understood as a collections of not only rights, but also obligations, consolidating the idea of "the social function of property". This last concept refers to social and environmental obligations private property carries within, a view adopted by almost all countries which in practice enabled adoption of land use planning and development of property taxation (Alterman, 2012; Jacobs, 2016).

The evolution of society, culture and technology changes the concepts of property and property rights. The advent of the airplane made necessary the removal of air rights from the property package, in order to foster society's progress made possible by this technology. The same concept was applied to minerals under the soil. In several countries, the national Constitution states that everything under the soil belongs to the community. Then, it is evident the concept of property of land as a *bundle of rights*, which can be separated one from each other. While some rights can be treated as individual, private, others can be considered common rights, to be managed by public institutions or regulated through legislation (Jacobs, 2017; Bengston, 2004).

A meeting of the European Economic Commission and urban planning experts, which took place in Italy in 1971, suggested new regulations separating the development rights from the property rights, being the former allocated to society and managed by the government. This concept of property appeared then in countries like Spain, England, Colombia and Brazil (Smolka, 2013; Furtado et al, 2010).

In conclusion, despite private property holds an important role on the consolidation of the democracy, of the market and of freedom - as defended by western countries - the abuse of individual use of land property may be harmful to the rest of society and the environment. It is at this point that *land use and public planning*, approaching property as bundle of rights which can be added or suppressed according to society needs, have a critical role for equitable and sustainable urban development. So, the current debate is on the governance over this bundle of rights. How far should these land use and environmental regulations go? To what extent can

governments take private property for common purpose? Who have the right over the value of land? Should increments in value of private land resulted from society efforts be recovered by governments? (Alterman, 2012; Jacobs, 2016).

The following section will address the *land value capture* concept, developing the discussion over property rights and land value charges' policies.

2.4 Land Value Capture

> *The unearned increment resulting from the rise in land values resulting from change in use of land, from public investment or decision or due to the general growth of the community must be subject to appropriate recapture by public bodies (the community), … (UN-Habitat, 1976, Recommendation D.3(b), p.30).*

Land Value Capture (LVC), or also called *public value capture* and *land-based finance*, is a process held by financing tools funded on the principle that land is one of the basis of production and consequently an asset capable of funding urban development. It is made through a set of instruments used by local governments which the main objective is to transform rises in private land value – the so called *unearned increment* - in public revenues for the delivery of urban services and implementation or improvement of infrastructure (Alterman, 2012; Furtado, 2012; Walters, 2016). The use of LVC instruments can give the municipalities a more entrepreneurial role in the development of their cities, by creating additional real estate value through planning and regulation, and recapping this betterment through different mechanisms, sharing the benefits of urban development in a more equitable way with the community. When well designed, LVC tools can also steer development to desired areas and open opportunities for efficient partnerships with the private sector (Peterson, 2009; Vetter 2016).

Land value capture mechanisms are being used for centuries. Construction of roads and aqueducts financed by appreciation of land is documented by the time of the Roman Empire. Fees imposed on landowners regarding public works can be found in Portugal and Spain in the 1500s. The reconstruction of London after the Great Fire of 1666 charged landowners for widening the streets in front of their properties. The reconstruction of Paris headed by Baron Haussmann around 1850 used value gains from land to pay public debts regarding the works. Latin America have cases in the 1600s in Mexico and 1800 in Colombia. Countries which faced destruction by the World Wars I and II used several value capture tools to reconstruct themselves, like France and Japan (Peterson, 2009; Smolka, 2013).

In the past ten to fifteen years though, finance of urban infrastructure through LVC advanced strongly in the generation of high amounts of revenues. Colombia invested more than US$ 1 billion in urban infrastructure financed through land instruments, between 1999 and 2009. Other examples reaching the ten digits can be found, not exclusively, in India, England, Middle-East and China (Peterson, 2009). According to Smolka (2013) the growing awareness among local governments of the importance of land value capture tools is a result from the progressive economic stabilization associated to fiscal decentralization and, among others, the pursue for the formulation of equitable policies and distribution of benefits from increasing land values to finance community needs.

2.4.1 Land values: current use, market and increases

But how are the increases in land values and, moreover, the use and exchange values of land determined and to whom do they belong? The value of land is determined by the combination of its *utility*, *scarcity* and *desire* of the market for it. Land's utility is unquestionable, it is an essential asset for production and living. Land is also considered a finite asset, it is scarce, it is practically not possible to create more land than what nature provided (*with some exceptions, like The Netherlands*). Therefore, the condition that most influences the formation of land value is the desire by the purchaser, which is backed up by his ability to pay. It is the purchasing power of the consumers that will allow them to participate in a market and determinate the price of this good.

The economist Adam Smith differentiated the value of a good in *use value* and *exchange value*. The use value of land reflects the value for the landowner of the land with its current utilization. The exchange value of land, on the other hand, is determined by the market, when the land is put in comparison and competition with other similar properties. The exchange value of land in practice is represented by the *market price of land*, which is the quantity effectively paid in a purchase. This market price, however, is different from *market value*, which is a theoretical sale price (exchange value) considering symmetry between buyer and seller and fair conditions in the open market. The market price can be higher or lower than the market value, depending on the circumstances within which a transaction occurs.

Appraisal of land usually looks for determining the *market value* of a property. One of the methods of land appraisal known as *Abstraction Method* (or simple Land Residual Method) calculates the land value in the real estate market as the sale price of the developed land (which is the ability to pay of the consumer) minus the development cost (building costs, capital costs and knowledge) (Eckert, 1990).

Increases in value of private owned land can happen mainly due to investments of the owner in improvements of accessibility and infrastructure of his plot or due to investments of public bodies and the general community in those and other qualities. In this last case, the land may benefit directly (improvement right in front of the plot) or from a spillover effect (improvement of location qualities close to the plot). These efforts performed by others than the landowner can be *hard measures* and urban services like infrastructure implementation, improvement in transportation, garbage collection, security, education, and so on; or *soft measures* such as land management actions performed by local governments, for example, land use changes allowing more profitable uses and permit for increasing density. Added to those, a third factor - population and economic growth, which are results of society investments and efforts, may also contribute to raises in values of private owned land (Muñoz Gielen, 2010, p.7).

For example, a plot allowed to housing use can have a specific current use value. If changes in regulations allow commercial land use (a more profitable one), the exchange value of that plot will be higher than the current use value. The land will be exchanged considering its *highest and best use*, in this particular example, the more profitable commercial use, which has a higher price. This increment in value of land happened because of an action not performed by the landowner, that is why it is called by the literature *unearned increment* (Alterman, 2012).

2.4.2 Capturing increments in land values

The separation of property rights in a bundle of rights presented in the debate of section 2.3 can be materialized also in the separation of benefits inherent to property. So, to whom belongs the rights over increases in value of land created by others than the landowner? While conservative liberal theories argue that any increase belongs unquestionably to the legal landowner, other

ideas (also found among liberals) support that while the use value may belong to the private owner, the exchange value, which materialize the increases, belongs to the society that created that value (Muñoz Gielen, 2010, p.8). In that sense, if property value decreases due to land policies or other community's action, who deserves to absorb these wipe-outs? Should then the landowner be compensated? Many European and American legal systems states that taxing gains does not obligate the government for eventual losses. Sweden legal framework, nevertheless, demands compensation by the government if land value reduces in specific situations (Alterman, 2012; Kalbro, 2007; Barnes 2014; Walters 2016).

In practice, there seems to be no consensus of the amount of value to be captured over gains from public and community efforts. Cities around the globe are seeking hard to decide how the division of profits should be done between government and society, land owners and developers. Some scholars define that an aggressive policy would capture all increment in value of land made by actions or events that were not made by landowner effort, including land market forces, population and economic growth, other private investments and public interventions. A softer approach would seek to capture the increase from public administrative actions and public physical investments only (Peterson, 2009; Furtado, 2012). Another discussion resides if LVC mechanisms should act also on the values of buildings or productivity related to the plot. Despite some scholars advocate that these assets should not be taken into account, the separated assessment of land value and improvements is very difficult and hardly feasible, so capturing value over land and improvement seems to be a more pragmatic measure (Smolka, 2013).

2.4.3 Land Value Capture mechanisms

As the debates over LVC (ownership of increments and amount to be captured) assumes different sizes and intensities depending on cultural and legal contexts around the world, diverse understandings of ways of capturing increase in values of land by local governments can be found, resulting mainly in two types of land value capture mechanisms: direct and indirect (Alterman, 2009, Muñoz Gielen, 2017).

Direct LVC instruments work over the principle that increases in value of land generated from actions not performed by landowners, like public efforts to service land with infrastructure or to change land use regulations, should be shared with society and not fully absorbed by the property owners of land (Alterman, 2009; Smolka, 2013; Sandroni, 2011). These set of mechanisms hold a redistributive concept, supporting the idea of using profitable land developments (market driven uses) to finance unprofitable land development (social housing, parks, public facilities). It may also allow the capture of windfalls from wealthier, good structured areas, and application of the resources in poorer serviced areas. In practice, direct LVC instruments are usually tax-based and includes not only recurrently taxes and fees as land value tax, tax upon property transfer and capital gain tax, but also one-time payment charges such as fees for changing land-use regulations.

Indirect LVC mechanisms, on the other hand, try to move away from the ideological debate and promote the capture of value supporting the idea that negative externalities of urban development should be internalized by the landowners and developers. This means that, for example, the costs for society to allow more density should be paid by those building in this higher density. Therefore instruments which are based in this rationale seek to transfer the costs of urban services provision from local governments to the developers and landowners (Alterman, 2009, Suzuki, 2015, Muñoz Gielen, 2017).

Indirect instruments, appear to have more successful implementation cases than direct instruments. The formers have higher acceptability in order to compensate for development

impacts, it is easier to expose the clear link between "creating value and capturing value", they hold administrative feasibility in places with inefficient property tax systems, and can be used as a land planning tool. On the other hand, direct tools, in particular *tax-based* instruments as property tax, may hold more sustainable sources of revenue, since they suffer less the fluctuations of the real estate market. (Suzuki, 2015; Muñoz Gielen, 2017).

Direct LVC tools face difficulties of implementation both in developing and developed countries (Alterman, 2009; Alterman, 2012). As this variation of instrument have strong ideological principles, it usually challenges cultural aspects and legal understandings, slowing down its implementation. When the development rights are not legally separated from property ownership rights and, moreover, this separation is not socially understood and accepted, direct LVC instruments may have their implementation hampered. That's the case of European countries as The Netherlands and Germany. Nevertheless, even when the capture of unearned increment is legally recognized, the case of countries like England and Poland, implementing direct instruments also face difficulties. In England, several attempts to introduce a betterment charge over increases in value of land failed successively since 1947 due to lack of political consensus regarding development rights. Positive experiences though, can be found in Spain, Colombia, South Korea and Brazil (Alterman, 2009; Muñoz Gielen, 2017). The model of CEPACs used in Brazil is able to sell development rights as stocks, successfully consolidating in the market the ideological debate.

2.4.4 Value capture in market and planning contexts

Besides de rationale of the instrument, determined by the legal framework and cultural context of the city, LVC is a market dependent mechanism. Therefore, its functioning might be also conditioned to the operation and risks of land markets, including the dynamics of supply and demand and fluctuations. Financing urban development using land is more effective in cities where fast urban growth takes place. Urban growth is usually a result of population and economic growth, which consequently produces rise in land prices - the *unearned increment*. Here emerges opportunities for revenue generation through LVC in order to finance, without compromising local government current budgets, the increasing demand for infrastructure and services. Nevertheless, due to the risk inherent to the land markets, some scholars advocate for the using of LVC as a complementary tool for financing capital budgets, and not the only one (Peterson, 2009; Bird, 2010; Walters, 2016).

The use of LVC tools must be carefully linked to solid land use planning and visionary sustainable development. Local governments may fall in the temptation to use the instruments only for generating money, focusing on extracting the most from landowners and developers and leaving aside the real goal of development financing. Therefore, it is important to earmark by law revenues from value capture to be used in benefit of the community (Rahemkamp, 2013 *apud* Suzuki, 2015).

The timing of implementation of the LVC tools might also determinate the effectiveness and the source of value capture. When the obligatory payment of charges or obligations is known beforehand by the developer, he may pass this cost to the landowner. This might happen since the final price of developed land is determined by the ability to pay of consumers, so, considering the fixed costs of construction and taxes, in order to keep his profit, the developer may drop the value of the obligations from the amount that will be paid for land. In this situation, part of the value of land is captured in practice. However, if the obligation is not clear to the developer before he buys the land, it is possible that the price paid for the acquisition was high. In this case, since the ability to pay has a limit, the developer will not be able to pass the obligation cost to the final consumer, therefore he will need to reduce his profit or fixed costs,

probably compromising the development. Therefore, transparency in the process of assignment of obligations is crucial for effective implementation of LVC tools (Muñoz Gielen, 2010, p.48, 201).

The following sections will explore a specific LVC instrument which flourished more in South America, with a special focus in its development in Brazilian cities: the Sale of Development Rights.

2.5 Charging building: Sale of Development Rights

Sale of development rights is a land value capture instrument that holds two strong ideological rationales: first that any increment in value of land belongs to the community and not the landowner, so a direct instrument; and second the recognition of the possible separation between *land ownership rights* and *land development rights*. The increasing importance of land use planning and the active role of society and governments in the urban development process demand and make clearer this separation of rights, so the community could manage urban growth and prevent the *tragedy of commons* (see section 2.3).

2.5.1 Rationales and design of SDR

There are mainly two types of *development rights* that the SDR encompasses: the right to change land use – from rural to urban, or from housing to commercial; and the right to build beyond pre-determined basic limits, being in area, density or height (Peterson, 2009). The application of the instrument allows, for example, local governments to levy for changes in permissible land uses, capturing the increment in value of land when more profitable uses are assigned, therefore following a direct rationale. Still, when buildings in higher density demand more infrastructure and the charge for development rights is used to provide this infrastructure, a mix of direct and indirect rationales can be observed. The SDR in this case allows the costs of more robust infrastructure to be internalized by the development at the same time that the increases in value of land resulted from the higher density permission is captured.

The way SDR is designed by local governments fits usually under the legal framework of land use planning. Land use planning, or urban planning, consists in a legal, social and technical process aiming at steering development of a city in a preferable sustainable direction concerning society needs. It involves decisions of if and how the city should grow, distribution of uses of land, protection of environmental and historical areas, approval or not of building and the way real estate should build. The nature of this process encompasses the clear conflict between private property rights and the public interest, as the rules instituted by the plans affect directly the way private property can and cannot be used. For that reason, urban planning plays a critical role in assuring management, justice and protection of the commons and private property rights (Peterson, 2009; Smit and Valiante, 2016).

2.5.2 Development rights and the FAR

The regulations stated by land use plans will determinate the functionality of SDR, regarding especially what rights will be charged and where they will be charged. One of the main regulations that affects what rights will be levied by the SDR regards density. This is a key factor in urban management in order to achieve efficient use of public facilities, concerning the cost-benefit of an amenity implementation and the feasibility of its maintenance. Compact development has more positive fiscal effects for municipal budget due to this spatial efficiency (Lynch, 2015). The density of urban areas is usually controlled by land use plans, mainly but

not only, using Floor Area Ratio (FAR) regulations. The FAR represents the intensity of land use by buildings, regarding their size. It is the ratio between the total constructed or usable floor area of a building and the plot where the building is inserted. For example, a 1,000.00 square meters building constructed in a lot of 500.00 square meters would have a FAR of 2. The management of FAR limits can prevent negative externalities from over density as traffic congestion, sunlight access and noise (Tsai, 2013; Barr, 2014; Kono, 2008). It is important to notice though that FAR regulations by themselves are not able to sustainable control how buildings are built, since they could allow full occupancy of the plots, suppressing natural drainage, for instance. However, when associated to *number of storages* regulations and *occupancy rates* (percentage of surface that can be occupied), there are more flexible to manage the building process and achieve environmental friendly policy goals.

The regulation of FAR represents in practice the regulation of the *development rights*. When the land use plan of a city assign the basic and maximum FARs to the plots of different zonings, what is done is the formalization of the development rights that are and are not in the *bundle of rights* of the landowner. The *Basic FAR* would determinate the amount of area that could be constructed in a piece of land, in a ratio between the building area and the land size, without any charges, freely to every landowner in the urban area. That means that the *Basic FAR* states the development rights that belongs to the landowner and the ones that can be sold by the community. At the same time, the land use regulations may select specific zones in the city where could be allowed construction over the *Basic FAR* and, consequently, where the SDR could be implemented. This selection is made according to availability of infrastructure and/or desire of city growing. When land use planning allows development over the base line on specific plots, those plots become more valuable to the market, opening opportunities for direct LVC through the Sale of Development Rights (Smolka, 2013; Furtado and Maleronka, 2014). If the revenues from the SDR are invested in other neighborhoods than the densifying area, a more redistributive effect can be achieved, since the value captured from more developed areas can be used to delivery urban services in poorer zones of the city (Walters, 2016). This definition of areas or zones where SDR can be implemented may work as a tool to encourage or restrict development and control density. Yet, when not correctly designed and managed, this strategy can produce serious negative effects in the city growing.

Another fact that precondition the use of SDR is the existence of demand for extra building rights. When this demand is not present, cities may experience sprawled development. That may happen because instead of paying for building with higher density, the market may opt for developing in several plots with low density, generating urban sprawl and consequently opposite effects of the purpose of the instrument, including higher costs for the municipality in infrastructure and transportation delivery (Walters, 2016; Lynch, 2015). This means that the condition of land markets and the administrative capabilities of the government to recognize it are crucial to manage the instrument in the direction of efficient and sustainable urban environment, and not the opposite. In cities where the basic line of development is very high (above 1 FAR), it is possible that the demand for extra building rights is very low, prejudicing the efficiency of the SDR and the capture of plus values. Lower FARs could be more effective in collecting the increments, when the real estate market in the city is very active (Furtado and Maleronka, 2014).

2.5.3 Calculation of charge

Another challenge when designing and operating the SDR is how much to charge. There are innumerous variations of the way this practice is done in different cities. Some levy a fixed value, like a fee. Others charge a percentage of land price, like Mumbai, in India, which

demands 80% of an assessment zone square meter price. Some examples can be found basing the tariff on construction cost, a wrong understanding since SDR is based on the value of land (Peterson, 2009; Furtado, 2010). The calculation of the increment in value of land is very inaccurate due to a special characteristic of this asset: every piece of land is unique. In theory, the difference of value of the highest and best use of land between a FAR 3 and FAR 1 of a plot, for example, would correspond to the increment in value of the higher density. Nevertheless, there are other variables that affects the highest and best use of land and consequently its evaluation, like the same uniqueness factor and the interest of the market in higher FARs (Smolka, 2013). The difficulties in assessing the values of land may lead municipalities to take shortcuts, like using fixed prices or calculating the charges based on tax plans, which are usually not updated and do not represent the real exchange value in the market (Furtado and Maleronka, 2014).

The most advanced mechanism to sell development rights achieving market price can be found in Brazil, where they can be sold in an open market of stocks, leaving the price formation to the freely dynamics of the market. This design variation of the SDR is named Certificates of Additional Potential Construction Bonds (CEPACs) and are being used since 2004. This version of SDR is able to maximize the revenue generation once the market value for the rights may be achieved, but the complexity and fierce competition of the process may exclude medium and small developers from it. In the cases of small developments, it could be fairer to charge the development rights based on the calculation of value of land. This would link the price to be paid for development rights to the price of the land the developer owns, and not a price defined in a stock market competition that small investors may not be able to afford. The auctions with CEPACs would be more interesting to capture values from big developing corporations investing in land (Neto and Moreira, 2012; Walters, 2016).

Differently from other direct instruments that can demand payment independently from the time a land use regulation is modified, like the property tax, the SDR is a tool that demands payment at the time that land use change or additional development rights are conceded (Muñoz Gielen, 2017). When used in order to also internalize impacts of new development (rationale mix), this upfront payment may allow municipalities to invest in infrastructure with the revenues of SDR, reducing or even annulling the compromising of other city's budgets (Peterson, 2009). The form of collection and administration of the revenues from the SDR is usually linked to the purpose assigned to it. In several cities in Brazil, for example, when the funds from SDR are earmarked for social housing provision, the revenues are collected in a housing fund managed by the local affordable housing department, which will allocate the investments in this area (Furtado, 2006).

2.5.4 Sale of Development Rights across the world

Besides Brazil, the SDR is also largely used in Colombia, which charges since 1997 changes in zoning and additional development rights through the instrument *Participación en Plusvalías.* This tool captures 30 to 50 percent of estimated value increase and applies the resources in affordable housing or infrastructure construction in poorer serviced areas.

Although SDR is more successful in South America, this tool is also largely used in other countries. The French urban reform of 1975, *Plafond Légal de Densité*, changed the basic FAR of most of the country to 1, except for Paris which was set at 1.5, and every development above this base line was charged based on the additional area to be constructed. Several cities in the United States, like Boston and San Francisco, demanded in exchange for higher densities the construction of affordable housing or other public facilities, charging in this case the additional development rights in kind, not in money (Smolka, 2013). In India, the SDR is being use to

compensate landowners for expropriation. Instead of paying landowners in cash, the government pays in development rights that can be sold in the real estate market and applied in several areas of the city. In the region of Mumbai, development over the FAR of 1 is also charged by the government and the revenues compound large part of the public investments in growing areas (Peterson, 2009).

The following section will take a closer look at the development of the SDR in Brazil, finalizing with special attention to the city of Curitiba, object of this research.

2.6 Sale of Development Rights in Brazil – from the *Solo Criado* to CEPACs

The use of the instrument S*ale of Development Rights* in Brazil is currently regulated nationally by the 2001 law *Estatuto da Cidade* where it is named Onerous Concession of the Right to Build (OODC). It's way of use is established locally by every municipality in their local *land use plans*.

2.6.1 The *Solo Criado* concept

The ideas that gave birth to the OODC started to be developed around 1975, when the academia and governments started a debate about the balance distribution between costs and benefits of urbanization (Furtado and Maleronka, 2014). The concept developed in that decade was the *Solo Criado* – "Created Land" – which stands for the creation of addition buildable floor not directly over the land. The rationales of this concept are the *unique floor are ratio* and the *permutable development rights*. A developer requiring to build over the basic line of one time the area of the plot would be required to compensate the community by giving for free another plot with equivalent area to the additional building rights. This process pursued an equilibrium between built and clear areas in the city. According to Furtado (2014), these principles sustained the *Solo Criado* as a tool that could isolate the economic effects of the zoning process, which may generate different valorization of land according to public decisions (like different FAR assignment and permission or prohibition regulations), also considering infrastructure availability. The *Solo Criado* would allow society to recover land valorization when landowners would have only the basic building rights.

However, the cultural context of protection of landowners and ambiguous legal frameworks lead the adoption of the unique basic FAR equal to 1 to be largely questioned and accused of unconstitutional. This debate culminated in the release of the *Letter of Embu* in 1976, where judges and urban specialist united stated the constitutionality of the unique basic FAR adoption for all urban area (Furtado and Maleronka, 2014; Teixeira and Moreira, 2011). Despite of this conceptual consolidation, the implementation of the instrument was extremely controversial and difficult. In 1980 some cities started to adopt the *Transfer* (not sale) *of Development Rights* tool to preserve historic buildings, though ignoring the unique FAR principle. Transfer of development rights is an instrument which permits landowners to sell unused development rights among them, transferring building rights from one property to another (Walters, 2016). It allowed the conservation of historical buildings by allocating the development parameters to other plots, therefore avoiding the demolition of the patrimony to free space for new construction.

The *Solo Criado* concept was phasing out until 1988, when the new Constitution delegated more fiscal responsibilities to the local governments – the decentralization process. Due to the conditions created by the new Constitution, several municipalities started to regulate the SDR, though with different interpretations of the concept of *Solo Criado* inherent to it (Furtado and Maleronka, 2014).

2.6.2 The implementation across the country

A study developed in 2006 by Furtado in 12 Brazilian cities presented the diversities in the way the SDR is used across the country. Although the instrument is legally present in the *land use plans* of more than 200 cities, it is only in a bit more than twelve cities that the tool was really implemented and is operative. Among the cities studied, the pragmatic use of the SDR materialize the different possibilities of understanding and operation of the tool.

One of the diversities pointed by Furtado (2006) was the form of calculation of the charge. Considering the change in land uses, only two cities levy this addition of development rights, Salvador (50% of the previous market value) and Campo Grande (70% of the increment in market value). Considering the rights regarding density, the form of calculation varies as using the virtual land area necessary to accommodate additional development, a percentage of the estimated construction cost and the simple multiplication of the additional right for the square meter market value of land. Several municipalities, including Salvador and Curitiba, use what is called *virtual land method* (Furtado, 2006). The concept of this method is based on the principle that if a developer wishes to develop 1,000 m² in an area where the basic FAR is 1 and the maximum is 4, he could or buy a plot of 1,000 m² and construct one time the land area; or he could buy a plot of 250m² and acquire the development rights referring to the 750 m², constructing then four times the land area. For this extra buildable area, the developer would pay equivalent to buy more three plots of 250 m². Municipalities usually get these square meters values from valuation maps used for taxation (Smolka, 2013). Furtado (2014) argues that this source of data is inadequate since the fiscal values are usually outdated, generating much less revenues than what would be possible through market value assessment. On the other hand, according to Smolka (2013), although this method may not extract the real market value of land, it gives consistency to the process, giving it validity.

The regulation of FAR, which materializes which *development rights* are private and which belong to the community, is not homogeneous. Three of the twelve cities studied assigned an unique basic FAR for the whole city - Natal, Goiânia and Florianópolis - being in the previous two the FAR equals to 1. In the other cities, the base line of development stablished within the implementation of the SDR was the basic FAR assigned by the previous zoning. The political issue to change FAR previously determined – which might be seen as *right removal* - is pointed as one of the main causes for the lack of adoption of the unique FAR equal to 1. The maximum density assigned is not clearly linked to the availability of infrastructure, although there are cases in which the concession of additional development is associated with the improvement of structure frameworks.

The land uses that can acquire additional development rights are also not uniform. In some cities, the SDR is not applicable to residential uses, probably reflecting a misunderstanding of the land value capture mechanism, that the instrument would burden the final consumer, increasing the real estate values of housing. As discussed in section 2.4, in theory, the ability to pay will determinate the exchange value, therefore, if the developer knows beforehand the obligation to pay for additional development, he may burden this cost to the landowner, not to the final buyer of the residential units.

The earmarking of the revenues of the SDR in Brazil usually follow a redistributive logic, being the value captured from more developed areas allocated to the delivery of urban services in poorer zones of the cities. Blumenau and São Luiz allocate revenues from SDR to the provision of affordable housing and public facilities. Other cities determinate more broad purposes of public services and facilities, adding infrastructure, slum upgrading, environmental protection, historical buildings conservation, and others. Some cities, like Florianópolis and Porto Alegre,

do not allocated any purpose of spending the revenues from SDR (Furtado, 2006), contradicting the rationale of the instrument to finance urban development.

The 2001 *Estatuto da Cidade* law appeared as policy trying to standardize the different practices across the cities, but it was not so successful in this goal. However, the use of the instrument increased in the past decade in order to increment capital budgets of local governments, concluding that the national efforts could, at least, diminish the negative political and legal reactions to its use (Furtado and Maleronka, 2014).

2.6.3 Auctioning Development Rights: the CEPACs

The difficulties in the appraisal of development rights and the timing of revenue generation not matching infrastructure construction time can, in theory, be solved by the model of Sale of Development Rights developed in the city of São Paulo in 1995: the Certificates of Additional Potential Construction Bonds (CEPACs). This process transfers the uncertain calculation of the SDR charge to the market's willingness to pay for it. By auctioning development rights among developers interested in benefiting from public interventions, it is expected the highest price for the rights to be achieved in order to pay for the public works. Moreover, the SDR held independently of specific real estate project development allows local governments to receive revenues before the private project starts and to invest in public facilities and services without incurring debt.

The SDR done through CEPACs enables a regulated and transparent way of formation of its value, although the initial price of the certificate is done by the government and sometimes questioned by the market (see the case of Curitiba in chapter 4). CEPACs were first present in 1995 in São Paulo but they were only regulated in 2001 by the *Estatuto da Cidade.* The first utilization of the tool was made in 2004 also in São Paulo (Faria Lima OU), but it can currently be used in the entire national territory. The use of CEPACs must be obligatorily associated to another instrument called *Urban Operation (OU)*, which allows cities to improve urban areas through a detailed plan of intervention, changing the zoning, upgrading development rights and charging for them. According to the law, the revenues from the CEPAC can only be used inside the limits of the OU, assuming the SDR in this case a more indirect rationale of internalization of the negative externalities of urbanization: the payment of public structure to support more density is made by those building in this higher density. In the case of the *OU Água Espraiada,* in São Paulo, the CEPACs revenues were earmarked to the construction of a cable-stayed bridge and the construction of 600 social houses in the slum upgrading intervention of the *Jardim Edith* area, inside the perimeter of the OU. In this case, a redistributive direct rationale can be observed, since the increments in value of land were used to finance a poorer serviced site within the area of intervention.

The number of bonds to be issued is limited by the amount of additional development that the OU can absorb. This limit is defined by analysis of the municipality considering existent structure and additional interventions to be done and financed by the instrument. Usually one CEPAC corresponds to one additional square meter of construction, but considering the different land prices inside the OU and the public desire to foster development in certain areas inside the OU, one CEPAC can be adjusted to 0.5 square meters to 3 square meters (Sandroni, 2010; Smolka, 2013).

The use of this mechanism of SDR is extremely sensitive to market fluctuations. Oscillations in the real estate markets observed between 2004 and 2009 coincided with success and failure of the auctions of CEPACs in São Paulo in this period. In times when the market was in expansion, the auctions were very successful, selling usually all the stock of bonds. In periods of recession, insignificant numbers of bonds were marketed. The coexistence of more than one

Urban Operation can also generate a market competition within the instrument, like the case of São Paulo. Some developers that previously invested in the *Faria Lima OU* eventually started to invest in the *Água Espraiada OU,* which had lower prices of CEPAC.

The timing and management of the implementation of the tool is also crucial for its success. When developers investing in the area of *the Faria Lima OU* realized that the CEPACs were going to be implemented as the only way to acquire DR, many of them anticipated their building permits buying building rights in the former model of acquisition, cheaper than the proposed CEPAC. This fact led the first action of this OU to sell only 10% of the bonds offered. This auction was also held in the last week of government of one party which lost the elections. This fact brought uncertainty to the developers regarding the stability of the process, affecting the operation of the SDR (Sandroni, 2010).

Besides the first and second cases of *Urban Operations* of São Paulo, the model of CEPACs was also used in a third case in 2009 in the city of Rio de Janeiro to revitalize the old harbor area of *Porto Maravilha,* providing the local government a considerable amount of resources beforehand to invest in the project. The fourth case of sale of development rights through CEPACs is object of this research and was made in 2012 in Curitiba. This case released 4,830,000 bonds in an OU consisting in converting a federal road that crosses 22 neighborhoods in the city into an avenue with fast transport system, green areas and higher density of occupation. The first auction of this project was able to sell 70% of the stock offered, however, for the lowest price of the bid (around US$ 100 per CEPAC), collecting half of the expected US$ 30 million (Sandroni, 2010; Smolka, 2013). Moreover, a decrease in the number of bonds sold was observed in the second and third auctions made, coinciding with a decrease in real estate activity (see Chapter 4).

The use of the CEPACs to charge for SDR is an advanced alternative that holds a lot of advantages but also many risks and drawbacks. The instrument in which it is embedded, *Urban Operation*, is largely debated in Brazil regarding weather this tool aims at sharing the plus values among society or is a mechanism being used to concentrate resources to projects of limited benefits, attending the priorities of few powerful stakeholders. This debate is inflamed by the fact that the revenues of the CEPACs can only be used inside the OU, in theory limiting the social function of land and the redistribution of benefits (Neto and Moreira, 2013). On the other hand, the boundary of the OU can be designed to maximize the distribution of benefits, like in the case of São Paulo that the inclusion of slum areas inside the perimeter of the OU allowed the upgrade of those areas to be financed by the SDR.

2.7 Model of causality: Conceptual Framework

Section 2.2 discussed the topic of municipal finances and the challenges to finance urban services within the global trend of decentralization through *land value capture* instruments. Sections 2.3 and 2.4 addressed the evolution of the concepts of property and discussed the implications of LVC use regarding property rights and land use planning. These sections also debated the ownership of increases in value of land, the conceptualization of land value capture, the justification of LVC use to finance urban development and addressed the different ways of application of LVC. Section 2.5 examined the LVC instrument *Sale of Development Rights,* covering its several forms of design, its implementation and operation within land use planning and the condition of local land markets. Section 2.6 finally addressed the use of SDR in the specific context of Brazil, briefly covering experiences in different cities of the country.

Based on this theoretical discussion, it is possible to draw connections between the concepts and its variables, creating a model of causal relations which identifies how the way SDR is used

impacts the amount of increases in value of land that is captured for financing public services and facilities. The model, here illustrated as a conceptual framework, presents besides the independent variable "the way SDR is used", also other context variables which may indirectly affect the revenues captured. The concepts drawn in the literature review are defined in this research and connected as follows in the next sections.

2.7.1 Sale of Development Rights and the independent variables

Sale of Development Rights is conceptualized in this research as a land value capture tool which charges modification in land uses and development above a specified base line, capturing the increments in value of land resulted from actions not performed by landowners. The base lines of development (basic floor area ratio) are determined by the land use planning, which stablishes then which development will be charged and which one will be free. The SDR may hold a mix of direct and indirect rationales. It can be applied with the argument of capturing increments in value of land which belong to the community (direct) and, at the same time, with the argument of the necessity to internalize costs of development (indirect), like when financing necessary upgrades in infrastructure to support development using the captured revenues.

The independent variable *the way SDR is used* will be split in sub variables design, implementation and operation of SDR. The *design of SDR* encompasses what rights will be charged, where they will be charged, how much they will cost, time of payment, how the collection will be made and what the revenues will be used for. The independent sub variables *implementation* and *operation* of the SDR falls on the administrative capacities of the local government to determinate its management through control of building permits, the time of payment, the way revenues will be assigned (if through a fund, earmarked) and its form of calculation (fixed price or through assessment of land values). Land value assessment, though, is not precise and is a complex task, what may lead local governments to adopt shortcuts like using the tax value from cadaster plans (valuation maps), which do not represent current land use values or exchange values, capturing revenues from land much lower than what is practiced by the market (Smolka, 2013; Furtado and Maleronka, 2014). Market monitoring is important then to update the data bases and capture the real values practiced. Moreover, the use of cadaster tax bases is sensible to political issues because usually the values in these plans are defined by law and not frequently updated since this is an unpopular measure (Walters, 2016). The SDR could also be managed through open market, maximizing its revenue generation once the market value for the rights can be achieved. This process, however, demands high administrative capacity and knowledge of the public administration (Walters, 2016; Sandroni, 2013). The timing of implementation and transparency of the process is also important for effective capturing the value of land and not impairing the development. In summary, the way the SDR is used (designed and then implemented and operated) impacts its capacity of value capture, affecting the amount of revenues generated (Alterman, 2009; Smolka, 2013; Sandroni, 2011; Walters, 2016; Muñoz Gielen, 2017).

2.7.2 Land Value Capture and the dependent variable

Land value capture is the transformation of *increases in land value* into extra-budgetary public revenues freely available for investments in the delivery of urban services and implementation or improvement of infrastructure and public facilities. It is made through specific urban instruments. (Furtado, 2012; Walters, 2016). Land value capture is relevant to finance investments in urban development, not only due to its capacity of revenue generation but also due to its redistributive principle, allowing the share of capitalized values of land among society. The dependent variable *amount captured from increments in value of private land* is

conditioned mainly by the way the LVC instrument is designed, implemented and operated, but can also be affected by contextual factors such as culture, property rights and land markets.

2.7.3 Culture and its context variables

Culture is a contextual concept which might influence the sale of development rights and its causal relation with land value capture. In this research it is defined as the history, cultural norms, systems and thinking about land ownership and its management. It may influence the land value capture capacity of urban instruments, specifically the SDR, when it presents challenges related mainly to the context variables *political support* and *tax payer resistance*.

The political support or acceptability of the implementation of SDR is crucial and is reflected by the commitment of politicians, the administration, academy and society to it, which is influenced by the amount of information disclosed about the instrument, the understanding of the benefits and the visibility of the revenues' spending (Walters, 2016). This understanding will affect decision regarding the division of the profits among stakeholders, influencing the amount of value to be captured (Peterson, 2009; Suzuki, 2015). In Brazil, for example, the consolidation of the SDR instrument in a national law helped to uniform concepts and increase awareness, diminishing negative political and legal reactions to its use by different local governments (Furtado and Maleronka, 2014).

Tax payer resistance is represented by the willingness to pay for the building rights, which is influenced by the visibility of and information about the instrument. Although in theory the SDR could have a high acceptability when presented in an indirect rationale, clearly linking "creating value and capturing value" (Suzuki, 2015), normally taxes and charges are unpopular in developing countries and the perception of value of a charge is usually as too high. This may affect the developer's decision when developing land. If the benefits are not understood and the instrument is only seen as a fiscal charge, this will lead them to search for alternative development methods, impairing, consequently, the use of the LVC instrument (Walters, 2016).

2.7.4 Property Rights and its context variables

Property rights form another contextual concept which affects the sale of development rights. Here it is narrowed as property of land and defined as a limited *bundle of rights*, which can be separated one from each other, added or suppressed according to society needs. While some rights can be treated as individual, private, others can be considered common rights, to be managed by public institutions (Jacobs, 2017; Bengston, 2004).

The context variable legal institution of *separation of building rights* – considered common - from land ownership rights – considered private (Jacobs, 2017; Smolka, 2013; Furtado et al, 2010), is crucial for the effective implementation of Sale of Development Rights, as this is one of its two ideological rationales (section 2.5.1).

It is important to note that the legal separation of property rights is different from political support specifically to the instrument SDR. The legal separation is a step before, since its consolidation allows the implementation of urban instruments like SDR and TDR. This separation is consolidated in Brazil, however, culturally sometimes this topic is still a challenge. This variable is included in this research in order to improve the external validity of the theoretical framework, since the operation of the SDR might be more difficult in countries where this separation is not consolidated and then should be taken into account.

2.7.5 Land Markets and its context variables

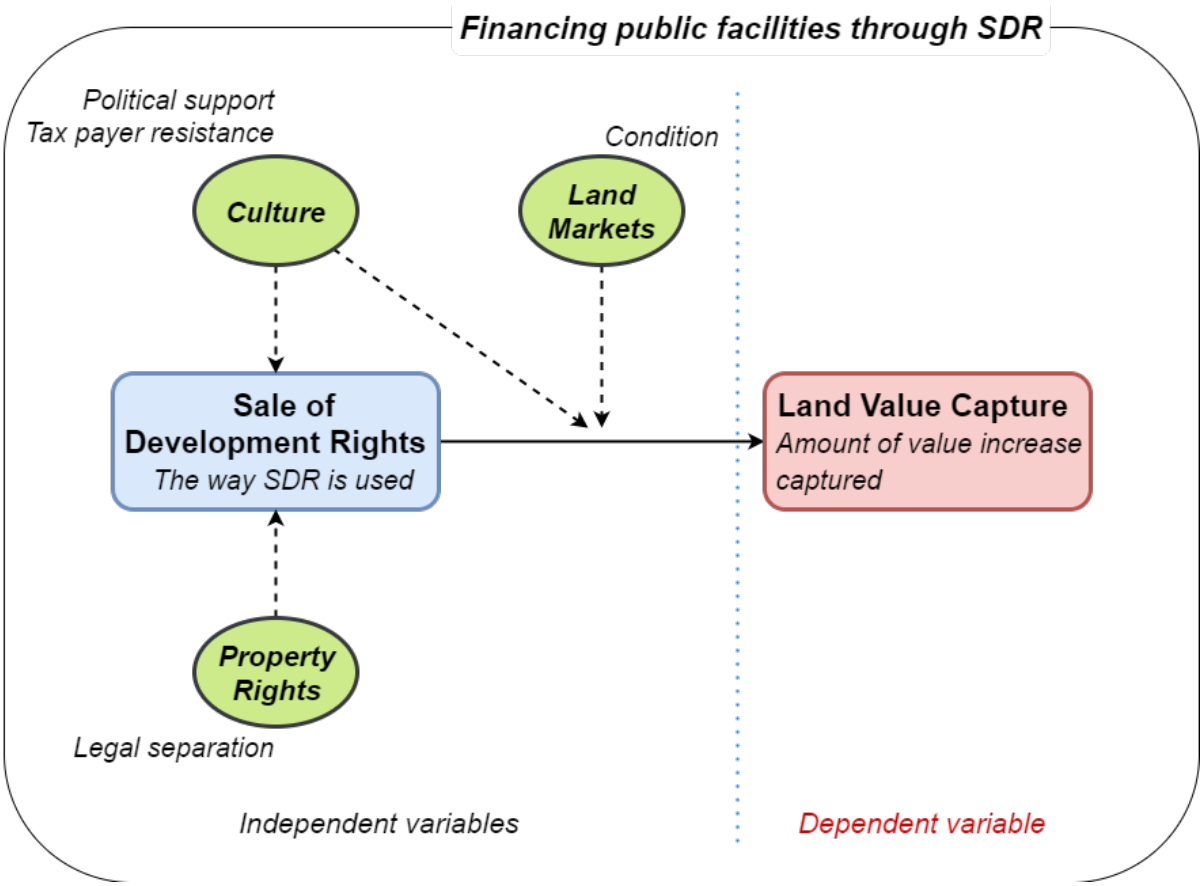
Land markets is a contextual concept which may influence the causal relation between sale of development rights and land value capture. Land markets are the dynamics involving the commerce of land and also its development, resulting in final real estate products to be sold, as buildings. The mutable condition of land markets is represented by the intensity in which these dynamics happen, like the relation supply and demand, fluctuations of values and transparency. As a LVC tool, SDR is a market driven mechanism, therefore it is susceptible to the framework of the private market, sharing the risks of this system (Peterson, 2009).

The basic principle for the operation of the SDR is the demand for extra building rights. If the land market is not strong and well-functional, if there is no demand for more development, the implementation of the instrument might be innocuous. Moreover, land markets are buoyant, they are affected by economic changes and also public actions such as land use changes and infrastructure development. That way, fluctuations of the market may cause the amount of revenues from the SDR to be cyclical. Therefore, it is important to take precautions against instability periods when the estate market declines, consequently prejudicing capital revenues generation. Besides that, when the SDR is operationalized through stock markets, as the case of Brazilian CEPACs, a robust financial market is necessary to support and give transparency and credibility to the process (Peterson, 2009; Sandroni, 2011; Smolka, 2013; Walters, 2016).

2.7.6 Conceptual Framework

The interaction of the concepts explained above can be organized in the following conceptual model exposing the casual relation between the way the instrument SDR is used and the amount of value increase captured in the case of public facilities financing.

Figure 1: Conceptual framework of the causalities between concepts and influence of context concepts and variables. Source: the author



The model exposes the direct causal relation between *Sale of Development Rights* and *Land Value Capture*, being the first concept affected by third (context) concepts *Culture* and *Property Rights*, and the relation between the main concepts affected by third (context) concepts *Culture* (again) and *Land Markets*.

Based on the theory reviewed in this Chapter 2 and the background presented in Chapter 1, the next chapter will design the empirical research proposal for answering the questions stated and achieve the goal of this work to explain how the way the instrument *Sale of Development Rights* is used impacts capturing of increases in value of private land in Curitiba.

CHAPTER 3. Research design and methods

3.1 Research objective and research questions

This research studies the financing of urban public facilities through the use of land value capture, specifically *Sale of Development Rights*. The objective is to explain how does the design, implementation and operation of the instrument *SDR*, in order words, how does the way it is used (the independent variable), impacts the amount of value captured from increases in value of private land (the dependent variable). The conclusions of this research help understanding how the adjustments of key variables in the use of the SDR impacts the efficiency of the instrument, consequently affecting the investments in urban development. This will contribute for understanding and improvements in the use of this tool in Curitiba, other Brazilian cities and even maybe other localities around the world (see section 3.7).

In order to achieve this goal, the following main research question was formulated:

How does *the way Sale of Development Rights is used* to finance public facilities in Curitiba impacts *the amount of value increase captured* from privately owned land?

The answer of this question identifies which variables of the different models of SDR present in Curitiba have biggest impacts in capturing land value increases. Two research sub questions were asked aiming at gathering information to make analysis and infer the causal relation between the instrument's design, implementation and operation, and its capacity of value capture:

Sub research question 1: How was the SDR designed and implemented in Curitiba and how is it operated to finance public facilities?

This question is being asked in order to examine the ways SDR is used in Curitiba. To answer this first research question, it was necessary to collect data about the design, implementation and operation of the instrument in this city. These data regards what rights are charged, where they are charged, how they are charged (calculation method), how much they cost, when they are charged, and what the revenues are used for (which public facilities and services) (See section 3.2 Operationalization).

Sub research question 2: What is the amount of value increase captured to finance public facilities from privately owned land by the SDR?

This question is being asked in order to identify how much the SDR captures in relation to current and increments in value of land and generates revenues in Curitiba. To answer this question, the collection and production of the following data was needed: a) measurement of the amount of revenues generated by the SDR; b) land values in several years during the period studied; c) measurement of how much the revenues represent in relation to current and increment in values of land.

3.2 Operationalization: variables and indicators

Operationalization is the translation of concepts from the Conceptual Framework (see Section 2.7) into *variables*, which are the manifestation of the concepts in the real setting, and then the unbundle of the variables into *indicators*, which are empirical measures of the variables (Van Thiel, 2014). This process was necessary to get from the theoretical review in Chapter 2, which identify the relations existent in the problem statement (see section 1.2), to the pragmatic identification of the data needed to be collected in order to answer the research questions.

The operationalization does not measure the full concept, but indicators of the concept. The goal was to identify the sub variables and indicators that measure most the independent and depend variables. This process followed three steps: definition of the concepts used, unbundle of the concept into variables that express the concepts in reality, and assignment of the values that the variables can assume – indicators. The definitions of the concepts were already made in section 2.7. The following topics will unbundle those concepts into variables and indicators that guided the data collection.

3.2.1 Sale of Development Rights and the independent variables

The variable of the concept *Sale of Development Rights* that concern this research is the *way the LVC instrument SDR can be used*. This independent variable was unbundled into three groups of several sub variables in order to deeply understand how the instrument works: design, implementation and operation.

3.2.1.1 Design of the SDR

The sub variables and corresponding indicators regarding the design of the SDR instrument are:

a) What rights are charged: measured by how the Floor Area Ratio (FAR) is assigned. The bigger the difference between the basic and maximum FAR, the more development rights (DR) are possible to be charged;

b) Where those rights are charged: measured by the zoning which assign the areas that can acquire extra development rights;

c) How those rights are charged: measured by the form of calculation of the price of the DR. Can be a fixed priced, an index over land value or auctioned;

d) How much those rights cost: measure by the price effectively charged for the DR, expressed in Brazilian Reais (R$) in absolute terms;

e) When they are announced: measured by the transparency in the process, when the developer knows he has to pay for the DR. Developers may know they need to pay for DR before buying land, transferring this cost to the land owner, or after buying land, compromising the quality of construction or the profit;

f) When those rights are charged: measured by the moment the developer needs to pay for the DR (before development, on the permit, after construction, etc.);

g) Why those rights are charged: measured by the purpose, the allocation of the revenues, translated in the urban facility or service financed.

3.2.1.2 Implementation of the SDR

The sub variables and corresponding indicators regarding the implementation of the SDR instrument are:

1. Planning capacity of the local government: measured by the management of long term vision plan for the city, clear specification of areas to absorb extra development rights and clear specification of destination of revenues. The more specific and updated these plans are, the higher is the planning capacity of the municipality.

3.2.1.3 Operation of SDR

The sub variables and corresponding indicators regarding the operation of the SDR instrument are:

a) Valuation procedures: measured by the form of assessment of land value used for calculation of the charge;

b) Administration capabilities: measured by the use of cadaster base to control land, the control of permits and supply of DR; control of information, bureaucracy of the process, time between expectation and real collection of revenues, knowledge in the operation of stock markets (for CEPACs) and the management of the revenues from SDR. The more organized and efficient these activities are, the higher administration capacity the local government has.

3.2.2 Land Value Capture and the dependent variable

The concept Land value capture is translated in this research as the amount of value increase captured from private owned land. This dependent variable was unbundled in the following sub variables and indicators:

a) Amount of revenues generated: measured by the values of revenues collected with the sale of DR, expressed in Brazilian Reais (R$) in absolute terms. These amount were compared to the total budget of the city and to the incomes of the annual land tax;

b) Amount of value captured: measured in two ways – 1) the ratio between revenues of the SDR model and the increment in value of land, and; 2) the ratio between revenues of the SDR model and current use market value of land. The higher is the ratio, the higher is the value captured from land;

3.2.3 Culture and the context variables

In order to measure the causal relation between the independent and depend variables, the context variables identified in the Conceptual Framework (see section 2.7.6) needed to be controlled so their influence in the focused relation could be also seen.

The context concept of *Culture* was translated in the following third (context) variables and indicators to be controlled in the study:

a) Political acceptability: measured by the presence and enforcement of legislation regulating the SDR, facility to operate the instrument and willingness of developers to buy additional DR. The higher facility and willingness to pay, the higher the political acceptability;

b) Tax payer resistance: measured by the willingness of developers to buy additional DR, developers perception of the value of the charge (high or low) and developers willingness to search for alternative development methods (lower density, TDR, etc.). The higher the willingness to look for alternatives and lower willingness to pay, the higher the tax payer resistance.

3.2.4 Land Markets and the context variable

The context concept of land markets was translated in the following third (context) variable and indicators to be controlled in the study:

a) Condition of land markets: measured by the fluctuations of the number of building permits per year and by the demand for additional building rights (in areas where it is possible to buy DR, how much was bought). The more oscillation in values, the more buoyant is the market. The mutant characteristic of the market was then crossed with the results of the SDR in order to determine its influence.

3.2.5 Property Rights and the context variable

The context concept of property rights was translated in the following third (context) variable and indicators to be controlled in the study:

a) Legal separation of property rights: measured by the presence and enforcement of legal framework separating the right to build on land from the ownership right of land.

The following table presents a summary of the operationalization:

Table 2: Operationalization

Concept		Variables	Indicators
Independent Variable	**Sale of Development rights**	**Design of SDR**	
		What rights are charged	Floor area ratio
		Where are they charged	Zoning
		How are they charged	Calculation method
		Price (how much)	Value charged in R$
		Time: transparency (when)	When developer knows he has to pay
		Time: of payment (when)	When developer pays
		Purposes (why)	Allocation of revenues
		Implementation of SDR	
		Planning capacity of local Government	Long term vision plan Specification of areas to absorb extra DR Specification of destination of revenues
		Operation of SDR	
		Valuation procedures	Form of assessment of land value
		Administration capabilities	Cadaster base + control of permits and supply of DR Control of information Bureaucracy of the process Time between expectation and real collection of revenues Operation of stock markets (CEPACs) Management of revenues
Dep. Variable	**Land Value Capture**	Amount of revenues generated Amount of value captured	Values of revenues from SDR Ratio between revenues and increment in value of land Ratio between revenues and current market value of land
Third (Context) Variables	**Culture**	Political acceptability	Legislation regulating SDR Facility to operate the instrument Developer willingness to buy extra DR
		Tax payer resistance	Developer willingness to buy extra DR Perception of value of tax Search for alternative development
	Land Markets	Condition of land markets	Fluctuation of number of permits per year Demand for extra building rights
	Property Rights	Legal separation of property rights	Legal framework separating property rights

3.3 Research strategy

The challenge of this work regarded how to collect and then analyze the data exposed in the previous sections in order to answer the proposed questions and achieve valid and reliable conclusions. The city of Curitiba uses three different models of the SDR: Onerous Concession

of the Right to Build (OODC), OODC sale through Shares (OODC-S), and the Certificates of Additional Potential Construction Bonds (CEPACs).

Each model of SDR (OODC, OODC-S and CEPACs) is used for different purposes, this means, their revenues are earmarked for the provision of specific public services and facilities. OODC is used for provision of social housing and environmental protection. OODC-S was used for conservation of historical buildings, slum upgrading, construction of public facilities (schools, childcare centers and others) and construction of a stadium. CEPACs are used for infrastructure provision and construction of public spaces in the area of the *Urban Operation Green Line*.

For this research, each purpose assigned through each model of SDR was treated as a *case.* For example, OODC for Social Housing is one *case*, OODC for Environmental Protection is another *case*, OODC-S for construction of public facilities is a third *case*, CEPACs for infrastructure provision is a fourth *case*, and so on. Each case encompasses different approaches in the use of the SDR, different ways of using this instrument, encompassing the following characteristics:

1. Each case acts in determined zones of the city;
2. Each case increases certain amount of density (FAR);
3. Each case uses a certain method of calculation of the charge;
4. Each case uses a certain method of assessment of private land value;
5. Each case sold development rights to a certain number of real estate projects;
6. Each case generated certain amount of revenues from the sales to the real estate projects;
7. Each case applied the revenues to the provision of specific public services and facilities.

The total universe of cases of SDR in the city of Curitiba can be observed in table 3:

Table 3: Total universe of cases of SDR in Curitiba.

Model of SDR	**Public facility & services *purpose***	**Year of introduction**
OODC (*Solo Criado*) *Calculation: market value*	Social Housing	1990
	Environmental Protection / Life quality	1995
OODC-S (Shares) *Calculation: price + index*	Historical Buildings conservation (UIEP)	1993
	Slum upgrading	2003
	Public facilities	2009
	World Cup Stadium	2010
CEPACs *Stock market*	Infra and public spaces	2011

The timeframe allocated to the works did not allow the analysis of all the cases of SDR in Curitiba. Therefore, the following sections will address how a criterial selection of cases was made and the several measures taken to ensure conclusions with high level of validity and reliability.

3.3.1 The case study: why this strategy?

The research questions of this study focus in one main independent variable of the concept *sale of development rights:* the way the instrument SDR is used (regarding its design, implementation and operation); and one main dependent variable of the concept *land value capture:* the amount of land value increase recovered. The causal relationship between these variables was studied through the strategy of *multiple case study*, which examines several cases and draws comparisons between them.

Case studies are conducted in real life settings and aim for depth examinations. This strategy allows the research to explain the specific phenomena in interaction with the wider context, and provides the possibility to compare the units varying the variables and looking for the differences. The use of this strategy leads to a detailed, deep and applied research, making a contribution to the solution of a concrete issue (van Thiel, 2014).

The literature describes case studies as holistic method which explores all factors that frame a phenomena (van Thiel, 2014). This research though, focused only in the causal relation between the independent and dependent variables identified through the theoretical review. Attention was paid, of course, to the context variables exposed in the conceptual framework (see section 2.7) so the interactions could be observed, but they were kept constant as much as possible in order to measure the causal relation between the main variables (see section 3.3).

3.4. Sample size and selection

3.4.1 First criteria: representativeness of cases

The first choice made in the design of the research was the number of cases to be studied. Section 3.3 presented the whole universe of SDR cases existing in Curitiba which, as already explained, was not possible to be extensively studied. Therefore, it was important for the further generalization of the findings to the whole population of SDR cases in Curitiba the selection of cases that are representative of the universe. This means that the cases chosen represent the use of SDR as OODC, as OODC-S and as CEPACs.

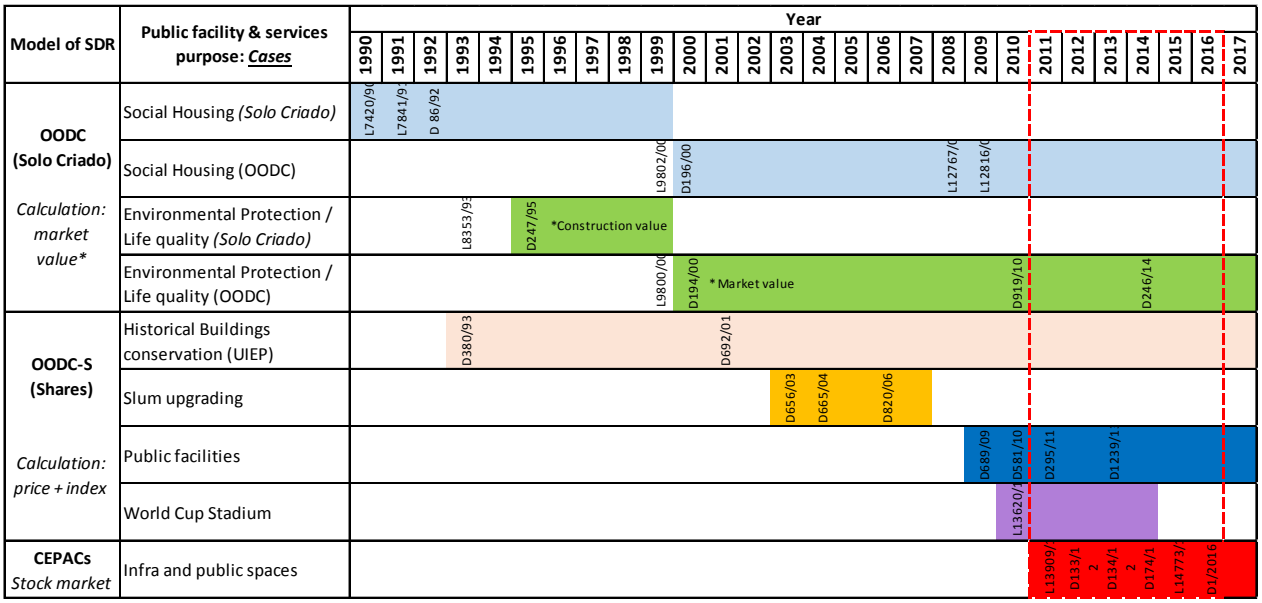
Added to that, to properly answer the research questions, a purposive selection of a set of contrasting and heterogeneous cases was made. The objective was to verify what the effect on the dependent variable is of the variation of the independent variable (the way the SDR is used). The variation of the independent variable might directly stablish the causal relation, and factors impacting the *capturing of value increase* might be more certainly identified (van Thiel, 2014).

Therefore, the representativeness of cases also allows the research to analyze the maximum variation of the independent variable by comparing the models of SDR: cases of OODC *versus* cases of OODC-S *versus* cases of CEPACs.

3.4.2 Second criteria: timeframe

The second choice made was the number of measurements to be done. Considering the strategy's goal to vary the independent variable keeping the context as constant as possible, the ideal situation would be choosing a time frame where the three models of SDR co-exist. This situation occurs from 2011 on (see figure 2). The limitation of the time frame was done by the availability of data, so until 2016.

Figure 2: The use of SDR in Curitiba since 1990 and its models (OODC, OODC-s and CEPACs). Highlighted in red the timeframe chosen for the research.



One drawback of narrowing the case by timeframe concerns the fact that urban instruments develop differently in time. During some years they might be successful due to several external factors and in other periods they might not be so effective. Nevertheless, while in different times the total revenue from each case may vary because of the fluctuation of the number of real estate projects using the tool, the individual capture from the real estate projects acquiring development rights is more or less constant.

3.4.3 Third criteria: control of third variables

Considering the conceptual framework presented in section 2.7, the causal relation between *the amount of value captured* (dependent variable) and *the way SDR is used* (independent variable) is also affected by factors that are outside the independent variable. These factors are embedded in context variables (or third variables) which are out of the range of this work for deep examination. Therefore, in order to proper analyze the main relationship and study the direct relation on focus, measures of control of third variables were taken:

1 – The third variables *political support* and *tax payer resistance* – related to *Culture* – was kept constant as much as possible. This was done by the timeframe selection of the cases studied. The sample of cases selected could be from 2004 on, after the promulgation of the local law 11,266/2004, which suited the municipal land use plan law to the national regulation *Estatuto da Cidade*. The release of this law is an evidence of the political commitment of Curitiba with this urban instrument, since the approval of the law runs through several discussion processes in the city's Chamber. Moreover, in 2004 the SDR was already being used in Curitiba for 14 years, which is enough time for the land and real estate markets to accept and understand how to deal with the instrument. Therefore, in this period the resistance to the tax might have been overcome.

2 – The third variable *legal separation of property rights* can strongly influence the design and implementation of the SDR in a city. However, in the specific case of Brazilian cities, this understanding was being discussed and gradually politically and socially accepted since 1970. The *Estatuto da Cidade* of 2001 legally consolidated this conceptual separation. Therefore, samples from 2001 on isolate and keep this context variable constant.

3 – The third variable *condition of land markets* is very dynamic and can influence the relationship between the main independent and dependent variables. It is almost impossible to keep this variable constant: since the 90s the production of the real estate market (here used as an indicator of the condition of land markets) had ups and downs, showing an explosive increase from 2005 to 2010. Therefore, considering that data regarding markets' indicators are available per year, the cases were analyzed and compared with each other within every year, isolating then the land market variable. Comparisons of cases in different years will take in consideration the influence of this context variable.

3.4.4 Final selection of cases

Based on the reflections and choices presented, the cases of SDR in Curitiba that match all the criteria and were selected for intensive study are the following:

1. OODC for *Social Housing* from 2011 to 2016;
2. OODC for *Environment protection* from 2011 to 2016;
3. OODC-S for Historical Buildings conservation from 2011 to 2016;
4. OODC-S for Public facilities construction from 2011 to 2016;
5. CEPACs for Infrastructure and public spaces from 2011 to 2016.

This set of heterogeneous cases involve the financing of urban development through the three models of SDR used in Curitiba, being two of OODC, two of OODC-S and one of CEPAC, allowing the comparison of designs and final results leading to the analysis of the causal relation with high levels validity and reliability of the findings (see section 3.7). The model of *OODC-S World Cup Stadium* was not selected for the study since the purpose of the funds is largely questioned and not in accordance to the laws of the SDR.

3.5 Data collection methods

The case study strategy demands collection of a lot of detailed data regarding the phenomena on focus. Therefore, different sources of information, attention to context variables and measures in different moments were done. The methodology to collect the data to study the cases and answer the research questions involved *content and secondary analysis*, which corresponded to examining existing literature, documents and laws, as well as numerical data provided by the municipality regarding results of the instrument application in the cases selected. Added to that, *interviews* with key informants (experts and professionals) involved in the different implementations of the SDR in Curitiba and players of the real estate market were held in order to complement and also triangulate information from the content analysis.

3.5.1 Content and secondary analysis

Previous research and studies, secondary and primary data from public bodies and associations provided qualitative and quantitative data which were analyzed and brought together in order to draw conclusions (van Thiel, 2014).

3.5.1.1 Design and implementation of the instruments

All legislation regulating the five cases of SDR was collected through the local government's website and organized. Previous research was also put together with the local laws, providing qualitative data for analysis of the design and implementation of the SDR for each case, regarding what, where, how, when, why and the planning capacity of the local government. Maps and GIS information concerning the zoning and the land use plan of Curitiba supported the qualitative data of the distribution of zones where the instrument can be used in each case, as well as the examination of the basic a maximum FARs.

3.5.1.2 Real estate market conditions

Monthly reports regarding the building permits issued by the local government were collected from the Municipality's website and compiled annually. This data also supported the analysis of the real estate market behaviour and the demand for additional building rights.

3.5.1.3 Real estate projects which acquired development rights through SDR

Data regarding the developments which upgraded building parameters through the five cases of SDR studied was collected in the Municipality, from the Municipal Secretary of Urbanism (SMU). The number of projects that acquired additional development rights between 2011 and 2016 are the following:

Table 4: Number of developments analyzed in each case

OODC *for Social Housing*	90 projects
OODC *for Environment protection*	21 projects
OODC-S *for Historical Buildings conservation*	81 projects
OODC-S *for Public facilities construction*	709 projects
CEPACs *for Infrastructure and public spaces*	51 projects

The total amount of developments analyzed to support the study of the models was 952.

3.5.1.4 Land values

Land prices were collected from a private local institute specialized in monitoring the real estate market: the INPESPAR (*Paraná Institute of Research and Development of the Real Estate and Condominium Market*). Since 1996, this institute collects data regarding the activity of the real estate market in Curitiba from ads of main newspapers and from real estate agencies in the internet. The information processed concerns the type of building, size, neighbourhood and price asked, for constructed and empty plots.

After collecting this data, the INPESPAR calculates monthly the average value of properties per neighbourhood according to the following methodology: 1) exclusion of outsider samples; 2) calculation of the average value; 3) elimination of 30% of the samples around the average; 4) new calculation of the average and the coefficient of variation; 5) checking of the validity of the data - more than 6 units and coefficient of variation below 0,30 (INPESPAR apud Gavriloff, 2013).

The average values per month provided by the INPESPAR were then reduced to average values per year per neighbourhood to be used in the analysis of this study.

3.5.2 Interviews

Interviews were used in order to complement and fill the gaps from the data collected through the content and secondary analysis. They helped enhance information regarding the operation of the instruments, including valuation procedures and administration capabilities, and the perspectives of the market. The method used was semi-structured interviews, which held guidelines with earlier prepared questions to get the necessary information but also had some opening for improvisation and collection of extra data to confirm the relation between variables (Van Thiel, 2014). Moreover, the interviews were also used to triangulate the information collected, by interviewing different sources, enhancing the validity and reliability of the findings.

The interviews were held by phone in July and August of 2017 with key informants: two members of the Municipality, who participated in the instrument's design, in its day-by-day operation and who work on its improvements; and with two architects who are key players of the real estate market, providing information about the market view regarding the instrument. The details concerning the interviews are summarized in the following table:

Table 5: Key informants interviewed

Respondent	Category	Position	Participation in SDR
Carstens, F.	Real estate market	Chief of architecture office in Curitiba and founding partner of the *Brazilian Association of Architecture Offices in Paraná* (AsBEA-PR)	Works with most developers in Curitiba using the instrument and participates in councils in the Municipality representing the private market
Schiavon, F.	Real estate market	Chief of architecture office in Curitiba	Works with most developers in Curitiba using the instrument
Polucha, R.	Government	Architect from the *Institute of Research and Urban Planning of Curitiba* (IPPUC)	Researches the operation of the urban instruments used by the Municipality, participant in the revision of the land use plan
Soffiatti, R.	Government	Real Estate Taxes Assessor from the *Municipal Finance Secretary* (SMF)	Worked with the calculations of OODC and OODC-S. Participant in the design of the OU-LV and the CEPACs. Researches the operation of the urban instruments used by the Municipality

3.5.3 Challenges and weaknesses of data collected

Some inconsistences were found in the data collected from the Municipality regarding the developments and upgrades in parameters. For some projects, upgrades were not in accordance to legislation. These units and others with irresolvable inconsistences, which stood for less than 3% of the total data, were excluded. Moreover, some developments lacked important data like land area or increment in FAR. However, these values could be complemented and calculated through individual consultation in the Municipality's data base.

Another weak point of the data collected regards the values of land. The ideal situation would be the analysis of each project that feeds the cases of SDR individually, modelling their precise land values. This task, nevertheless, is incompatible with this research due to its extreme complexity and time consuming. So, this work opted for using average land values per neighbourhood to produce the analysis of capture of value. The results have high level of validity due to the availability of reliable data from INPESPAR. Although the results might not be extremely accurate for each development project, they are valid to measure the performance of the urban instruments studied, which is the main goal of this research.

3.6 Data analysis methods

As can be observed by the data collection methods explained in section 3.5, the information collected are mixed between qualitative and quantitative data. Therefore, a mix of analysis methods were applied in order to determinate if variations in the way the SDR is used affects the amount of increases in value of land that is captured by the instrument.

3.6.1 Preparation of qualitative data

Qualitative data was organized conceptually and then interpreted, categorized and coded with specific labels in order to allow further crossings and comparisons to support the analysis. A code is the synthesis of what a piece of qualitative data means. Equal or similar data that follow a pattern had the same code assigned, allowing the further comparison between different information. Codes used are simple numbers or concepts with meaning. The literature calls this "backward operationalization" (Van Thiel, 2014).

Data reduction was performed in order to filter information and discard material that was irrelevant or inconsistent for explaining this research subject. The choices made in the processes of coding and data reduction were noted in a memo in order to strength the reliability of the research.

3.6.2 Preparation of quantitative data

3.6.2.1 Market behavior indicator: number of building permits

The data collected from the Municipality regarding *building permits* included all sorts of projects and all sizes, like new development, single family houses, renovation, expansion, and several kinds of land uses, including housing, commercial, industrial and so on. Therefore, it was necessary to filter the permits isolating the developments that stand for the real estate market, removing, for example, single family houses and renovations.

The number of permits was then filtered by the following criteria:

a) Above one housing unit (excludes single family houses);

b) Only housing, commercial and offices use (excludes industrial and others);

c) Only construction (excludes renovations and expansions).

After that, one more criteria was added to the data, regarding if the building permit was effectively used, in other words, if the development was constructed until the date of the collection, August 2017.

3.6.2.2 Land values: current market value and increments

The land values from 2011 until 2016 were compiled per neighbourhood and located in GIS for the creation of the valuation maps. In order to estimate the increase in property values, the base line used was the prices from 1996. This date was chosen for two reasons: first, the availability of the information; second, the change of the Brazilian coin to the Brazilian Real (R$) was consolidated in this year, therefore, conversions of money would not be necessary and all the values would need to be only corrected by inflation.

The correction of inflation between 1996 and the years among 2011 and 2016 was made using the official *General Index of Market Prices (IGP-M)*. This index is calculated monthly through weighted average of other three indexes (wholesale prices, consumer prices and construction costs) and is commonly used in Brazil for value corrections in real estate operations, like renting and sales (BCB, 2017).

The land values of each development feeding the five cases studied was calculated by multiplying its area for the average value of the neighbourhood where it is located. This calculation was made for every project for the year 1996 and the year when the development had its permit released. The increment in value of land was then calculated by correcting the prices of 1996 by the IGP-M and subtracting the current market value of the year of the permit release from the corrected value of 1996. Therefore, the increment in value estimated in this research considers raises that occurred from any intervention, being public or private.

3.6.2.3 Revenues from the SDR

The price charged by each SDR instrument was calculated for every development feeding the cases following the methods and formulas pertinent to each model, according to the legislation (see next section 4.2.1). In the cases of the OODC, the land values were used in the calculation of the charge. In the cases of OODC-S, the fixed prices of the shares specific by decrees were used. And in the case of the CEPAC, the price of the CEPAC's certificate was used to estimate the charge. As after July 2014 it is not possible to track which price was paid for the certificates used since more auctions were made, it was calculated the minimum (R$ 200.00) and maximum (R$ 336.00) prices for each development. The final results of these charges (min. and max) in the total sum of the case of CEPACs are very close, so an average value between the maximum and minimum value captured was used.

3.6.3 Analysis

After the coding and organization of the qualitative data, and the preparation of quantitative data, the following step was comparison and crossing, seeking for causal relations and interconnections. The maximum variation of *the way SDR is used* by the analysis of the cases of OODC, OODC-S and CEPACs allowed inferring the relation between independent sub variables of design (like FAR), implementation (like time and transparency) and operation (like form of calculation) and the dependent variable final result of value capture.

3.6.3.1 Demand for development right analysis

In order to analyze the demand for additional building rights and the impact of the land markets in this demand, it was isolated the type of development that most acquired development rights and that is the most operated by the real estate market: apartment's building. From the total permits issued by the municipality in the period studied, it was first isolated the use *apartment's*

building and then the zones in which the acquisition of additional development rights is possible through any of the five models.

3.6.3.2 Amount of LVC analysis

The values charged for development rights were crossed with the land values for each project feeding the cases, allowing the analysis of the amount of current use value and also increment in value that was captured by the different models of SDR.

In order to compare the outcomes between the five cases, though, several adjustments were necessary. As one of the building rights upgraded is the FAR, it is not correct to compare an OODC project that acquired 100% of the available extra FAR with and OODC-S project which acquired only 20% of the additional right. Also, comparisons between acquisition of *height right* with *FAR right* generates distortions. Therefore, several criteria and different comparisons were made in order to achieve reliable and valid results (see section 4.3.4).

3.7 Reflections on validity and reliability

This research aims at drawing conclusions with high level of validity, including *internal validity*: explaining the relationship between the variables; and *external validity*: being able to generalize the findings. The use of the strategy case study tends to provide high level of internal validity due to the amount and depth of data collected. On the other hand, in theory this concentrated study has limited external validity because it relies on the particular cases and context analyzed of Curitiba (Van Thiel, 2014).

3.7.1 Internal Validity

The internal validity was enforced first, as already mentioned, by the chosen *multiple-case study* strategy, which analyzes situations with rich detail e depth; and second by the isolation of the focus variables keeping third variables constant as much as possible. This allowed the maximization of the variance of the independent variable and observations of the effects in the dependent variable, consequently allowing the research to infer the causal relationship between the way SDR is used and the amount of value increase captured to finance urban development.

Validity is also enforced by the method which used the same data base of land values for all cases and developments plus the calculation of the charges using the methodologies described by each pertinent legislation. The method of calculation of increments in land values was based on prices of 1996 corrected by an accredited inflation index. Although the prices of land collected are averages from neighborhoods and not prices of each single plot, all the cases used the same data base which is one of the most reliable available in the city, providing results that stands for the reality. Moreover, the triangulation of data done by interviews with key players from the real estate markets and from the Municipality not only diminished the subjectivity and risky bias of the interpretation of qualitative information but also filled the gaps of these data, enhancing the internal validity of the research.

One limitation regarding the validity of the findings resides on the fact that the analysis of major qualitative data provides weaker certainty about systematic causal relations between two variables than statistical analysis, which is based on major quantitative data. For that reason, this research infers as much as possible the causal relation between *the way SDR is used* and *the amount of value captured*, and not assures this relation.

3.7.2 External Validity

The limited generalization of the findings of case study research strategy can be enhanced by the selection of representative cases. This means that the selection might choose cases encompassing as wider as possible all the characteristics of SDR cases in Curitiba, allowing then the analysis of a higher range of factors that may be valid for other cases not studied. This criterion was explained in section 3.4.1.

Besides the generalization to the other SDR cases in Curitiba, this research could also be valid to other cities. When using case study strategy, the generalization of the findings can be done by generalizing to theoretical propositions instead of generalizing to populations. That means that the findings can be generalized in theoretical frameworks which are suitable for analyzing similar cases (Swanborn, 1996 apud Muñoz Gielen, 2010, p.73). This is also cited by the literature as *transferability*, a characteristic of qualitative research (Van Thiel, 2014). Curitiba was one of the pioneer cities in Brazil in the use of *Sale of Development Rights* and now holds more than 27 years of experience with it. So, it is possible that the findings of this research could be representative for other cases in this same research domain, like the use of SDR in other Brazilian cities, and maybe, even in other cities around the world which holds similar cultural and legal frameworks, even that they were not studied.

3.7.3 Reliability

Reliability refers to repeatability, the consistency of measurements. It means that if another researcher performs the same study following the steps described, the same result should be found. The accuracy of the measurements in this research were secured by the clear differentiation of values the independent variable can assume and by the measurement of these values done through clear and precise indicators. The consistency of the study was achieved by the criterial selection of the cases which encompasses large number of real estate projects to have their values analyzed, and also by the triangulation of data to confirm the information collected. Moreover, the choices made when collecting and analyzing data were noted in a memo in order to strength the reliability of the research.

CHAPTER 4. Research findings and analysis

4.1 Introduction

This section will present the data collected and processed regarding the use of the instrument *Sale of Development Rights* in Curitiba together with the analysis of the results. The narrative will follow the sequence of independent and dependent variables in parallel with the context variables, as detailed in the operationalization of section 3.2. At the same time, comparisons between the five cases studied will be drawn. The findings will support the argumentation to answer the proposed research questions in Chapter 5.

4.2 The way the SDR is used

The way the SDR is used in Curitiba varies according to the three existent models: OODC, OODC-S and the CEPACs. Each of these models encompasses variations in the design and subsequent implementation and operation of the SDR tool, as will be explained in the following sections.

4.2.1. Design of the instrument

4.2.1.1 What rights are charged

The five cases of SDR act in specific zones of the city allowing new land uses, development above the basic FAR and increase in the number of floors of a building. Additionally, the CEPACs is the only model which allows and then levies increase in the number of residential units (another density parameter), and specific increase in commercial area. The legal frameworks of the five cases do not specify a payment if the developer only changes the use of land.

The additional development rights can be purchased through the five cases of SDR in specific residential, transition and special zones, where the basic FAR is variable, ranging from 0.4 to 5.0. The highest base lines are observed in the central zone (5.0), the civic center where governmental and several institutional buildings are located (5.0), the structural zones which are corridors holding mass public transport infrastructure (4.0) and a pedestrian special zone (3.6), which encompasses the *Rua XV de Novembro*, a commercial street in the city center. Almost all residential zones of the city hold a basic FAR of 1.0, except for the *Residential Zone 4*, where the base is 2.0.

The *OODC-Environmental Protection* is more focused on increasing height of buildings, so it allows increases in the number of floors up to 6 more storey and up to more 0.8 FAR. All the other cases allow increases up to 2.0 additional FARs depending on the zone, except for the CEPACs which goes until 3.0 additional FARs.

Considering the higher FARs (above 2.0), only the two cases of OODC-S allow more intense use for the central area and the structural zones, adding to their base lines 5.0 and 4.0 FAR (respectively) more 2.0 FAR. For the zones where the base is equal to 2.0, the four cases except for the CEPACs can increase the development in more 0.5 FAR. Finally, for the zones where the base is 1.0, the five cases can improve more the development, achieving 2.0 addition for the OODC-Social Housing and the two cases of OODC-S, and additional 3.0 for the CEPACs.

The basic allowed number of floors are also very contrasting, starting from 2 and ending in 8, except for the special structural zones, poles of the *OU-Green Line* and the central area, where

the number of floors is unlimited, conditioned only to air traffic restrictions. All the SDRs can upgrade the development adding between 1 and 6 more floors. The CEPACs removes the height limitation in the majority of the zones of the *OU Green Line*.

Most land use changes for all cases allow new uses which require more intense occupation, as apartment's buildings, hotels, corporate buildings, communitarian uses and commercial of greater dimensions.

Although Curitiba's land use plan allocates differentiated basic FARs to the territory, in most of the zones the base line is one time the size of the plot, aligned with the principles of the *Letter of Embu*. Controversially, the zones where the basic rights are higher (above 1.0 FAR) embrace the majority of the most expensive neighborhoods in the city, like the ZR-4, the city center and the structural zones. Therefore, areas with high land values are already benefited with more development rights for free, fact that actually could be one of the reasons for the higher land prices.

Besides that, it is interesting to note that the OODC and OODC-S charge mostly the same rights: they upgrade the same parameters. Moreover, the OODC-S operates in additional zones to the OODC, including areas where the base line is already 4.0 and 5.0 FARs. The CEPACs include one ZR-4 zone which has the same parameters of the ZR-4 zones that are located outside the OU-LV. Therefore, the same settings of parameters are charged with different prices (OODC, OODC-S and CEPACs). This analysis already suggests the existence of competition between the models of SDR. Unfortunately, until 2016 there was no case of upgrade of development rights using CEPACs in the ZR-4, what would allow interesting comparisons.

The following table summarizes the basic and maximum parameters of all five cases of SDR studied. For the detailed parameters of each zoning, check *Annex 1*.

Table 6: Summary of basic and maximum building parameters.

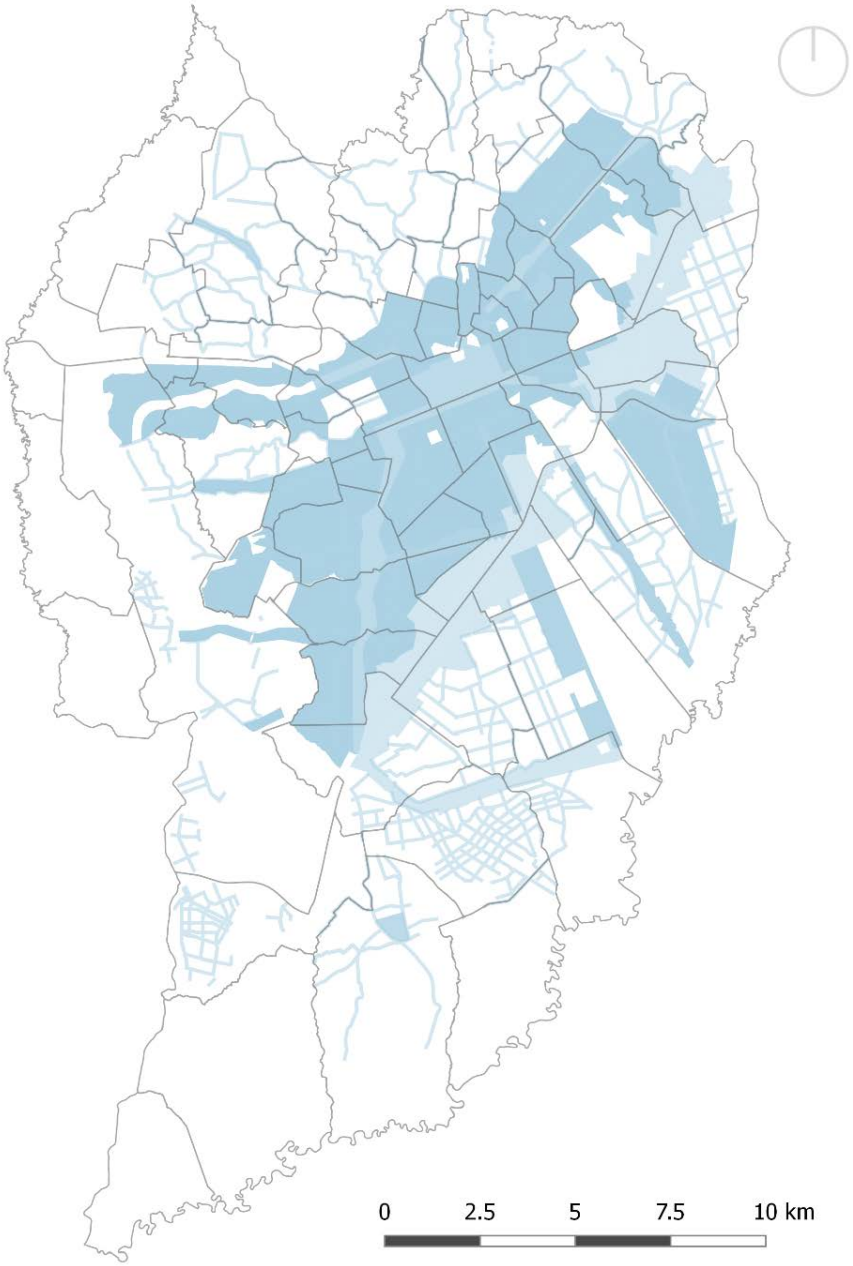
ZONE		BASIC F.A.R.	BASIC N. FLOORS	OODC Social			OODC Envir.			OODC-S Historical			OODC-S Public			CEPACs Infra & P.S.		
				ADD F.A.R.	ADD FLOORS	CHANGE USE	ADD F.A.R.	ADD FLOORS	CHANGE USE	ADD F.A.R.	ADD FLOORS	CHANGE USE	ADD F.A.R.	ADD FLOORS	CHANGE USE	ADD F.A.R.	ADD FLOORS	CHANGE USE
Central Zone - ZC		5,0	Unlim.	-	-	-	-	-	-	2	-	N	2	-	N	-	-	-
Residential Zones	Controlled Ocupation – ZR-OC	0,4	2	1,1	2	Y	-	-	-	1,1	2	Y	1,1	2	Y	-	-	-
	One – ZR-1	1,0	4	-	-	-	-	2	Y	-	-	-	-	-	-	-	-	-
	Two – ZR-2	1,0	2 to 4	0,5	2	Y	0,2	2	Y	0,5	2	Y	0,5	2	Y	-	-	-
	Three – ZR-3	1,0	3 to 4	0,5 to 1,5	1 to 5	Y	0 to 0,2	2 to 4	Y	0,5 to 1,5	1 to 5	Y	0,5 to 1,5	1 to 5	Y	-	-	-
	Four - ZR-4	2,0	6 to 8	0,5	2 to 4	N	0,4	2 to 4	Y	0,5	2 to 4	Y	0,5	2 to 4	Y	-	-	-
	Batel – ZR-B	1,0	2 to 4	-	-	-	-	2	Y	-	-	-	-	-	-	-	-	-
	Mercês – ZR-M	1,0	2	1,5	6	Y	-	-	-	1,5	6	Y	1,5	6	Y	-	-	-
	Alto da Glória – ZR-AG	1,0	2	1,5	6	Y	-	-	-	1,5	6	Y	1,5	6	Y	-	-	-
	Santa Felicidade – ZR-SF	1,0	2 to 4	0,5	2	Y	0,2	2	Y	0,5	2	Y	0,5	2	Y	-	-	-
	Umbará – ZR-U	1,0	2 to 4	0,5	2	Y	0,2	2	Y	0,5	2	Y	0,5	2	Y	-	-	-
Transition Zones	Av. Mal. Floriano Peixoto – ZT-MF	1,0	2	0,5	2	N	-	-	-	0,5	2	N	0,5	2	N	-	-	-
	Nova Curitiba – ZT-NC	1,0	4 to 8	0,5 to 0,8	2	Y	0,5 to 0,8	2 to 4	Y	0,5 to 0,8	2	Y	0,5 to 0,8	2	Y	-	-	-
	BR-116 – ZT-BR-116	1,0	4	0,8	2	N	-	-	-	0,8	2	N	0,8	2	N	-	-	-
Special Zones	Estrutural (Central Street)	4,0	Unlim.	-	-	-	-	-	-	2	-	N	2	-	N	-	-	-
	Avenues – SE-MF, SE-CF, SE-WB, SE-AC	1,0	4	1,5	6	N	-	-	-	1,5	6	N	1,5	6	N	-	-	-
	Engenheiro Costa Barros St. - SE-CB	1,0	4	0,8	2	N	-	-	-	0,8	2	N	0,8	2	N	-	-	-
	Conectoras - SE-C	1,5	4 to 6	0,5	4	N	0,5	4	Y	0,5	4	N	0,5	4	N	-	-	-
	Civic Center - SE-CC	2,0	6 to 8	0,5	4	N	0,4	2 to 4	N	0,5	4	N	0,5	4	N	-	-	-
	Umbará (Commercial) - SC-U	1,0	2	-	-	-	-	-	-	0,5	2	Y	0,5	2	Y	-	-	-
	Santa Felicidade (Commercial) - SC-SF	1,0	2	-	-	-	-	-	-	0,5	2	Y	0,5	2	Y	-	-	-
	Institutional - SE-I	1,0	3	0,5	1	N	-	-	-	0,5	1	N	0,5	1	N	-	-	-
	Social Housing - SEHIS	1,0	2	0,5	2	Y	-	-	-	0,5	2	Y	0,5	2	Y	-	-	-
	Linhão do Emprego - SE-LE	1,0	2 to 4	0,5	0 to 2	N	-	-	-	-	-	-	-	-	-	-	-	-
OU Green Line	Poles - POLO-LV	1,0	Unlim.	-	-	-	-	-	-	-	-	-	-	-	-	3,0	Unlim.	Y
	Special Sectors - SE-LV	1,0	6	-	-	-	-	-	-	-	-	-	-	-	-	3,0	Unlim.	Y
	Transition Zones - ZT-LV	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	1,5	4	Y
	Residential Zone Four - ZR-4	2,0	6	-	-	-	-	-	-	-	-	-	-	-	-	0,5	2	Y
	Special Sport Zone - ZED	0,5	2 to 4	-	-	-	-	-	-	-	-	-	-	-	-	0,5 to 2,0	4 to 6	Y

Highest FARs (above 1,0)

4.2.1.2 Where the rights are charged

The five cases of SDR allow additional development in specific residential, transition and special zones. Overlaps of the models of SDR happen in many of these zones, giving options to the developer and generating a local competition between the models in the same zone. The CEPACs is the only case which acts in a specific perimeter of the city without overlaps, due to the *Urban Operation* setting that isolates its area. The figure 3 exposes the zones of the city where additional development can be purchased through the SDR. The more intense the blue color, the more models of SDR act in the same area.

Figure 3: Map of where SDR operates in Curitiba. Data source: Municipality of Curitiba. Map: the author

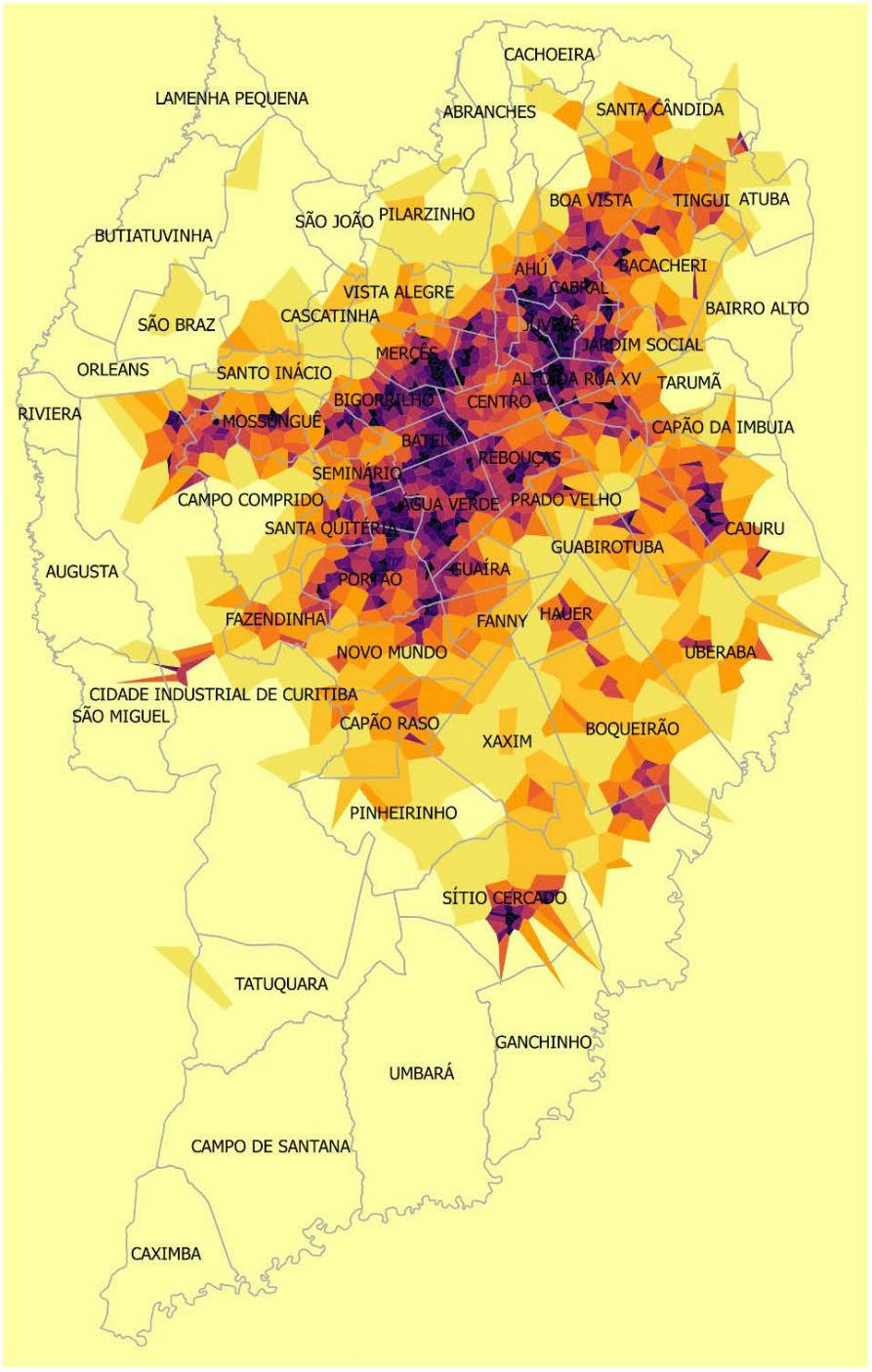


The following map graphically exposes the intensity of use of the SDR over the territory through a *Voronoi diagram*. This diagram is made by drawing a line across the mid distance between two points and subsequently constructing polygons. The closer the points are, the smaller will be the polygons. In the following map, the darker is the color, the smallest is the

polygon, therefore the more developments in that area upgraded building rights through the SDR. Exceptionally extrapolating the timeframe of this research, the data includes developments since the first OODC, from 1992 until 2016.

The acquisition of additional building rights is concentrated more around the central area (expensive neighborhoods) and in the neighborhoods Sitio Cercado, Boqueirão and Cajuru, which are popular areas. The darker colors also match the location of the structural zones, which are areas where the government wishes to foster development. Therefore, Curitiba could manage well one of the urban functions of the SDR besides LVC: steer urban growth.

Figure 4: *Voronoi diagram* from SDR use over Curitiba's territory. Data source: Municipality of Curitiba. Map: the author



4.2.1.3 How the rights are charged

The calculation method of the price of the additional development rights varies in the five cases according to the model of SDR.

For the *OODC Social Housing* and *OODC Environment Protection* the additional development rights are charged based on the virtual land method. That means that the city burdens the value of an amount of imaginary land area that would be necessary to accommodate the extra development in the current parameters. For example, if a land of 1,000m² with a basic FAR equals to 1.0 is improving its FAR to 1.5, it is necessary more 500m² of land to accommodate this extra 0.5 FAR. If the basic FAR of the same plot was 2.0 and the upgrade also more 0.5 FAR, the necessary extra virtual land would be 250m². This additional virtual area is multiplied by the market value of the real land in order to determine its value. Finally it is applied a reduction index of 0.75 when the upgrade is additional FAR and 0.15 when it is only additional floors. When both extra rights are purchased (FAR and extra floors), it is loaded the higher value between them (Polucha, interview 2017).

This calculation method is done by the following formula:

$$ADP = \frac{Ad}{BF} \times Lv \times i$$

ADP: additional development right price (in Brazilian Reais - R$);
Ad: additional development (in square meters – m²);
BF: basic floor area ratio (FAR);
Lv: land market value, from specific land appraisal (in Brazilian Reais - R$);
i: reduction index – 0.75 for additional FAR and 0.15 for additional floors.

For the *OODC-S Historical Buildings* and *OODC-S Public Facilities* the calculation of the price of the charge ignores the land value and is based in a fixed amount stablished by decree. The amount of additional construction, being either additional FAR or the area of additional floor, is multiplied first by a correction index. This index is variable according to the zone and is connected to the basic FAR. The higher the base line, the higher is the index, according to the following table:

Table 7: Relation between index and FAR for OODC-S

Base line of development (FAR)	Index (OODC-S)
until 1.0	0.3
1.5	0.4
2.0	0.6
more than 2.0	1.25

This in theory makes the SDR cheaper in areas with lower basic FARs and more expensive in areas with higher FARs. The result of this operation will state the amount of shares that the developer must acquire in order to upgrade the project. Finally the number of shares is multiplied by the value of the share specified by the current decree.

The calculation method of the OODC-S can be summarized by the following formula:

$$ADP = Ad \times i \times Sp$$

ADP: additional development right price (in Brazilian Reais - R$);
Ad: additional development (in square meters – m²);
i: adjustment index – variable according to the zone, from 0.3 to 1.25;
Sp: share price, determined by decree (in Brazilian Reais - R$).

For the CEPACs, the development above the base line is payed through the certificates that are purchased in auctions made by the Municipality or from other investors who have certificates acquired in the auctions. The price of the CEPACs is conditioned to the market. The minimum initial value of the auctions is established by the local government and the final sale price is then achieved in the open auction. The amount of CEPACs to be used to improve development is calculated by dividing the area of additional construction per an *equivalence factor*. This equivalence factor is stated by the law 13,909/11 and varies according to the zones. It aims at increasing the number of necessary certificates in areas with higher land values and which are more developed, and decrease the number of necessary certificates in areas with lower land prices and where development is desired (Soffiatti, interview 2017). The additional development price can be explained by the following formula:

$$ADP = \frac{Ad}{ef} \times Cv$$

ADP: additional development right price (in Brazilian Reais - R$);
Ad: additional development (in square meters – m²);
ef: equivalence factor – variable according to the zone, from 0.6 to 1.4;
Cv: CEPAC value – auctioned and negotiated in the market (in Brazilian Reais - R$).

Additionally, the CEPACs case charges upgrading of more parameters with other calculation methods. The increase in the number of housing units is charged in a fixed rate of 15 CEPACs for each additional unit. The improvement in commercial area is charged by dividing the additional building area per the equivalence factor and then per 8, resulting in the number of certificates necessary.

The three forms of charging the building rights follow a logic connected to the additional building area but not always connected to land values, case of the OODC-S. Nevertheless, the OODC-S has a very straightforward calculation method, allowing the developer to know the value of the charge precisely beforehand. The OODC, on the other hand, demands more work, since the assessment of land values is complex and not exact, although it is the most logical way to calculate LVC. The CEPAC is the most risky model for developers, once the final value of the rights could be in theory unpredictable due to the auction system.

4.2.1.4 How much the rights cost

As the calculation method of the cases of OODC (Social Housing and Environment Protection) consider the current land market value in each single development, the price of the building rights is affected by the land markets and is specific for each case. Moreover, constructing more floors without surpassing the basic FAR is much cheaper than improving the building capacity of the land, since the reduction index of the first drops the price to 15% while the second drops

to 75%. The data collected shows a high number of projects that improve only the height of the buildings. According to Carstens (interview 2017), depending on the conditions of the land, developers can construct more housing units in higher number of floors without the need to improve the FAR, maximizing the number of units offered to the market spending less in the acquisition of development rights. Moreover, housing in higher storey are more valuable than in lower ones.

On the other hand, in the cases of OODC-S (Historical Buildings and Public Facilities) the price of the development rights is fixed, adjusted by an index according to zoning. Until 2013 the published decrees stablished the values of shares which passed from R$ 350.00 in 2010 to R$ 618.27 in 2013. In 2014, the decree 942/14 established a new value for the share of R$ 655.40 and determined an annual correction of this amount according to an index related to construction costs. If charging development rights based in fixed prices can already generate distortions in collection, indexing the correction of the value to a *construction index* is a clear example of misunderstanding of the SDR's land value capture mechanism.

For the case of CEPACs, the price of the parameters' upgrade starts also in a fixed rate. However, the initial price of the certificates should represent the minimum land value inside the OU and then vary according to the market demand. Risky factors of the real estate market made Curitiba reduce the initial price to values below the minimum land price though (Soffiatti, interview 2017). The amount to be levied is adjusted by the equivalence factors according to the zone inside the *Urban Operation*. The three auctions that the Municipality handled in Curitiba sold the certificates for the minimum price asked by the government, respectively, R$ 200.00, R$ 325.00 and R$ 336.00, one of the facts the lead many to consider that the auctions were, so far, failures (Carstens, interview 2017; Schiavon, interview 2017; Soffiati, interview 2017).

Nevertheless, Soffiatti (interview 2017) pointed that the certificates are already circulating in the secondary market being sold for two times the original price. The negotiations in the secondary market do not provide additional resources for the municipality, but the intensity of the transactions may work as a thermometer of the market for the right time to launch auctions and for adjustments in the minimal price to be asked.

4.2.1.5 Time: transparency and payment

The land use plan of Curitiba states in which areas the SDR is possible. Therefore the obligation to pay for additional development rights – which is an optional action – is known beforehand by developers. The final price of the rights, though, can be early estimated for the cases of OODC, but will be precisely known only after the Municipality's appraisal of land. For the case of OODC-S the charge can be precisely calculated beforehand following the procedures in the laws. The CEPACs are dependent on the values of the auctions, therefore, very difficult to predict. Moreover, the CEPACs' law provides for the adjustment of the equivalence factors every 5 years, allowing tunings according to the behavior of the market.

The developer must apply for the additional development right before asking for the construction permit or during its process. The payment can be split in 10 parcels for the cases of OODC. For the OODC-S the payment can also be split, but the full amount must be cleared in order to issue the *using permit* (authorization to occupy the building after conclusion of works). When using CEPACs, the developer must assign the certificates to the cadaster number of the plot before or during the permit processing.

The unpredictability of the charges' values from the OODC and CEPACs put these models in disadvantageous positions when compared to the OODC-S. Developers may incur in less risk

when opting for the OODC-S, since the SDR costs can be more precisely advanced then securely managed.

4.2.1.6 Why the rights are charged

The *OODC Social Housing* generates resources for investments in social affordable housing. It allows development above the one limited by the land use plan in areas that are well served by infrastructure and could, therefore, absorb more density. There is a social principle of financing less structured zones of the city with resources coming from the development of richer zones Ciffoni (2011, p.257).

The *OODC Environment Protection* encourages owners of land with huge green areas to preserve those areas in exchange for more intense development in the portions of the land that are not greenfield. The legal framework of this instrument softly upgrade some parameters of plots that have more than 30% of their area occupied by forests, providing more incentives without charging in money, only requiring the preservation. Moreover, little improvement in FAR and huge upgrade in the height of the buildings can be allowed through the payment for this additional rights though the instrument. The funds from these sales are allocated in an environment and social fund, to be used for preservation of public green areas, riparian forests, and acquisition of land for construction of public facilities (Ciffoni, 2010, p.265).

The *OODC-S Historical Buildings* earmarks the funds to the restoration and conservation of buildings holding huge historical and cultural value for the city (UIEPs). For each important building, a specific decree is created with the number and value of shares offered to the market. The number of shares is related to the constructed area of the UIEP but also to the expectation of costs of restoration. There are situations that the number of shares was improved after some time in order to support increases in restoration costs, like the *UIEP - Quartel da Riachuelo* (decrees 1275/12, 760/13 and 192/14) and the *UIEP – Casa do Estudante* (decrees 588/07, 386/08 and 1604/09).

The *OODC-S Public Facilities* earmarks the revenues for the provision of urban services. However, the specific purposes changed over time since its creation in 2009. The original earmarking was for the construction of schools and childcare centers (decrees 689/09, 581/10). In 2011 the decree 295/11 created a new amount of shares allocating the resources to the construction of social and communitarian facilities. In the following year, the decrees 359/12, 2007/12 and 1260/12 specified a new purpose of works and expropriation related to the road system. Currently the funds are earmarked for the construction of public facilities and creation of public green spaces (decrees 1239/13 and 993/14). Therefore, there appears to be no long term planning for the use of this model of SDR, since the purposes change every year in response to immediate demands coming from judiciary organs (Polucha, 2017a).

The model of CEPACs follow the regulation of the instrument Urban Operation (OU). The purpose is to charge intense development and use the resources in the provision and improvement of infrastructure and public spaces inside the boundaries of the OU. The project of conversion of the *Green Line* in an urban avenue which started in 2003 needed complementation and improvements. So in 2011 the instrument was implemented in order to raise funds for these works and promote the urban redevelopment of the region (Soffiatti, interview 2017).

Despite the differences in planning priorities, the three models studied in Curitiba earmark the revenues for the provision of urban services, following the principle of LVC to finance urban development and avoiding aleatory spending of the resources.

4.2.2. Implementation of the instrument

4.2.2.1 Planning capacity of the local government

The OODC follows a long term vision plan. It is embedded in the land use plan of Curitiba through the local laws 9802/00, 12767/08, 12816/08 and the decree 196/00 for social housing earmarking, and the local law 9800/00 and decrees 194/00, 919/10 and 246/14 for environment protection. The instrument acts in specific areas of the city where available infrastructure can support additional development and where urban growth is desired. Its implementation follows the logic of the city's planning, using the FAR and current market land values to calculate the charge, capture increment and redistribute the resources (Polucha, 2017a). The legislation clearly earmarks and protects revenues from being spent in other purposes than the ones specified.

The OODC-Shares, on the other hand, are less integrated in the long term vision of the development of the city. They appear to have been created to attend urgent and punctual demands, with purely collection goals (Polucha, 2017a). Regarding the *OODC-S Historical Buildings*, although the criteria for selection of UIEPs and the purposes are clearly defined by the decree 380/93, the development parameters that can be improved are set in every subsequent decree for UIEPs. That means that the amount of rights to be upgraded and sold can be changed by any new decree. This liberty gives flexibility to urban management but at the same time it is sensible to political influence, incurring the risk of inconsequent modifications not aligned to the city's land use plan. The same situation applies to the *OODC-S Public Facilities*. The additional parameters for both OODC-S are basically the same since their creation, still, there is space for distorting these settings if any government party wishes to. The amounts and prices of shares are created based on budgetary punctual needs, not taking in consideration land values where the additional development will take place or the redistributive logic in the urban development, exposing a narrowing in the planning vision regarding the potential of the LVC tool.

The CEPACs implemented through the specific *Urban Operation* plan (OU-LV) envision development for 20 to 30 years ahead. The plan specifies the basic and improved development parameters and also earmarks the uses of the resources from the sale of the CEPACs. Nevertheless, the choice of the *Green Line* for the use of this tool was not largely discussed among the planning organs of the Municipality, nor society. There might have been other smaller areas with higher acceptability of a new instrument than the site chosen, which crosses 22 neighborhoods through 20 kilometers – an enormous area to be managed with a new instrument and to have a new concept of SDR absorbed by the market. The increase in the parameters is also considered very little for the potential of the instrument and investments. It was made this way in order to speed up the implementation process through minimum changes in the original land use plan. The creation of the Urban Operation suffered the discontinuity phenomena of Brazilian governments, when the changes in political parties brake and disrupt processes, losing information and forcing development of projects without proper care. While the city of São Paulo has a permanent commission to control the *Urban Operations*, in Curitiba the process was held within limited members of some departments, who changed during the works (Soffiatti, interview 2017).

Although a plan was constructed for the use of the CEPACs, it created an isolated bubble inside the city, ignoring the outside and consequently generating competition with the other SDR instruments. Developers are more willing to construct outside the OU where there is still space, immediate demand, and is cheaper, than to invest in a new riskier modality. Moreover, the market in Curitiba is very conservative and resistant to the CEPAC concept, considering it too complex and expensive (Carstens, interview 2017; Schiavon, interview 2017), leading even

construction syndicates to organize a boycott of the auctions, impairing the development of the instrument (Soffiatti, interview 2017). Soffiatti (interview 2017) also pointed that there was not much disclosure regarding the benefits of the tool, not only as an upgrade in building rights, but also as a bond, an investment.

The Municipality of Curitiba has high planning capacity which was able to develop the SDR instruments that could be implemented. However, it is noticeable the ruptures in the implementation process, once different instruments were assigned to same areas and complex plans were made without broad discussion. The implementation of three instruments reflect the influence of political moments and budgetary urgencies in the planning capacity of the government.

4.2.3. Operation of the instrument

4.2.3.1 Land assessment procedures

Differently from several Brazilian cities that uses cadaster values to charge the SDR (Furtado, 2007), Curitiba calculates or consider current land market values in the case of OODC and CEPACs, although this factor is ignored in the case of OODC-S.

The OODC uses current market land values in order to calculate the price of the extra development. The amount of virtual land to be acquired is calculated by the Municipal Secretary of Urbanism (SMU), according to the basic and additional parameters. The appraisal of land in order to assess its market value (theoretical sale price, see section 2.4.1) is made then by the Municipal Finance Secretary (SMF) following the procedures stated by the local law 7291/1988. According to this law, the appraisal must consider the prices practiced by the land market, the land's location and its characteristics including area, topography, buildings, accessibility and distance to public facilities.

In the case of the CEPACs the payment for the additional development is made though the certificates and not a calculation of land values. Nevertheless, the initial price of the certificates offered in the auctions is set through feasibility studies and calculation methods considering the land values, development cost, profit of the developers and the risks of development. The equivalence factor is also set in order to adjust the amount of certificates necessary according to the land values of the zones (Soffiatti, interview 2017).

4.2.3.2 Administration capacities

The Municipality of Curitiba have a robust cadaster system of all urban land in the city. Every plot is assigned a fiscal number, GIS located and catalogued with information like area, zoning, development parameters, possible upgrading parameters, landowner data, constructed area, taxes, locks for public purpose or environmental damage, and so on. Every permit assigned and purchase of development rights is registered in this system and can be managed or viewed by all related departments – urban, finance, environmental, etc. Therefore, the control over individual information of properties is relatively precise and trustable.

However, there is a huge difficulty to condensate all the information regarding urban instruments. The local government apparently does not monitor the operation of the tools. This research, as well as other previous works from Ciffoni (2011) and Polucha (2017a), faced enormous difficulties to consolidate data from the Municipality as its disperse in many departments and the control is not standardized (Polucha, interview 2017b). The Affordable Housing Company (COHAB), for example, was not able to inform consolidated data about the revenues from the OODC, one of its source of income for investments. The same happened

with the Municipal Secretary of Environment (SMMA), which could not provide information about the OODC. The Municipal Secretary of Urbanism (SMU) have control over the developments that upgrade building parameters, but its control lack financial information.

Moreover, there seems to be no control of the supply and demand of development rights. The land use plan and the models of SDR set basic and maximum parameters for the zones in the city but do not state a limit in the building area for each zone. So in theory, all plots could construct the maximum allowed by law (Polucha, interview 2017).

The purchase of development rights follow procedures determined by law, passing though several departments inside the government structure. The level of bureaucracy varies according to the model of SDR. This influences the market's choice for the model of SDR to upgrade the parameters (Carstens, interview 2017; Schiavon, interview 2017). The cases of OODC-S require less steps so have simplified administration since their calculation is very straightforward. However, as already discussed, the final result is a simple collection of revenues losing the opportunity of re-equilibrium of urban development. The OODC demands more work from the authorities, involving land assessment, several departments' manifestation, and administration of specific funds. The outcome is a more logical land value capture procedure and effective redistribution of urban benefits. The CEPACs is the most complex case, which demands besides the control of the certificates, the operation in the stock markets. It also requires the creation of detailed prospects, including feasibility studies and the possibilities of investments, and involvement of the *Ibovespa* - the stock market operator in Brazil - and the *Commission of Mobile Values (CVM)*, an institution of the Federal Government responsible for regulating the markets.

The following table summarizes the way SDR is used in Curitiba:

Table 8: Summary of the way the SDR is used in Curitiba.

Variables	OODC Social Housing	OODC E. Protection	OODC-S Hist. Build.	OODC-S P. facilities	CEPACs
Design of SDR What rights are charged	FAR, height and land uses	FAR, height and land uses	FAR, height and land uses	FAR, height and land uses	FAR, height and land uses
Where are they charged	Specific residential, transition and special zones	Specific residential, transition and special zones	Specific residential, transition and special zones	Specific residential, transition and special zones	Urban Operation Green Line
How are they charged	$ADP = \frac{Ad}{BF} \times Lv \times i$	$ADP = \frac{Ad}{BF} \times Lv \times i$	$ADP = Ad \times i \times Sp$	$ADP = Ad \times i \times Sp$	$ADP = \frac{Ad}{ef} \times Cv$
Price (how much)	Variable according to land market value	Variable according to land market value	Fixed, adjusted by index according to the zoning	Fixed, adjusted by index according to the zoning	Variable according to market (auction) and adjusted by eq. actor
Time: transparency (when)	Known before development	Known before development	Known before development	Known before development	Known before development
Time: of payment (when)	Before issuing construction permit	Before issuing construction permit	Before issuing construction permit	Before issuing construction permit	When CEPACs are auctioned
Purposes (why)	Finance social affordable housing programs	Finance environmental management programs	Finance the restoration and conservation of historical buildings	Finance provision of public services and facilities construction	Finance urban development inside the *OU-LV*
Implementation of SDR *Planning capacity govern.* Long term vision plan	Instrument embedded in city's Land Use Plan	Instrument embedded in city's Land Use Plan	Instrument used to solve emergency demands	Instrument used to solve emergency demands	Instrument used inside long term plan (OU-LV)
Specif. areas to absorb DR	Yes	Yes	Yes	Yes	Yes (OUC-LV)
Allocation of revenues	Yes	Yes	Yes	Yes	Yes (OUC-LV)
Operation of SDR Form of assessment of land value	Current market value appraisal (L. 7291/88)	Current market value appraisal (L. 7291/88)	Does not consider land value.	Does not consider land value.	Land value considered for initial price of bond
Administration capabilities Cadaster + control permits	Yes	Yes	Yes	Yes	Yes
Control of information	Not standardized	Not standardized	Not standardized	Not standardized	Not standardized
Bureaucracy of the process	Medium	Medium	Low	Low	High
Operation of stock markets	N.A.	N.A.	N.A.	N.A.	Outsourced
Management of revenues	Specific fund	Specific fund	Government account	Government account	Urban Operation

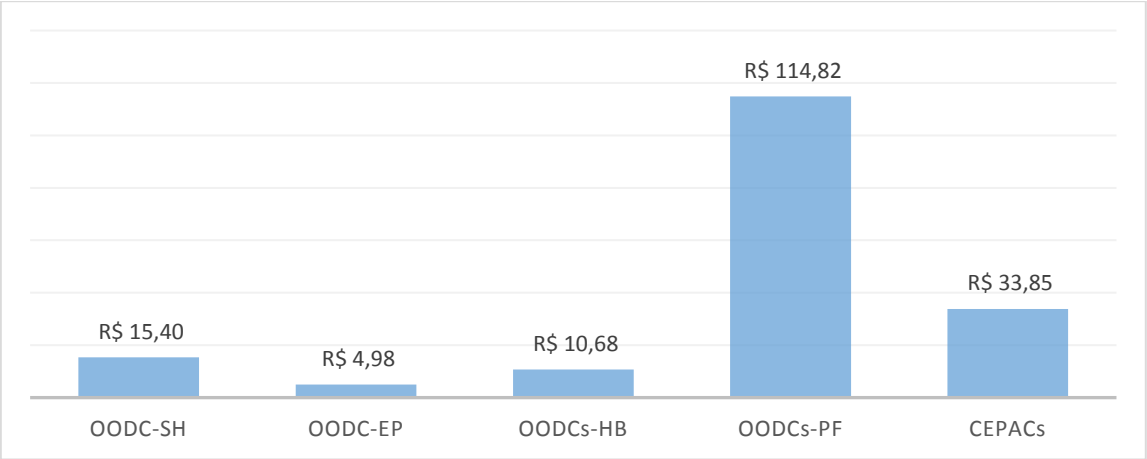
4.3 The amount of value captured from land

The following section will present the data collected regarding the financial results of the five cases of SDR studied in order to analyze the amount of value captured by each case and compare the results of this dependent variable with the variations of the independent variables discussed in section 4.2.

4.3.1. Amount of revenues generated

Between 2011 and 2016 the amount of revenues generated by the five models of SDR was R$ 179.74 million (around US$ 57.60 million). This amount stands for only 0.46% of the total revenues of the city, but it is equivalent to 7.36% of the amount collected by the annual land tax (IPTU). The annual land tax stands for around 6.27% of the total budget of the city every year. The graphic 1 below exposes the distribution of the revenues among the five cases studied:

Graphic 1: Distribution of total revenues from the SDR between 2011 and 2016, in R$ millions. Source: Municipality of Curitiba.



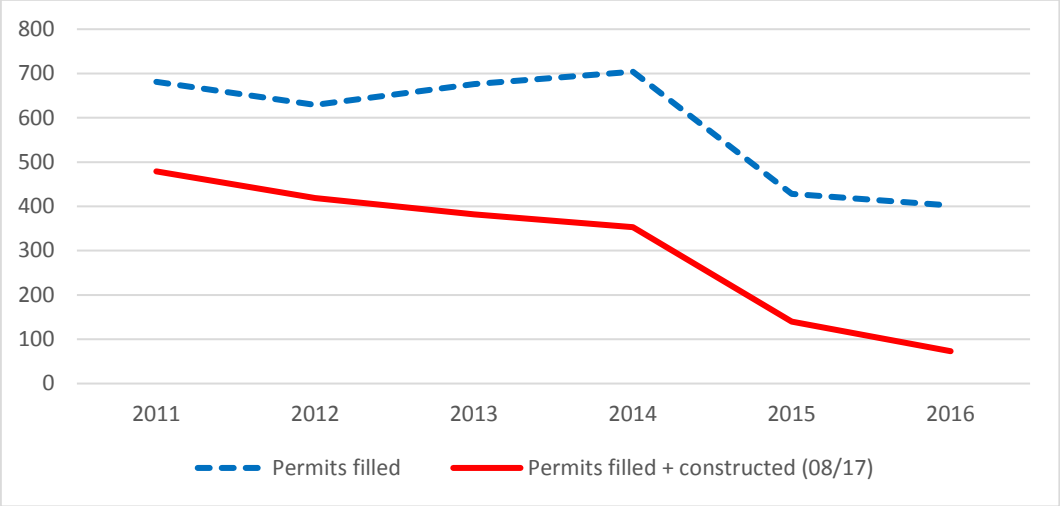
In the period studied, the year with the highest amount of developments acquiring additional building rights was 2012. In this year, the revenues generated by the five models was R$ 49.4 million, equivalent to 14.31% of the tax revenues from land (IPTU). The number of projects analyzed in 2012 was 272 developments, which stands for only 0.04% of the total number of individual properties in the city which pays the annual land tax without reductions (605,000) (Soffiatti, interview 2017). Therefore, while the IPTU captured in average R$ 570.00 per fiscal unit, the SDR captured in average R$ 181,676.00 per fiscal unit, 318 times more. These data proves that the SDR has high potential to convert increment in land values and generate public revenues.

4.3.2. The condition of land markets: real estate market behavior

According to data collected from the Municipality (SMU), 28,423 building permits applications were filled between 2011 and 2016. This number includes all sorts of projects and all sizes. From this number, only 3,520 permits stand for the real estate market activity on focus, including construction of housing (apartments and condos), commercial and office's buildings. Until August 2017, only 52% of those developments had their construction concluded (1,846 projects).

The graphic bellow shows the number of construction permits filled (housing, commercial and offices) between 2011 and 2016 and the ones concluded:

Graphic 2: Market production of housing, commercial and offices between 2011 and 2016: permits filled and built (until August, 2017). Source: Municipality of Curitiba.

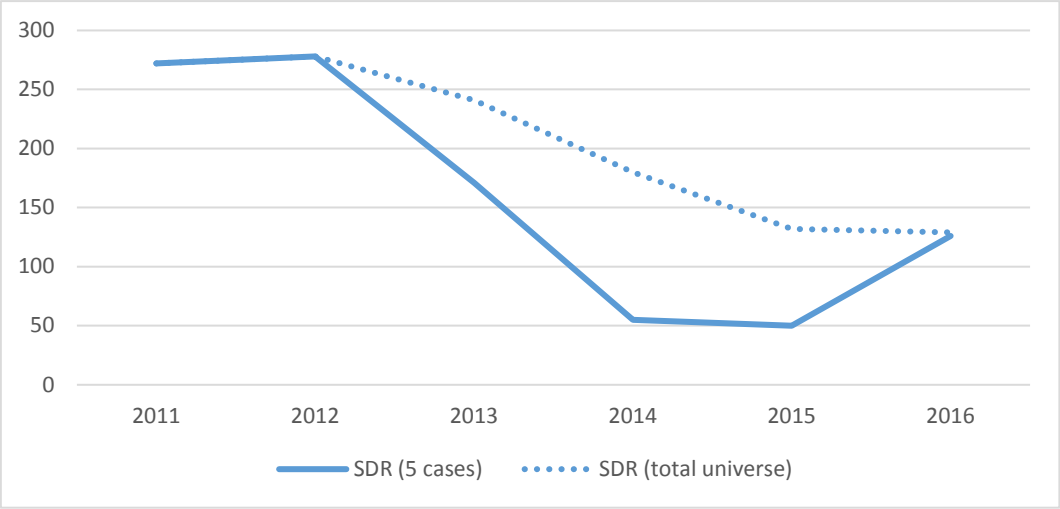


It can be observed from the graphic that the number of projects filled diminished from 2011 until 2016. Although the number of permits issued increased a bit in 2013 and 2014, when considering the concluded developments, the market activity decreased in the period studied. The Economy of Brazil raised powerfully between 2002 (GDP of US$ 508 billion) and 2011 (GDP of US$ 2.6 trillion) when a financial crisis hit the country (World Bank, 2017), affecting the sensible real estate and land markets (Carstens, interview 2017; Schiavon, interview 2017).

4.3.3. Demand for additional building rights

The findings concerning the real estate market's behavior are aligned with the number of projects which acquired development rights during this period. The acquisition of extra building rights dropped between 2012 and 2016, as exposes the graphic below:

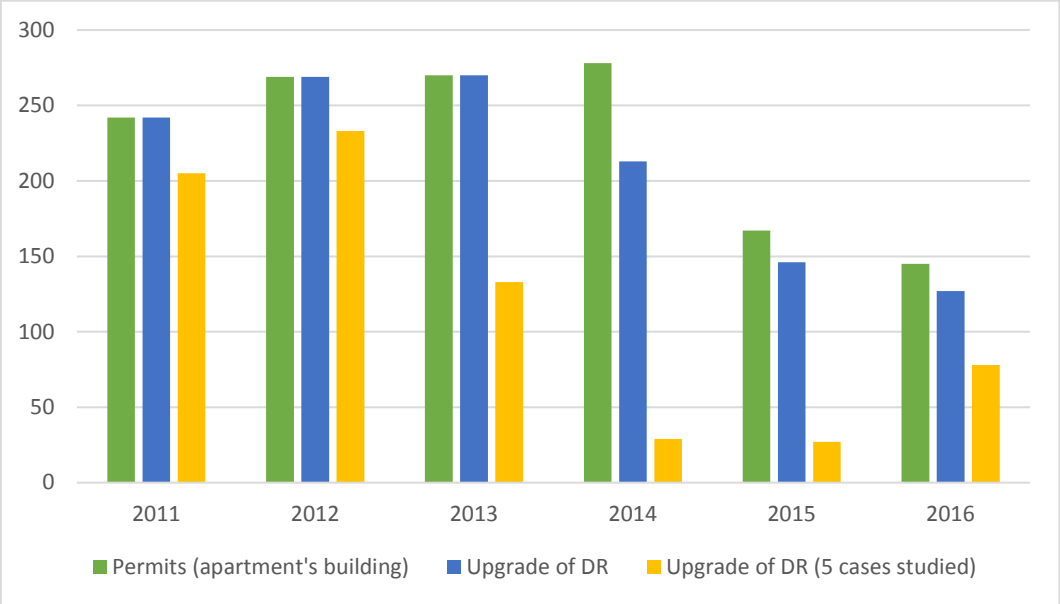
Graphic 3: Number of developments that upgraded parameters through five cases of SDR studied between 2011 and 2016, and comparison with the total universe of SDR cases. Source: Municipality of Curitiba.



The demand for additional building rights was analyzed through the specific land use *apartment's building.* The graphic below exposes, for this particular use, the number of

developments that took place in zones where upgrade in building rights is possible through any model acquisition of development rights and the number of developments that upgraded the parameters. The five cases studied are shown separately:

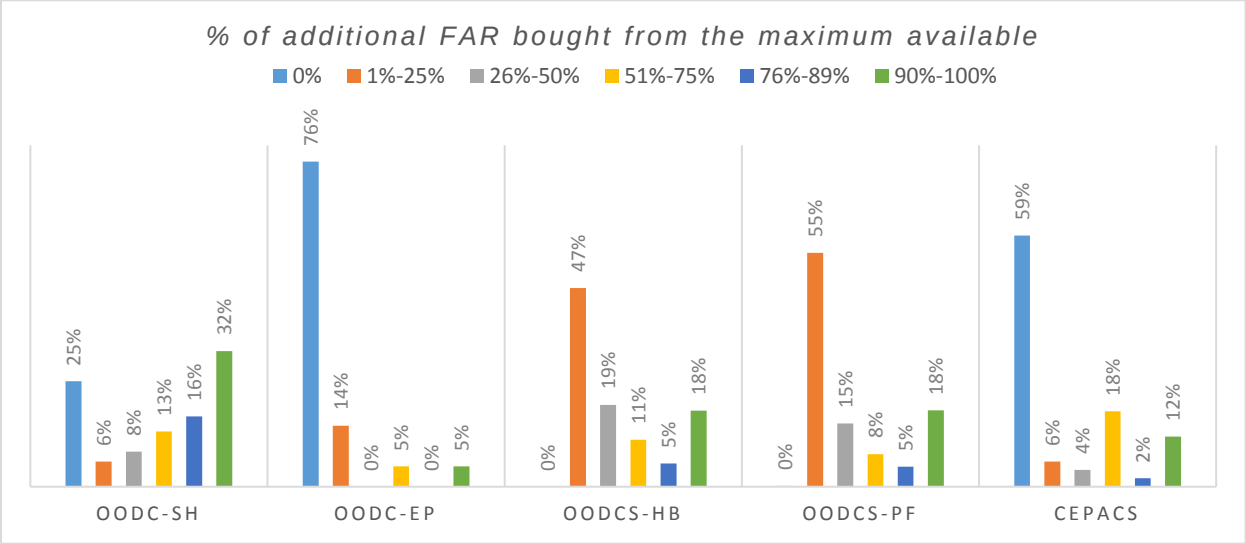
Graphic 4: Number of apartment's building projects which upgraded parameters vs. number of permits vs. five cases of SDR studied, between 2011 and 2016. Source: Municipality of Curitiba.



For this particular type of development, the number of projects that bought additional building rights is more or less constant, on average 92% for the whole period (2011-2016). The difference between the total number of developments upgrading parameters and the five cases studied represent the model of SDR not contemplated (*OODC-S World Cup Stadium*) and the model of *Transfer of Development Rights* (TDR). In this period, the TDR was used by around 22% of the projects to upgrade parameters. The *OODC-S World Cup Stadium* also had high representativeness between 2013 and 2015; however, as stated in section 3.4.4, it was not studied since the purpose is questionable.

It is clear that there is demand for additional building rights in Curitiba, since most the projects that can upgrade parameters do it. However, the amount of additional rights purchased goes in the opposite direction. The following graphic compares the amount of additional FAR purchased from the maximum available between the five models of SDR in any land use and any base line. Only 32% of the projects upgrading development through the *OODC Social Housing* purchased all the additional rights available. For the both cases of OODC-S this amount is 18% and for the CEPACs only 12%. Half of the projects using the OODC-S bought between 1% and 25% of the available potential, probably just adjusting some extra area constructed. In the case of the CEPACs, 59% of the interventions did not improve any FAR, only changed other parameters like number of floors. The case of the *OODC Environment Protection* is very different from the others since its focus is on improving the height of the buildings and not the FAR. For that reason, 76% of the developments did not improve any FAR.

Graphic 5: Amount of additional FAR bought from the maximum upgrade available, per case



This behavior is confirmed by the Municipality (Polucha, interview 2017b) but only partially recognized by the market. While Carstens (interview 2017) see this trend in the developments, Schiavon (interview 2017) claims that projects managed by his office always purchase the maximum available, advocating that the proportion between the price paid for the land plus the building rights and the sale price of the property sold is more advantageous.

These data allow the assumption that although there is demand for additional building rights, the basic parameters might be usually almost enough to the market, leading it to partially upgrade basic rights. When concerning the instruments, moreover, maybe their design which allows the purchase of only additional floors and put no minimum acquisition of building capacity could have some contribution to this phenomenon. Sometimes, depending on the conditions of the land, developers can produce higher number of housing units only by upgrading the height of the buildings and not the FARs (Carstens, interview 2017). The height parameter is much cheaper to improve than the building capacity.

4.3.4. Values of land: current use and increases

After examining the market behavior and the demand for supplementary building rights, an analysis of the land markets is necessary to determine the amount of value captured by the SDR. This analysis was done through the average market values of land. In Curitiba, on average, the land values decrease from the center to the periphery. In 2016, the neighbourhood with the lowest price of land was *Butiatuvinha*, in the northeast part of the city, with an average of R$ 614.01 per square meter of land. The most expensive neighbourhood is the city center, with average values of R$ 3,989.03 per square meter. The difference between them is almost 650%. The following maps expose the average land market values per neighbourhood, in the years of 1996 (corrected by IGP-M 2011), and from 2011 until 2016. The prices are in R$ per square meter.

Figure 5: Land values (R$/m²) in 1996, average per neighbourhood, corrected by IGP-M index of 2011. Data source: INPESPAR, 2017. Map: the author.

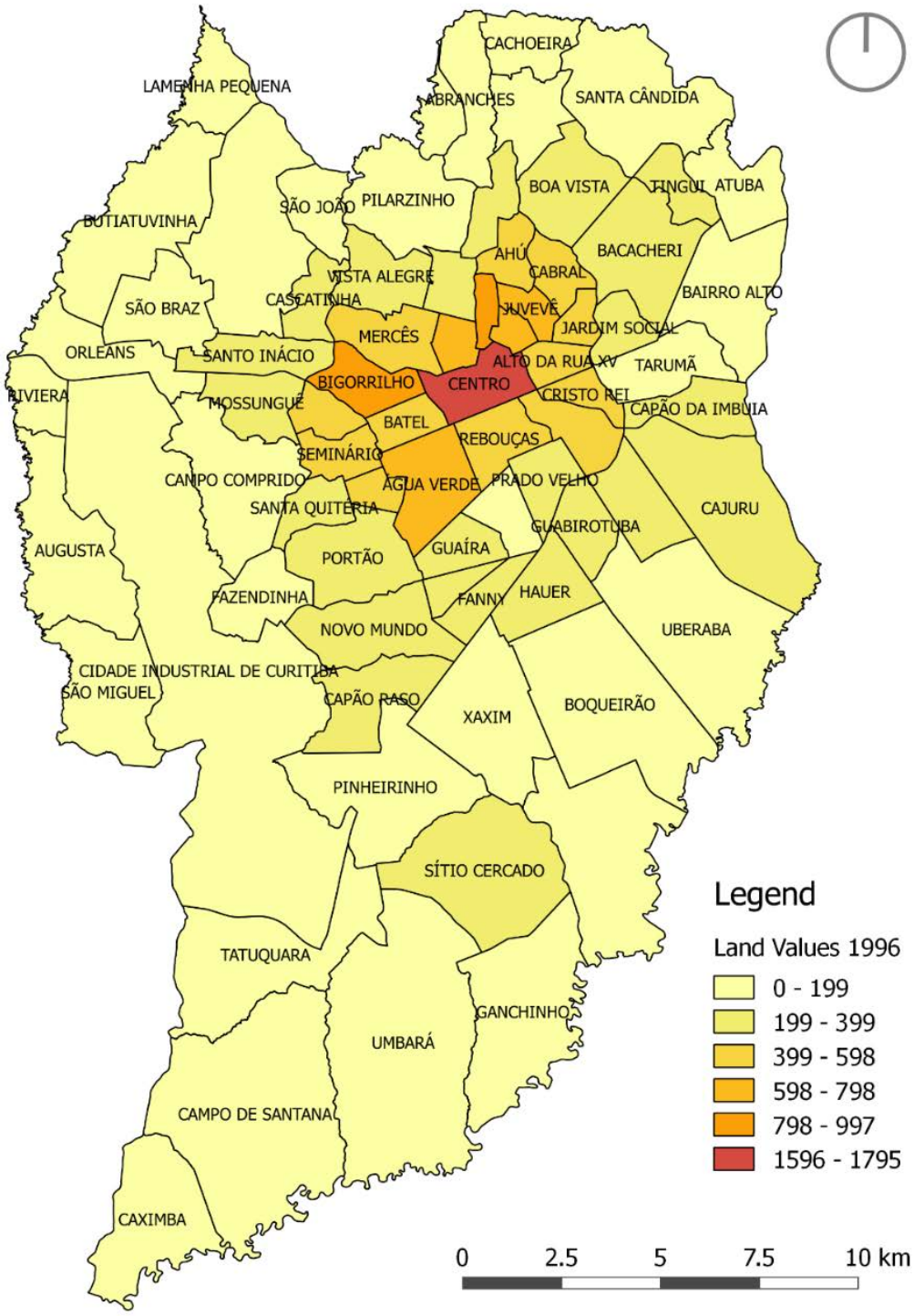


Figure 6: Land values (R$/m²) in 2011, average per neighbourhood. Data source: INPESPAR, 2017. Map: the author.

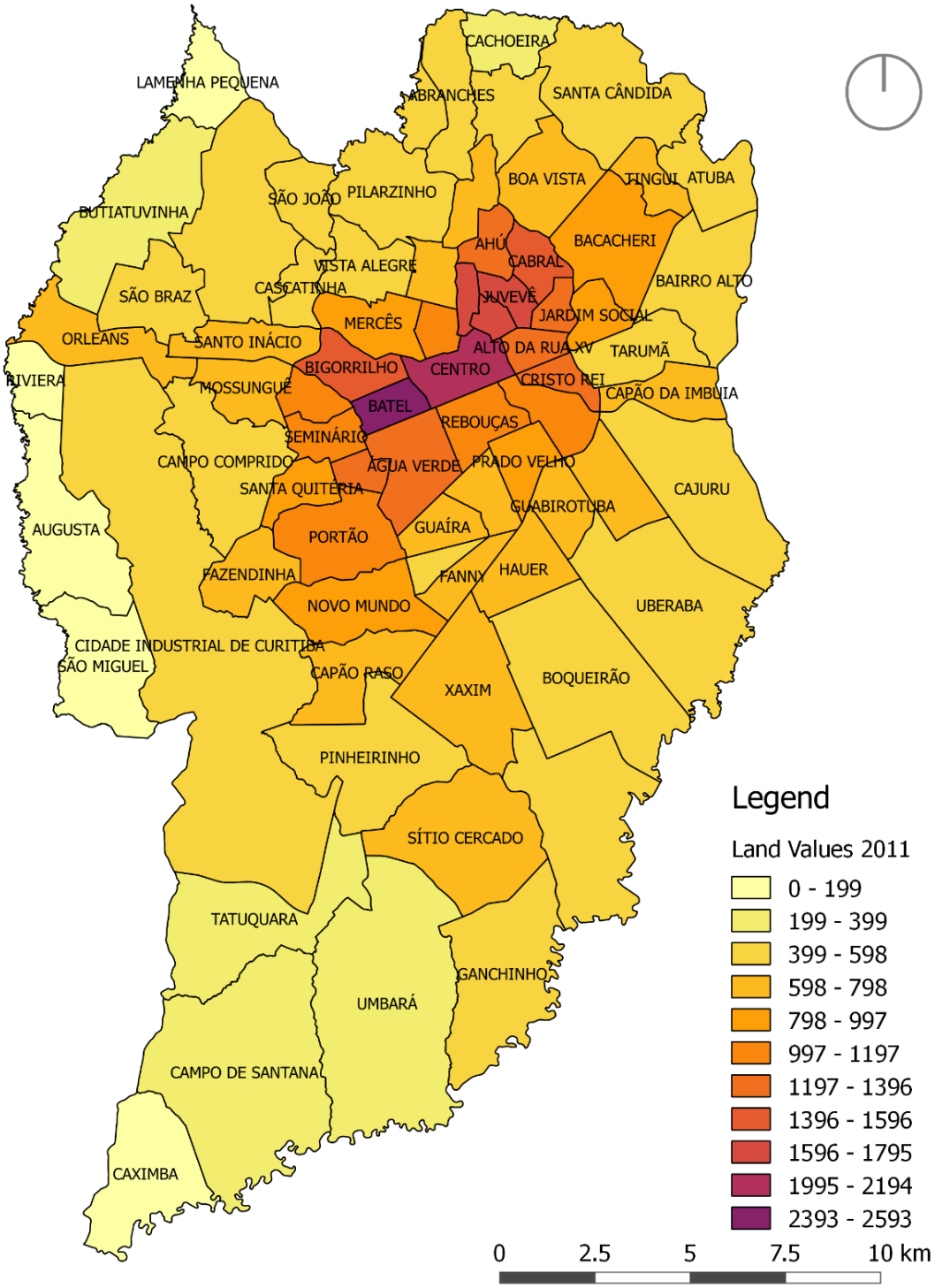


Figure 7: Land values (R$/m²) in 2012, average per neighbourhood. Data source: INPESPAR, 2017. Map: the author.

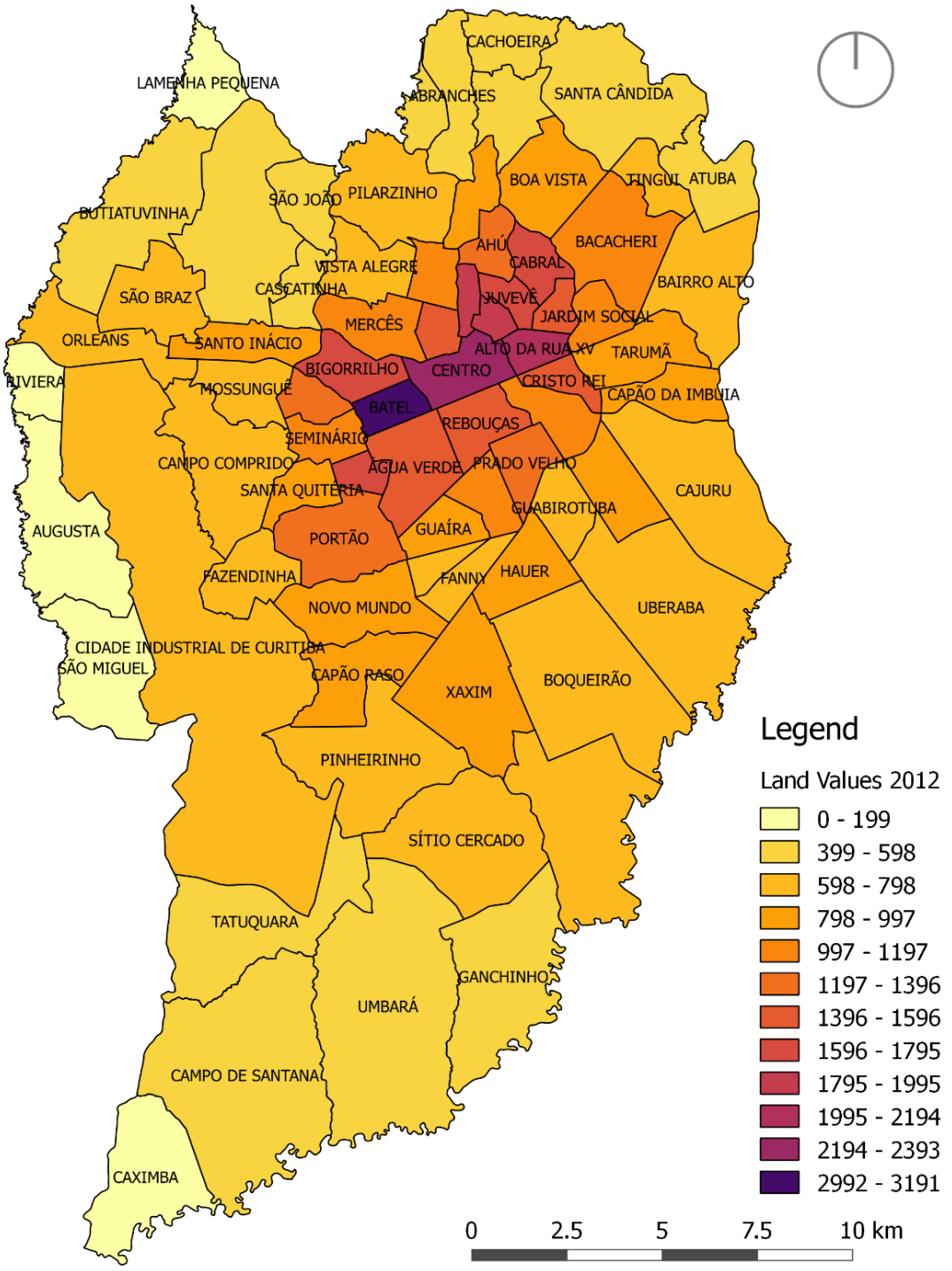


Figure 8: Land values (R$/m²) in 2013, average per neighbourhood. Data source: INPESPAR, 2017. Map: the author.

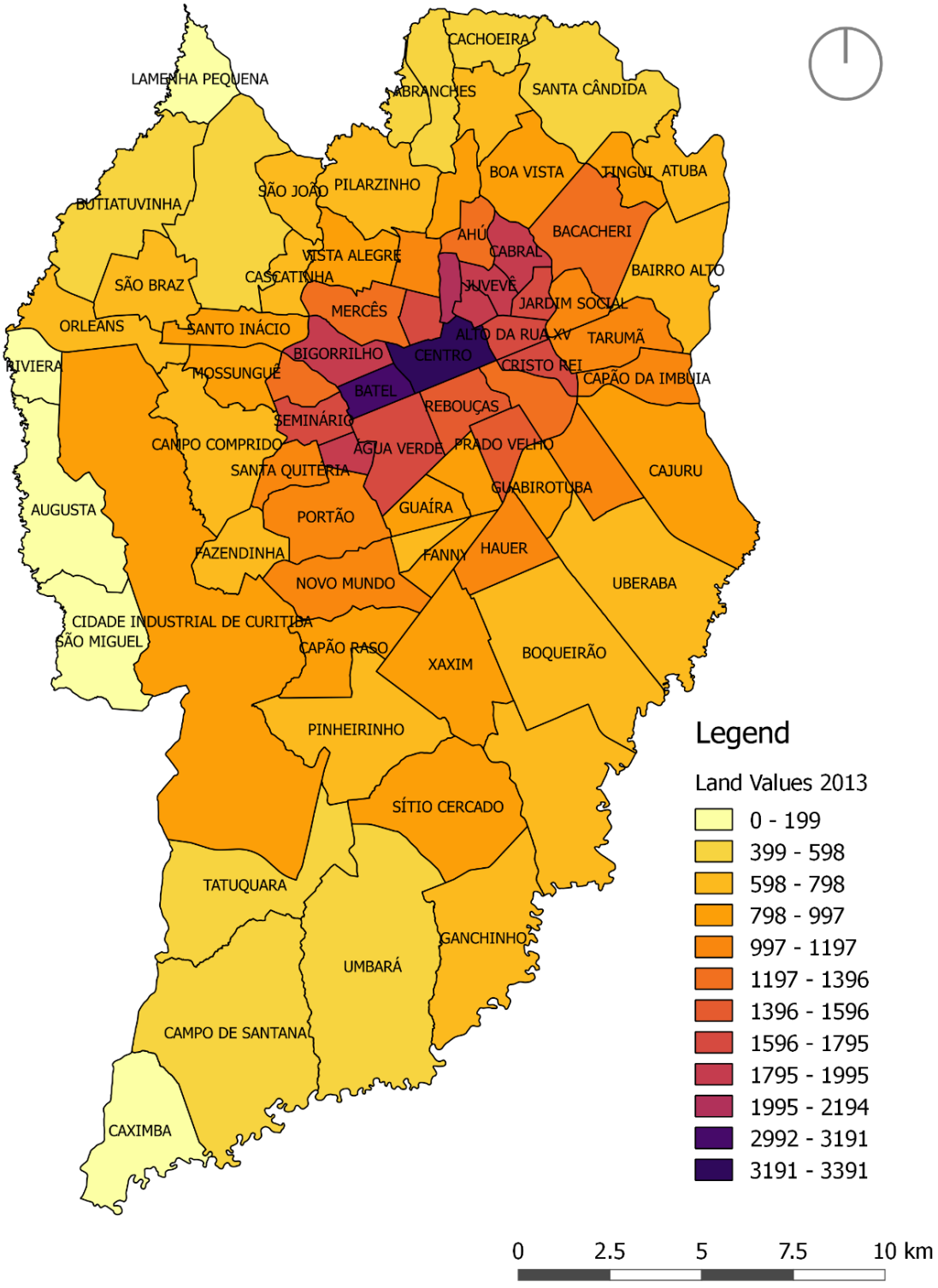


Figure 9: Land values (R$/m²) in 2014, average per neighbourhood. Data source: INPESPAR, 2017. Map: the author.

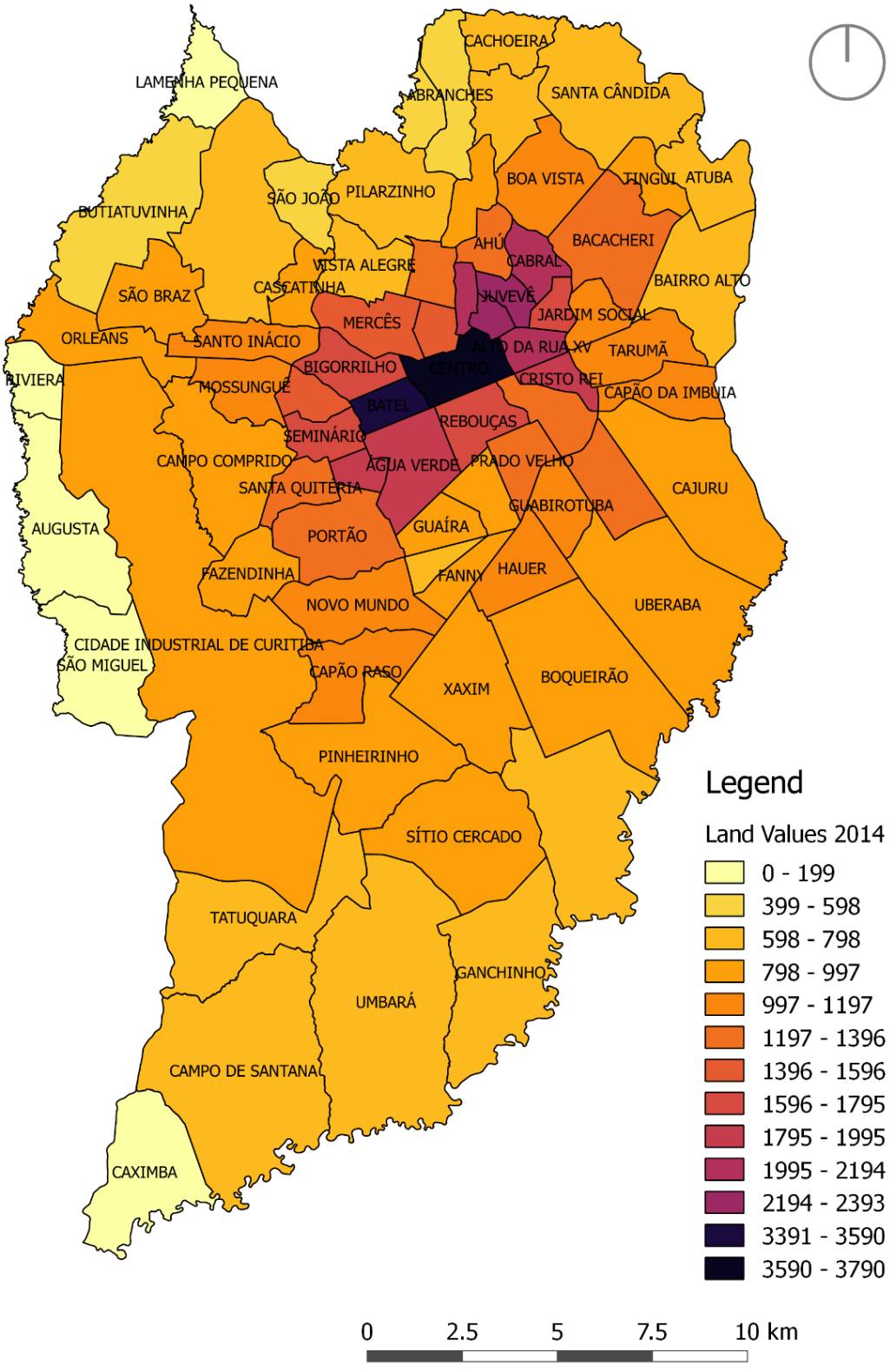


Figure 10: Land values (R$/m²) in 2015, average per neighbourhood. Data source: INPESPAR, 2017. Map: the author.

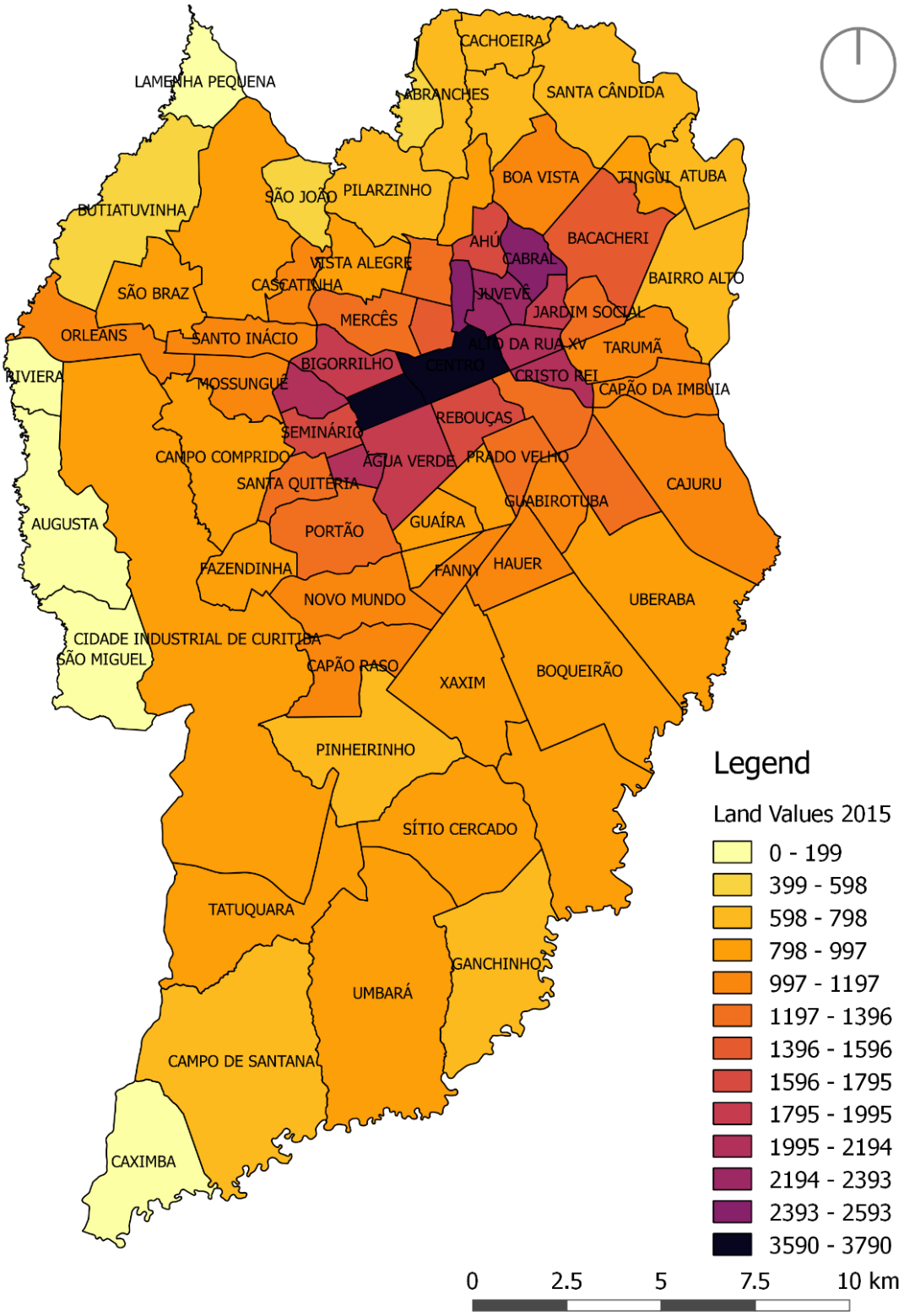
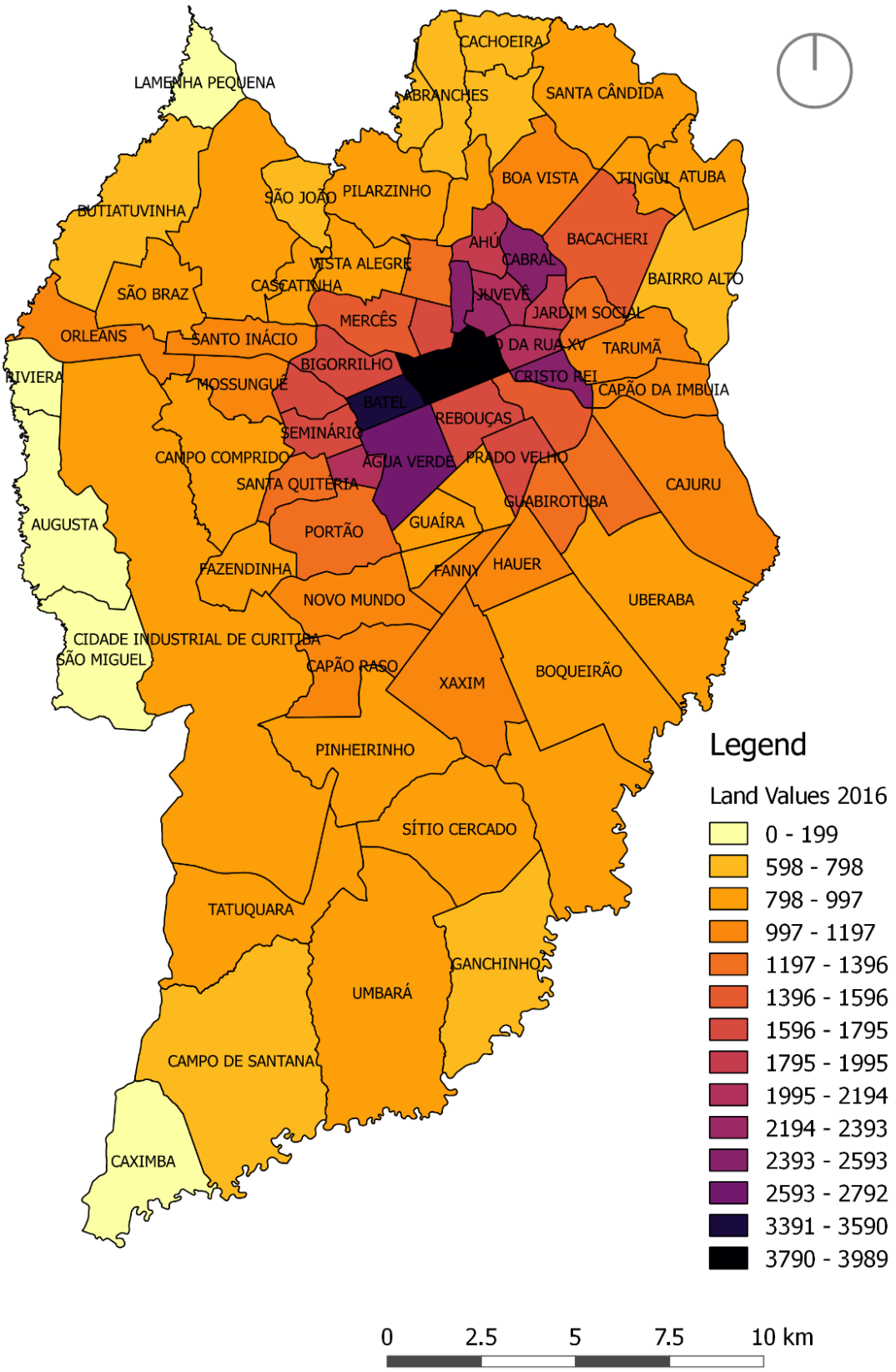


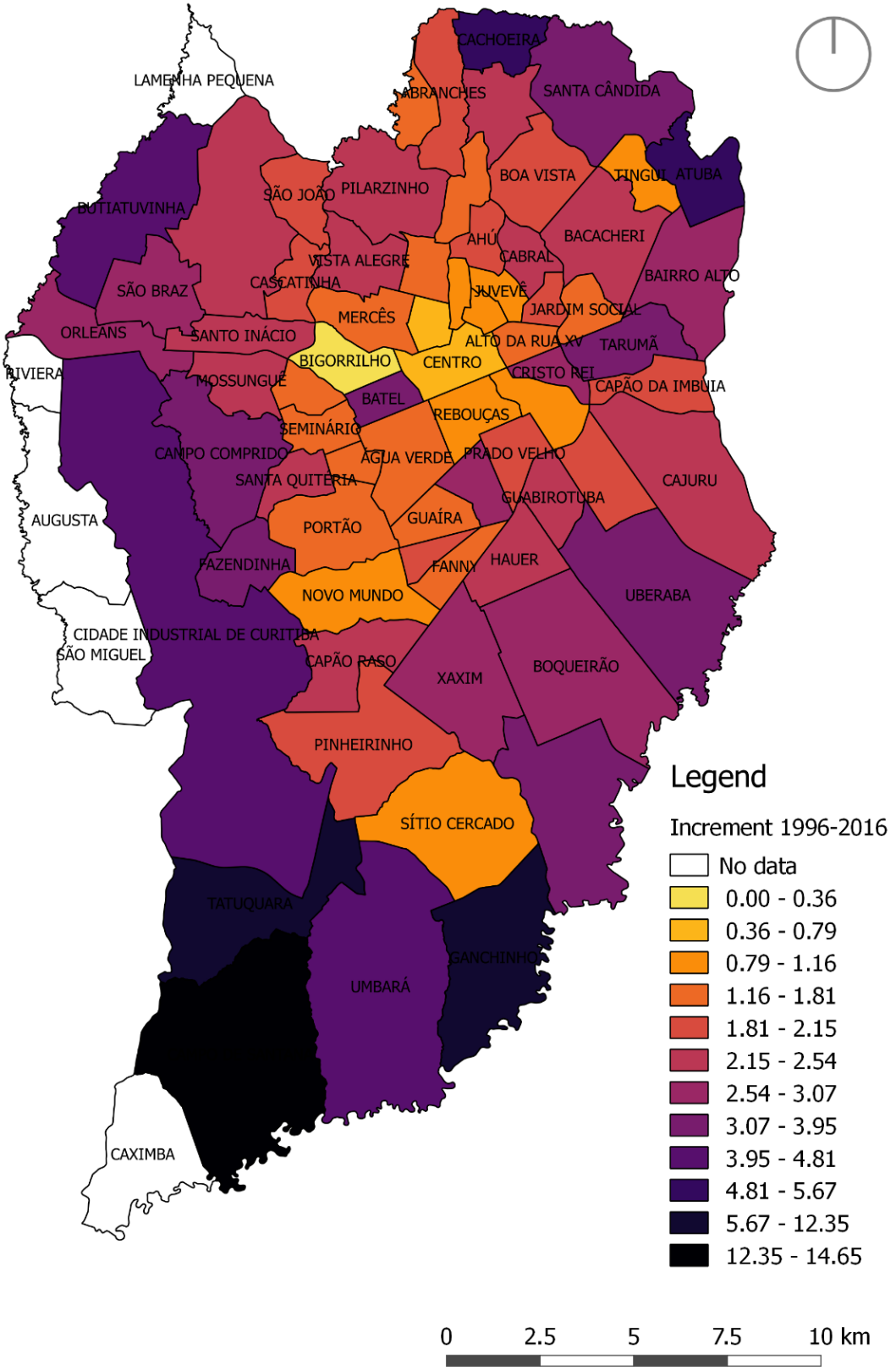
Figure 11: Land values (R$/m²) in 2016, average per neighbourhood. Data source: INPESPAR, 2017. Map: the author.



The following map shows the increment in value of land, discounting inflation, from 1996 to 2016 – 20 years – in every neighbourhood. The darker the color, the higher was the increment in the value of land. It is curious to see that while the gradient of land values decrease from the center to the periphery, the gradient of increment in value runs in the opposite direction, from the periphery to center. This could be explained by the expansion of the city from the center, provision of infrastructure and conversion of rural land into urban land, increasing the prices. The neighborhoods which had the biggest gains are *Campo de Santana* and *Tatuquara*, which had their values increased 15 and 13 times in the past 20 years. They are followed by *Ganchinho, Atuba, Cachoeira, Umbará, Cidade Industrial de Curitiba* and *Butiatuvinha*, that had gains between 5 and 7 times. While then most of the other neighborhoods raised between 2 and 4 times their land values, the central areas *São Francisco, Centro* (Center) and *Bigorrilho* gained between 1.3 and 1.7 times.

The legend of the map states for how many times has the land value of 1996 increased, discounting inflation. For example, for the neighbourhood *Água Verde*, the value in 1996 was R$ 202.07, which corrected by the IGP-M would be equivalent to R$ 995.45 in 2016. In 2016, the land value was to R$ 2,701.37. Therefore the increment in value is R$ 1,705.92, which is 1.71 times the original adjusted value of 1996 (R$ 995.45).

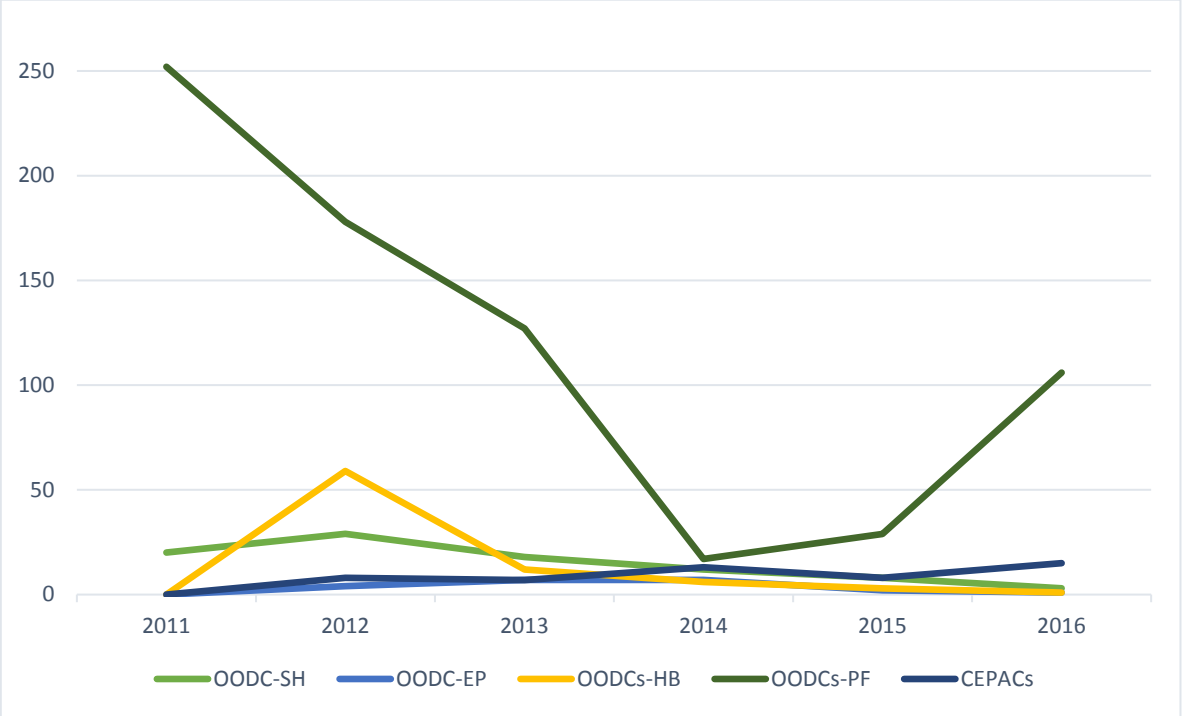
Figure 12: Increment in land values between 1996 and 2016, average per neighbourhood. Data source: INPESPAR, 2017. Map: the author.



4.3.5. Amount of current and increment in land value captured

The total number of developments that acquired additional development rights between 2011 and 2016 in the five cases studied was 952. The distribution of these developments over the period studied can be observed in the graphic below:

Graphic 6: Number of developments for each case of SDR. Data source: Municipality of Curitiba.



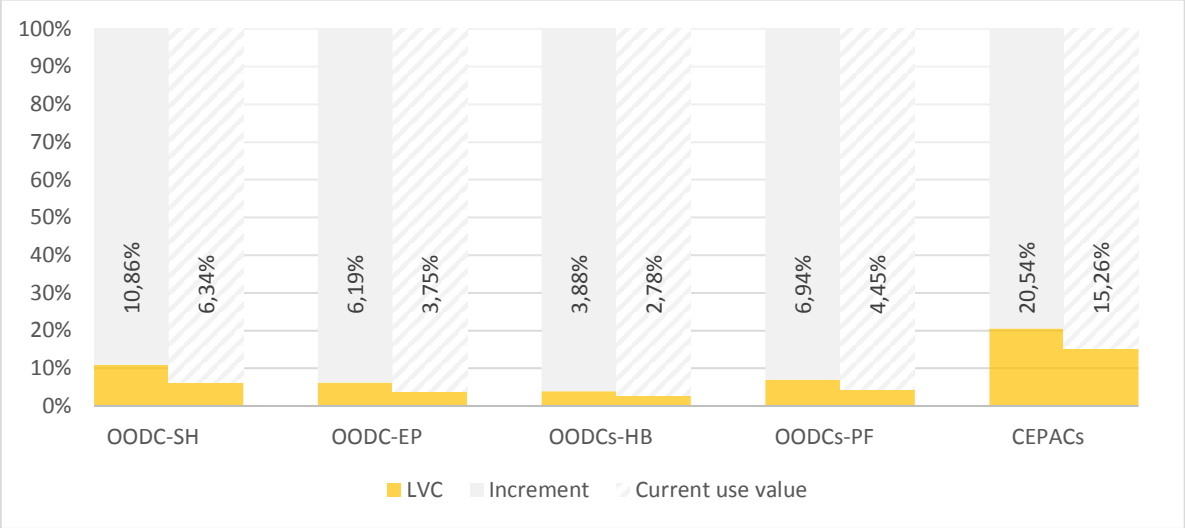
It is remarkable the predominance of the use of the model *OODC-S Public Facilities*, probably because, as already exposed, its coexistence in the same zones with other models of acquisition of building rights plus its lower price and less bureaucracy when compared to the other models (Polucha, interview 2017).

The following analyses compare the amount of value captured by each model of SDR studied according to the methodology explained in section 3.6. Different criteria adopted for the comparisons generated different results, enhancing the visualization of the effects in the dependent variable from the variation of the independent variable.

4.3.5.1 Analysis 01: Any amount of FAR sold vs. any basic FAR

The first analysis made was considering any percentage of additional FAR sold and any base line, including then basic FAR equals to 1.0, 2.0, 4.0 and so on.

Graphic 7: LVC over *increment* and *current market* value of land (any % sold, any basic FAR)

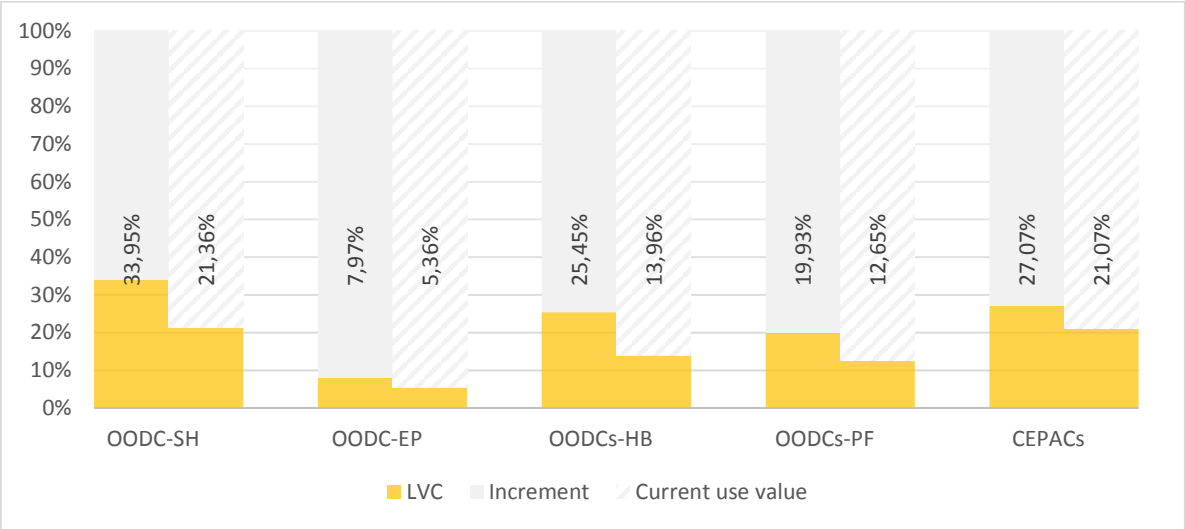


These data expose that the amount of LVC over increment ranges from 3,88% to 20,54%, being the CEPACs and OODC Social Housing cases the ones able to capture more. These values are gross, mixing several criteria among the cases, therefore, although the results represent the complete performance of each model during the period, the comparison might be distorted.

4.3.5.2 Analysis 02: Maximum amount of FAR sold vs. any basic FAR

The second analysis made was considering the maximum additional building rights sold, that means that the development must have bought over 90% of the additional development rights available, in FARs. The base line in this comparison is still variable.

Graphic 8: LVC over *increment* and *current market* value of land (maximum sold, any basic FAR)



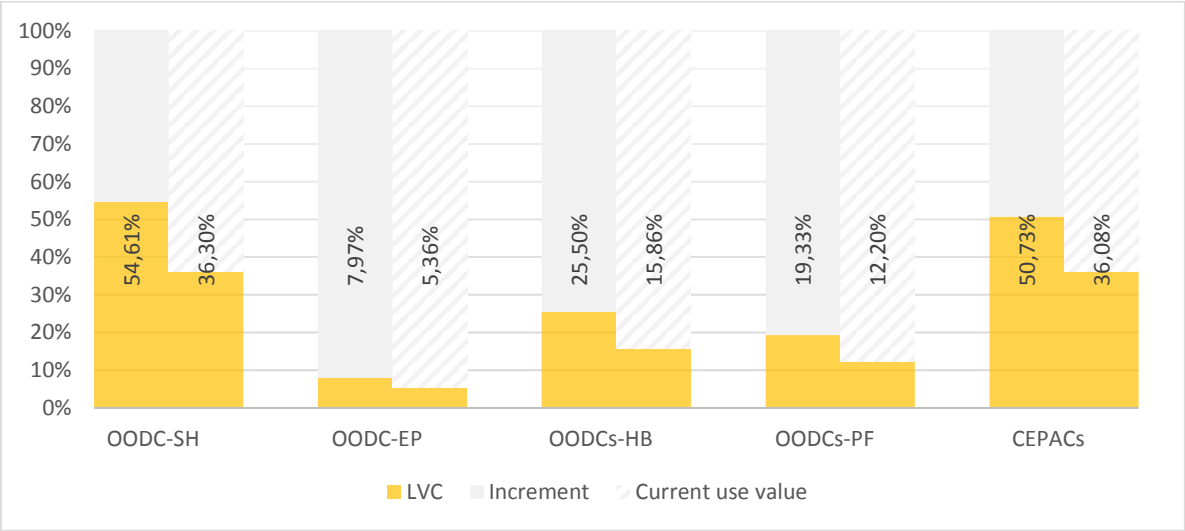
When projects that acquired all the available additional building rights are compared – therefore allowing the instruments to perform in their maximum capacity, the analysis is more coherent. In this comparison, started to be more clear that the form of calculation of the charge considering the land values provides a much better result of LVC. The *OODC Social Housing* captured more value than both cases of OODC-S. The CEPACs performed a little lower than the *OODC Social Housing* when considering the increment but had the same result when

considering the current market value. Notice that the certificates were sold in the auctions for the minimum price.

4.3.5.3 Analysis 03: Maximum amount of FAR sold vs. basic FAR = 1

The third analysis filtered the projects by the maximum FAR sold (over 90%) but now isolating the zones where the base line of construction is one time the size of the plot (FAR=1).

Graphic 9: LVC over *increment* and *current market* value of land (maximum sold, basic FAR=1)

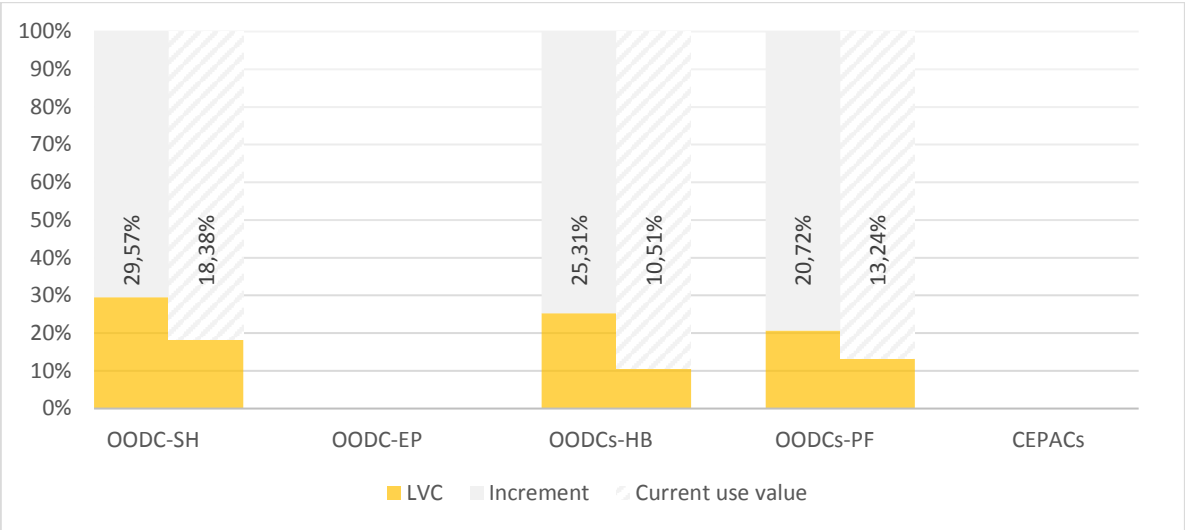


The cases of *OODC Social Housing* and CEPACs could capture more than 50% of the increment in value of land from the projects which are included in the parameters most aligned with the original logic of the instrument (base line equal to one and additional development charged). The *OODC Environment Protection* is not able to capture much, since for the projects included in these parameters, the increase possible was only 0.2 FAR. The cases of OODC-S captured between 19% and 25% of the increment in value, half of the models which calculate the land prices or auction the rights.

4.3.5.4 Analysis 04: Maximum amount of FAR sold vs. basic FAR = 2

The fourth analysis considered still the maximum additional FAR sold but the base line equals to two times the size of the land (FAR = 2).

Graphic 10: LVC over *increment* and *current market* value of land (maximum sold, basic FAR=2)



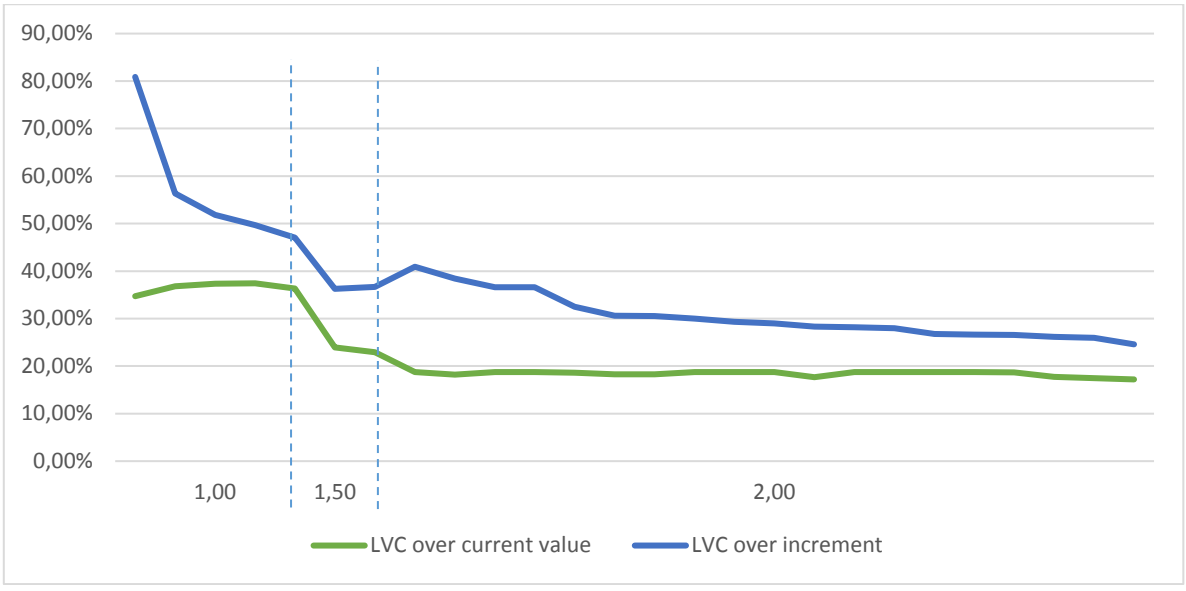
When the basic parameter is more generous the amount of value capture is lower. For the case of *OODC Social Housing*, when the basic FAR is 1.0 the LVC is around 50% from increments, when the base line is 2.0, this conversion drops to 29% of the increment. In both analysis (basic FAR=1 and basic FAR=2) the upgrade of the parameters was 0.5 FAR (so total FARs equals to 1.5 and 2.5). As the formula for the calculation of the tax involves the basic FAR, the higher it is, the lower will be the LVC.
The cases of OODC-S kept the amount of conversion almost constant in relation to the basic FAR=1, since the formula adjusts the amount of shares necessary. The index for the FAR=1 is usually 0.3 and the index for FAR=2 is usually 0.6.

4.3.5.5 Analysis 05: Base line parameters and the amount of LVC

The next analysis was looking for verifying the relation between the amount of value captured and the basic building parameters. The objective was to verify if the variation in the definition of the basic FAR influences the amount of value captured from current use and increment in value. Since for developments analyzed in the case of CEPACs the base line was always 1.0 FAR (there was no project in the ZR-4, where the basic FAR is 2.0), this case was not possible to be analyzed with this criterion. The case of *OODC Environment Protection* was also excluded due to its low focus on FAR. Therefore the examination was done in the cases of *OODC Social Housing* and the two cases of *OODC-S*.

The formula for the calculation of the *OODC Social Housing's* charge already restricts the LVC depending on the basic parameters. The higher is the addition of right and lower the base line, the higher will be the capture of value. For the zones where the basic FAR is 1.0 and the addition is 0.5, the maximum LVC is 37,5% of the current market value. For the zones where the basic FAR is 2.0 and the addition also 0.5, the maximum LVC possible is 18,75% of the current market value. The same effect can be observed in the capture of the increment in value, with some exceptions (like the neighbourhood *Centro*). Keeping constant the additional FAR (over 90% of the maximum allowed) and variating the basic FAR exposes higher amounts of capture over increment for the basic far equals to 1,0 (average 55%) while for basic FAR equal to 2,0 the capture was average 30%.

Graphic 11: LVC in relation with the basic FAR (OODC-Social H.) (maximum sold, variable FAR)



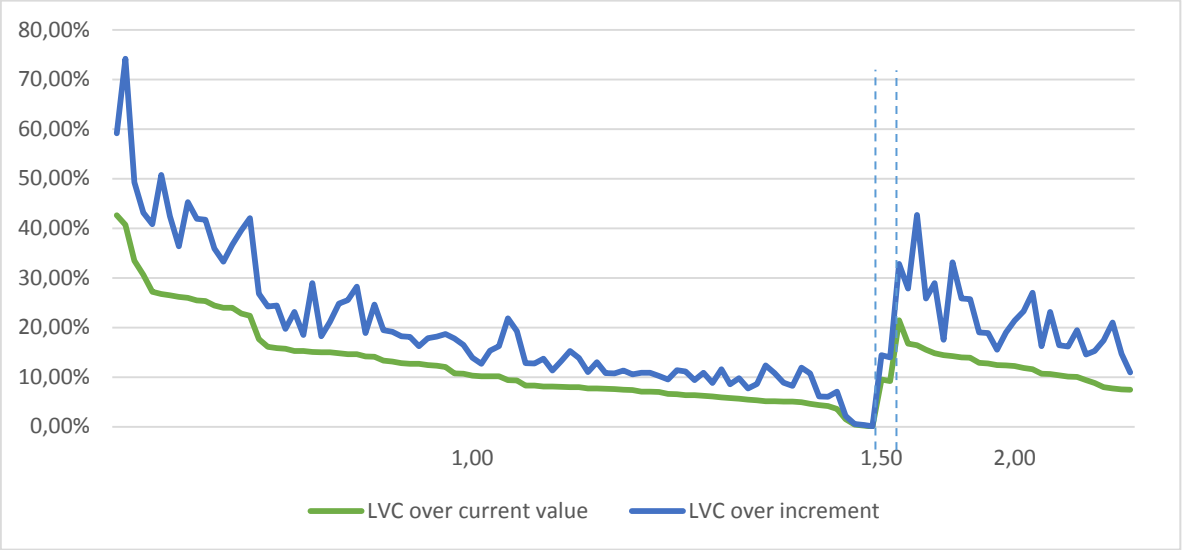
The graphic above exposes that the value captured over current market value keeps almost constant in the maximum restricted by the formula (37,5% then 18,75%), but the capture of

increment in value – which is variable due the diverse increases that happened - trend to decrease the higher is the base line of development. In the *Residential Zone of Controlled Occupation* (ZR-OC) the base line is 0.4 and the addition can be until more 1.1 FAR. For this specific case, the maximum LVC would be 206% of the current market value.

Some zones of Curitiba with the higher values of land have the lowest indexes of possible LVC over current use. In the *Residential Zone 4 (ZR-4)*, which holds some of the most expensive plots in the city, the LVC possible over current market value is only 18.75%, because the basic FAR is 2.0 and the maximum addition is 0.5. However, several expensive neighborhoods are located within ZR-3, which allows a maximum value capture of 37.5%, 60% and 112.5%, depending on variations of the ZR-3 (different types of streets allow different basic building rights within the ZR-3 area).

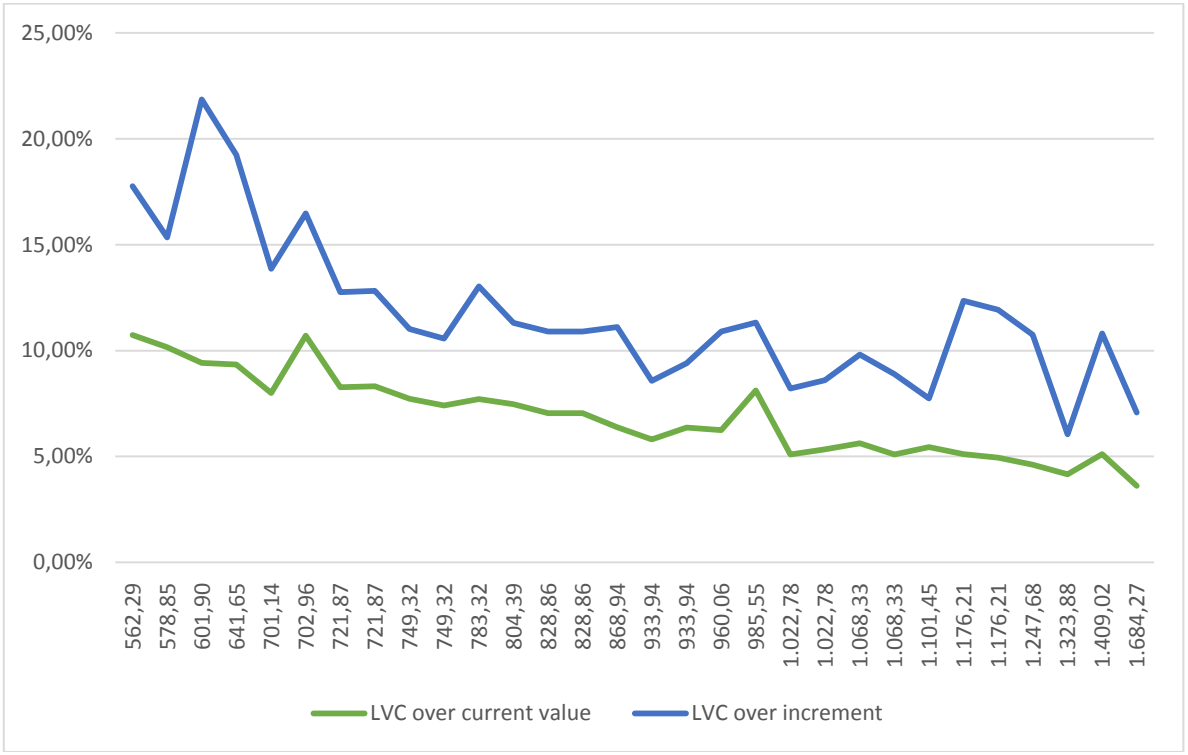
The same analysis done for the cases of OODC-S showed a complete different result. Due to the nature of the charging and the formula, there is no exclusive relation between the amount of value capture and the basic parameters. That happens because the indexes usually adjust the charge in relation to the base line. When the basic FAR is 1.0, the index is usually 0.3. When the basic FAR is 2.0, the index is usually 0.6.

Graphic 12: LVC in relation with the basic FAR (OODC-S) (maximum sold, variable FAR)



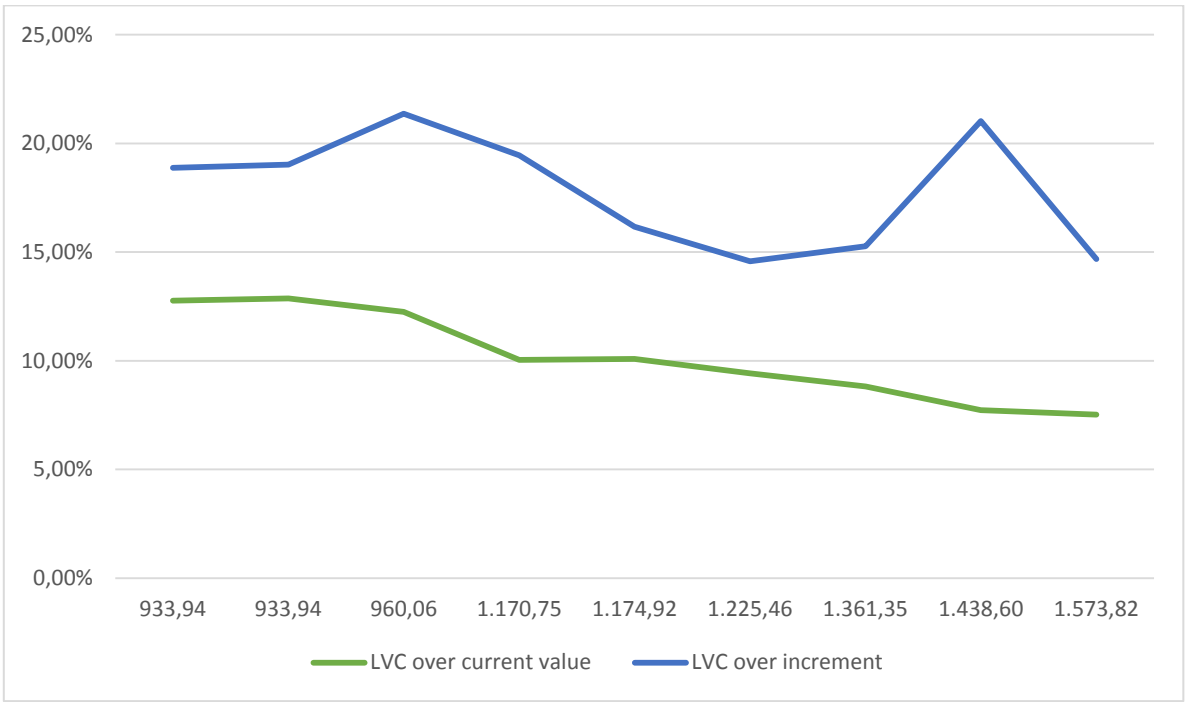
The graphic above exposes how capture of value varies with no exclusive relation with the base line of development. There are episodes when the FAR is 2.0 that the conversion is superior to when the FAR is 1.0. The additional factor that influences the amount of value capture appears to be the current market value of land. Since the formula charges the increase of parameters by multiplying it by a fixed amount and an adjustable index, for a constant basic FAR the higher is the land price, the lower is the LVC.

Graphic 13: LVC in relation with the land values (OODC-S) (maximum sold, basic FAR=1)



The graphic above exposes that for a constant basic parameter (FAR=1) the amount of value capture trends to decrease the higher is the value of land. The same happens when the base line is 2.0:

Graphic 14: LVC in relation with the land values (OODC-S) (maximum sold, basic FAR=2)



The analysis of these data regarding the two cases OODC-S exposes the distortions in LVC and the exclusively collection character of this modality. There is no pattern of value capture and there are distorted connections with the increment in value of land. This seems to be coherent with the fact that the objective of the instrument is to achieve a budget, independently from the source, and not to re-equilibrate urban development.

CHAPTER 5. Conclusions

This research studies the use of the land value capture tool *Sale of Development Rights (SDR)* to finance urban development. The main goal is to explain how the way the instrument is used, regarding its design, implementation and operation, impacts the amount of value captured from increases in value of private land.

The city of Curitiba uses the SDR to aid financing urban development for almost three decades. It was also one of the pioneer cities to use the instrument in Brazil in the 1990s. The implementation of the tool happened in stages and suffered several modifications, due to time period contexts, political phases, land and real estate markets dynamics, and policies regarding public administration. The result is that the city encompasses three different models of SDR: *Onerous Concession of the Right to Build* (OODC), *OODC sale through Shares* (OODC-S), and the *Certificates of Additional Potential Construction Bonds* (CEPACs). Each model of SDR is used for different purposes: OODC for provision of social housing and environment protection, OODC-S for conservation of historical buildings, slum upgrading and construction of public facilities, and the CEPACs for infrastructure and public spaces provision in the area of the *Urban Operation Green Line*. Since 2011, the three ways of using the SDR coexist embedded in the land use planning of the city, raising an opportunity and a need to evaluate whether the tool in Curitiba is working well or not in converting increases in land values into public funds for investment.

Chapter one presented this background information in detail and stated the research questions of this study. Next, a theoretical discussion in chapter two provided the bases for the formulation of a conceptual framework to aid answering the questions. Chapter three transformed theory in practical indicators in order to collect and measure data to achieve the research objective. These data were presented in an analytical way in chapter four. The following sections will answer the proposed research questions using the theoretical debates and the empirical findings, as well as discuss the validity of the results and how they fit into the urban management body of knowledge.

5.1 Answering the research questions

This section aims at answering the proposed research questions following the methodology presented in chapter three, in a structured narrative starting by explaining the independent variable, then the dependent variable, and finally the relation between them. The discussion will make use of the findings exposed in chapter four supported by the theory debated in chapter two.

5.1.1. The use of the instrument SDR in Curitiba

The first research question to achieve the research goal of this study is:

How was the SDR designed and implemented in Curitiba and how is it operated to finance public facilities?

The SDR was designed in Curitiba in three different models. The first model created 1990 aimed at collecting resources for the provision of social housing, and in 1995 another variation was built to finance environment protection programs. First named as *Solo Criado* and then *Onerous Concession of the Right to Build* (OODC), this model allows and charges additional development above the base line stablished by the land use plan. These additional building rights are increases in building area, regulated by the *Floor Area Ratio (FAR)*, more height of

the buildings increasing the number of floors and changes in land use. The improvements through the tool are allowed in specific zones of the city, integrated in the land use plan of Curitiba (check figure 3). The upgrade in parameters are charged following the virtual land method, where the necessary area of land to accommodate the additional development is calculated and then priced according to current market values – assessed in each individual development project. A reduction index is applied of 75% for upgrade in FAR and 15% for upgrade in height. Therefore, the price of the building rights is related to the market values, variating according to its dynamics. This logic makes the tool easy to be justified. The possibility to use the instrument to upgrade building parameters is clear in the legislation and known by the market.

The second model appeared first in 1993 to meet a demand of restoration of huge institutional and relevant buildings of the city, and another variation was created in 2009 to meet different punctual necessities of urban services provision, like slum upgrading and public facilities construction. Each purpose has its funds from the SDR earmarked by specific decrees. This model followed the basis of the first OODC, allowing and charging upgrades in the parameters of FAR, height and land use. The areas of the city where this model operates are mainly the same as the first OODC, adding some more zones. However, this variation stablished a form of calculation by shares and adjustment indexes, ignoring the land value variable. Each share is equivalent to one square meter of additional development. The price of the upgrade is formed by the value of the share stated by decree and the indexes that adjust the number of shares according to the zone. The creation of this model confused the market, since more than one SDR tool can be used in one zoning. This fact enhanced the view of the market of the SDR tool as a collection mechanism, *another tax*, and not an urban instrument.

The third model of SDR was created in 2011 and operated only in one specific region of the Curitiba: the *Green Line*. The setting of the *Urban Operation Green Line* (OU-LV) aimed at complementing the urbanization works in a federal road that cuts the city. The OU allowed the implementation of the *Certificates of Additional Potential Construction Bonds* (CEPACs) to upgrade building parameters inside its boundary and charge it. The improvements are also in FARs, height and land use changes, plus density in number of residential units and specific increase of commercial area. The equivalence of the certificates and additional building right is variable according to the zone inside the OU. In some zones one certificate is equal to one square meter, but in others the number of square meters can be higher or lower. The CEPACs are sold to the market through open auctions in the stock market system, starting at a minimum value stablished by the Municipality. The CEPAC's certificate is an asset: building rights registered in a paper that can be assigned to any development inside the OU. That means that it can be exchanged between developers in a secondary market. Its value will then variate according to the market demand. However, the amount collected by the government will be restricted to the one burdened in the auctions. The amount of value capture of land can only be known after the assignment of the paper to a plot. The instrument is used in a long term plan of the development of a lengthy urban area, although the choice and boundary of this area was not properly discussed inside the municipality, impairing the maintenance of the master land use plan.

In summary, the *Sale of Development Rights* in Curitiba is operated through three different models that coexists, sometimes acting in the same areas. It is clear the competition between the OODC and the OODC-S, once they offer the same rights for different prices. Depending on the price of land, acquiring rights though the OODC-S is usually easier (requires less steps) and much cheaper than through the OODC. Also, these two models compete with the CEPACs. Since Curitiba still have lots of space and demand for development in neighborhoods other than those inside the *Urban Operation Green Line* (where the CEPACs operate), the market still

opts for developing out of this intervention. The mix of models is sometimes confusing and decreases the credibility and social worth of the land value capture instrument SDR, exposing it as a purely collecting mechanism.

5.1.2. The amount of value captured by the SDR in Curitiba

The second research question to achieve the research goal of this study is:

What is the amount of value increase captured to finance public facilities from privately owned land by the SDR?

The capture of increments in value of land is different for each model of SDR. Moreover, as none of the instruments require a minimum purchase of additional building rights, not all developments upgrade fully the parameters, affecting the total amount of captured land values.

Considering the five cases studied in the period between 2011 and 2016, in absolute terms the SDR was able to capture only 7,76% of the estimated increase in value of land that happened in previous 20 years. When confronting the five cases in absolute terms, the CEPAC is the model which is more capable to revert land value increases in public revenues. This SDR instrument captured equivalent to 20,45% of the raises, while the OODC converted equivalent to 10,86% and 6,19% (social housing and environment protection) and the OODC-S made only 3,88% and 6,94% (historical buildings and public facilities).

However, if only the developments which acquired all the improvement available for FAR are considered, the LVC increases considerably. The *OODC Social Housing* captured equivalent to almost 34% of the increment, followed by the *CEPACs* (27%), *OODC-S Historical Buildings* (25%), *OODC-S Public Facilities* (20%) and the *OODC Environment Protection* (8%). These data calls attention that measures to assure the full purchase of additional development are important for the performance of the instrument, being it incentives or rules. The CEPACs' law gives additional incentives for the acquisition of more than 80% of the maximum FAR allowed, like changing the form of calculation of parking area, more additional development right (10%) and extra density in number of units.

The largest capture of value increase happens when the logic and principles of the SDR discussed in the *Letter of Embu* are fully implemented: the base line allowing construction in area equal to one time the size of land and anything over that line being charged (see section 2.6.1). From the developments that matched these parameters, the *OODC Social Housing* and the *CEPACs* were able to capture equivalent to 55% and 51% of the increments in land value. Nevertheless, the model of OODC-S kept the same results – 25% and 20%. The *OODC Environment Protection* presented the equal 8% since its focus is increasing height and not FAR.

As debated in Chapter 2, there is no consensus of the amount of value to be captured over gains from public and community efforts (see section 2.4.2). In the design of the SDR, Curitiba did not stablished any amount of value capture goal. But the data examined showed that some ways of using the SDR captured more values than other ways, empirically confirming the theoretical doubt regarding how the division of profits should be done between government and society, land owners and developers.

5.1.3. The use of SDR and the amount of land value captured

The main research question which translates the objective of this study is:

How does the way Sale of Development Rights is used to finance public facilities in Curitiba impacts the amount of value increase captured from privately owned land?

The design, implementation and operation of the SDR impact the final amount of capture of land values as follows:

5.1.3.1 The form of calculation

The design of the calculation of the charge affects hardly the amount of LVC. Calculating the price of building rights considering current market values of land or even auctioning the rights produce higher rates of conversion than using flat rates.

When the charge is calculated by the *virtual land method* (OODC) the price follows the particular conditions of each property and the capture is usually high. The SDR captured more than 25% of the equivalent increment in all the developments which fully upgraded building rights and were charged with this method. However, the reduction index added to the formula discounts the value 25% and 85% depending on the right acquired. The structure of the formula also conditions the LVC: the higher is the ratio between the additional rights and the basic rights, the higher will be the value captured. That means that few basic rights with high improvements will outcome large LVC, and generous basic rights with few improvement will result in poor LVC.

On the other hand, disregarding current land market values and calculating the charge through fixed prices for additional square meters (OODC-S) requires more careful planning than what is done in Curitiba. The formula for calculating the charge is too simple for the complexity of variables involved. The findings showed that for plots with the same basic parameters and adjustment index, the higher is the price of land, in general the lower will be the LVC. This phenomena trends to happen in the capture of current market value and also of increments (see graphics 13 and 14), although the instability of the graphic line suggests that other variables could also be affecting the conversion. The SDR captured more than 25% of the equivalent increment in only 38% of the developments which fully upgraded building rights and were charged with a fixed price. There are neighborhoods with very different land values and different history of land valorization, but with the same zoning parameters assigned. In these cases, the simple application of an adjustment index will not solve the discrepancies in LVC rates between those areas, and opportunities of LVC from wealthy zones might be being lost.

The possibility of auctioning the development rights (CEPACs) appears to be the most powerful way to capture land values. The SDR captured more than 25% of the equivalent increment in 100% of the developments which fully upgraded building rights and were charged through building certificates. This method, however, is initially very similar to charge development for a fixed rate, although studies considering land values are held for the formation of the certificate's initial price. As the open market will define the final price of the rights, here stands again the risk of over capturing or capturing very few. The fixed price charged for the shares in the OODC-S was usually higher than the CEPACs. But the basic and additional parameters of the CEPACs are more coherent, with few basic rights and high improvements, allowing higher LVC rates. Moreover, the land values inside the Urban Operation are, on average, lower than in the areas of OODC-S. In Curitiba, the results from auctioning (CEPACs) and the virtual land method (OODC) of calculation were similar, but the certificates of rights were sold for the minimum price asked by the Municipality. It can be expected, so, that due to market demand and competition, probably the value in future auctions will raise, increasing massively the LVC.

In Summary, the OODC considers the current market value of each land when calculating the charge, achieving in general high rates of LVC, coherent with the particular conditions of each

case. When the land value is disregarded, like in the OODC-S and at a certain level the CEPACs, there is the risk of converting very little land value or to charge so much that would impair development. In Curitiba, apparently the fixed price of the shares from OODC-S is very low in relation to the land it operates, therefore outcoming very poor results of LVC. Charging a fixed rate for all urban land will certainly generate little capture of value and many discrepancies, since the difference in the price of land between the cheapest and priciest neighbourhood where the OODC-S acts in Curitiba is 500%. The adjustment index inserted in the formula could work to diminish the incoherences, but it is related to the basic FAR of zones and not to land values.

The CEPAC, on the other hand, presents high rates of value capture even when the certificates were sold to the market for the minimum price asked by the Municipality. So, as already mentioned, there is a risk that increases in the price of the certificates in future auctions due to the inherent competition of the market may capture too much from low valued land, overcoming the *unearned increment*. Moreover, an hypothetical high increase in the price of the CEPACs during an auction could turn development unaffordable for small investors since higher prices might pass their limited budgets. Therefore, the boundary of the *Urban Operation* should be smaller, encompassing neighborhoods with similar land prices in order to avoid these discrepancies. Another possibility would be better tuning the *equivalence factor* of certificates to fit land market conditions of each area. The current boundary includes areas with differences in value of more than 200%.

5.1.3.2 The relation between the base line of development and the upgrade

The three models of SDR charge mainly the same upgrades in development rights: FAR, height and land use. The *Letter of Embu* and the academia advocate the basic building right to be equal to one time the size of the plot to all urban land in order to equalize economic disparities of zoning (Furtado and Maleronka, 2014). But when considering LVC capacity of the urban instrument, it is the relation between the amount of basic rights that is already in the bundle of rights of the developer and the possible upgrade of these rights that affects how much value of land the tool will be able to capture. The higher is this ratio (additional right / basic right), the higher is the LVC rate.

For the OODC, which actually uses a ratio between the additional and basic FAR in the calculation's formula, the value capture rate when the basic FAR is equal to 1.0 is almost twice the rate when the FAR is 2.0. That happens because the possible upgrade for the base line 2.0 is only 0.5 FAR (0.5 / 2.0 = 0.25), while for the base line 1.0 the minimum upgrade is 0.5 (0.5 / 1.0 = 0.5).

For the OODC-S, the calculation does not include the FARs directly, but an index that is related to it. The higher is the basic FAR, the higher is the index, increasing the price of the extra building rights. Therefore, this model has an advantage over the OODC: a poor relation between the additional and basic FAR or a generous base line can be compensated by a high index of correction to increase the amount of value capture. For the cases of OODC-S, development in zones with base lines 2.0 and upgrades of 0.5 capture almost the same as basic 1.0 and upgrade of 0.5, due to the index's adjustment.

The design of the CEPACs combines both optimal settings: great FAR rate and correction by an index. In this case the base line is usually 1.0 (except for the ZR-4) and the possible upgrade in development is high, achieving additional 3.0 FARs. Therefore the relation between the base line and upgrade is high (3.0 / 1.0 = 3). Additionally, the amount of necessary certificates is adjusted by the *equivalence factor*.

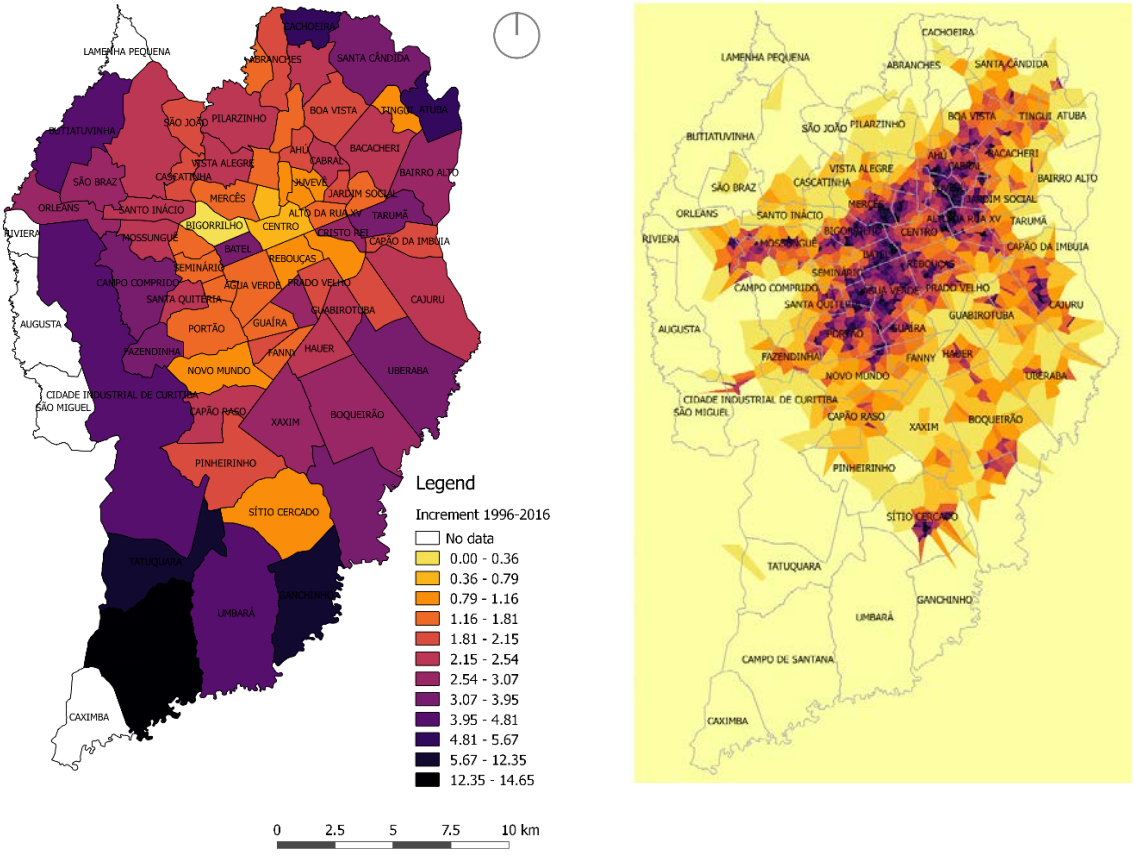
5.1.3.3 The amount of building rights acquired

The SDR instruments can only capture properly land values if they can sell all the extra building rights they offer. According to theory, one precondition to the use of SDR is the existence of demand for additional development rights (Walters, 2016). The findings in Curitiba revealed that only between 12% and 32% of the developments acquire all additional building rights available. As the data collected exposed that there is demand for parameters' upgrades in the city, maybe some adjustments in the design of the tools are necessary to guarantee their full purchase.

5.1.3.4 Location where the SDR acts

When comparing the map of the *increment in value of land in the past 20 years* and the map of *intensity of use of the SDR* (*Voronoi diagram*), in any model, it is possible to verify that prices of land increased less in the areas where the instrument operates (except for the neighbourhood *Batel).* Two possible conclusions could be inferred from this finding: 1) the LVC mechanism could be working, therefore preventing land prices to increase too much. Although it is expected that the prices in the periphery increase more than in the central area due to city expansion, the SDR could be contributing to hold prices since, according to theory, when the obligatory payment of charges is known beforehand by the developer, he may pass this cost to the landowner (Muñoz Gielen, 2010, p.48, 201), converting the raises in public revenues. 2) the SDR is not proper operating or operating at all in the areas of the city where land prices are raising the most, losing opportunity of large public revenues generation.

Figure 13: Map of increment in value of land 1996-2016 *vs.* map of intensity of SDR use. Source: INPESPAR, 2017; Municipality of Curitiba, 2017. Map: the author.



5.1.3.5 The planning capacity of the local government

The models of SDR which were apparently better studied and planned by the government are able to convert more increments. The OODC and the CEPACs were created with a long term vision plan to finance constant demands like affordable housing, environment protection and infra-structure provision (although the plan of the CEPAC is largely questioned, see section 4.2.2). Moreover, they are operated through several planning departments (urban, environment, affordable housing, finance). The OODC-S, on the other hand, was created to collect funds for specific punctual demands, which is an inconsistent use for an instrument that leaves long time marks in the city. Therefore the model is shy when charging upgrades in development, since its design apparently was not well studied regarding all the consequences of its way of use.

5.1.3.6 The context variables: coexistence of many models and the market

Finally, although the presence of different modalities of SDR allows the comparison of results between them, their coexistence is apparently a problem itself. The predatory competition between the instruments which operate in the same zones (OODC and OODC-S) affects the global amount of value capture by directing the market to the models that are cheaper and easier to buy (less bureaucracy). This phenomenon was confirmed by all the interviews and is reflected in the graphic 6 (see section 4.3.4) which shows the higher number of developments upgrading building rights through OODC-S. As exposed in chapter 4, the design of these models outcome lower capture of land values. Therefore, the total capture of increment made by the SDR is lower than if only one effective tool was operating.

The market considers the SDR in Curitiba bureaucratic, sometimes confusing and subjective to the decision of the public agents. There is clear competition between the models, once the OODC-S is cheaper than OODC for the same development and also cheaper than the CEPACs, preventing developers from investing in the Urban Operation and continue constructing in other areas of the city.

The SDR is sometimes viewed as an extra cost and a penalty to the market (Carstens, interview 2017), although its social and urban value is recognized (Schiavon, interview 2017). The market in Curitiba is very conservative, resistant to innovative tools like the CEPACs (Soffiatti, interview 2017). It is also evident, as discussed in the theory review, the resistance of the market to the ideological challenges the SDR imposes, specially concerning property rights. Once the land use plan concedes some parameters, it is very hard to reduce them.

Moreover, developers also can buy among them building rights – through the *Transfer of Development Rights* – with prices 30% cheaper than the SDR (currently during the crisis period of the market) (Carstens, interview 2017). So there is also competition between different types of urban instruments.

5.2. The importance of the findings

The conclusions of this research help understanding how the adjustments of key variables in the use of the SDR impacts the efficiency of the instrument, consequently affecting the investments in urban development.

5.2.1. The instrument SDR

The Sale of Development Rights is a powerful tool to recover plus values, generate funds and finance urban development. But its operation demands a very active market associated to a

careful design and implementation. The relation between the basic rights and upgrades must be finely tuned, as well as assessment of increments of land values. Constant attention to the land and real estate markets is necessary since they are dynamic and sensible to public decisions and external economic factors.

5.2.2. The impact of the lack of unique national policies

In Brazil, several municipal policies are done independently by every local government. Although the *Estatuto da Cidade* framed urban tools in an uniform way for all cities, several crucial parameters like the ones discussed in this research (FAR, calculation methods) were left apart from the national policy. Consequently, every Municipality designed a different way to use these parameters which, as demonstrated by this work, change completely the amount of value capture and behavior of the market. This situation may generate competition between cities, letting local governments reluctant to implement stronger social and land management policies – like reducing building rights or using more powerful tools, once they could drive the market to act in neighbor cities with brander parameters. As already stated by authors like Furtado (2006), a standardization of the use of urban instruments in Brazil is urgent.

5.2.3. Contribution to urban management

This research fortifies urban management's body of knowledge by contributing to the literature with empirical conclusions regarding the use of the land value capture tool SDR. It also strengthens the debate regarding pros and cons of different designs of the SDR and the LVC outcomes resulting from these diverse strategies.

5.2.3.1. LVC as a response to fiscal decentralization

Section 2.2 handled the consequences of fiscal decentralization assigning more responsibilities to local governments and the search for alternative sources culminating in capture of value from land. Curitiba assumed the provision of several urban services according to the *Subsidiary Principle* (see section 2.2.1), including basic health and education, transportation, public facilities, affordable housing and environment protection. As expected by the theory review, an ideal balanced situation between expenses and revenues does not exist, and in Curitiba around 40% of the budget income comes from intergovernmental transfers (Curitiba, 2016). Vicious circles of national and state level transfers or borrowings may lead to political control and lack of independency (see section 2.2.1), phenomenon that Curitiba experienced in the period studied (Felix, 2016). In that sense, the search for alternative sources of revenues took place in the city since the 1990s, culminating in the development of LVC tools like the OODC (see section 1.1.4).

5.2.3.2. Land values dynamics and the opportunity of LVC

Section 2.4 addressed the debate concerning land value capture, including the concepts of value, mechanisms to capture value and the influence of the context. Land values in Curitiba raised strongly in the previous 20 years of the timeframe analyzed by this research. Discounting inflation, values increased from 2 to 15 times, in response to the urban and economy growth (see the growth of Brazil in section 4.3.2), and public efforts which invested in public transportation, public equipment, mobility, etc. (see section 2.4.1).The opportunity to use LVC tools to recover these *unearned increments* (see section 2.4) was taken by the Municipality through the implementation of the SDR charging upgrades in FARs, height and changes in land use (see section 2.4.1).

5.2.3.3. LVC goals and possibilities

The main objective of LVC is to transform rises in private land value in public revenues for the delivery of urban services and implementation or improvement of infrastructure. The cases studied in Curitiba captured value and applied the resources in the provision of affordable housing, environment and historical buildings conservation, public facilities and infrastructure. Moreover, the design of the SDR in Curitiba is able to steer urban development to desired areas and restrict in others.

5.2.3.4. SDR rationale

The tools in Curitiba were created as alternative sources of revenues with a redistributive concept to capture windfalls from wealthier, good structured areas, and application of the resources in poorer serviced areas. The cases studied stand mainly for *direct LVC mechanisms* which were discussed in the theoretical chapter (see section 2.4.3). The CEPAC is one instrument under a mix of rationales (direct and indirect) since the resources are used to internalize the impacts of more intense development.

5.2.3.5. LVC and the debate on property rights

Recapping the debate regarding property rights in section 2.3, *direct LVC tools* face difficulties of implementation since they have strong ideological principles that challenge culture and legal understandings concerning property rights. In Curitiba the SDR is operating for almost three decades and the interviews revealed that there is still some resistance to it coming from the market. The innovative body of the CEPACs is hampering its operation and modifications in the basic building rights currently granted to landowners (basic FAR) is hardly criticized by the market (see section 2.6.2).

In section 2.5 the functional principles of the SDR were discussed. One of them concerns the regulation of FAR, which in practice represents the regulation of part of property rights' bundle: the *development rights* (see section 2.5.2). In Curitiba, some landowners hold too much building rights in their bundle since in certain zones of the city the basic FAR can be 4.0 and 5.0. Most literature advocate the adoption of the base line of development equal to one time the size of land and charging everything beyond this threshold (Furtado, 2006; Sandroni, 2011; Smolka, 2013; Furtado and Maleronka, 2014). Although the cases analyzed confirmed that LVC is higher when landowners have only the basic rights (see sections 2.6.1 and 4.3.4.3), this study demonstrated that it is not a restrict base line that will allow efficient LVC, but the relation between the basic and maximum building parameters. A basic FAR equal to 1.0 with 0.5 upgrade will capture less land values than a basic FAR of 2.0 with upgrades of 1.5, for example.

This approach could facilitate adjustments of the parameters in cities that face difficulties to reduce building rights, as this measure is very political and ideological sensible – although perfectly legal under Brazilian legislative framework and fair before society needs (see section 2.6.2). But here stands a debate: enhancing possible upgrades would allow more density to be constructed, challenging the environmental and structural capacity of the urban area. Should then a political and ideological shortcut to improve LVC be taken risking sustainability and environmental quality of the urban space?

5.2.3.6. LVC and the market

Besides the property rights' debate, it must be reinforced that LVC is a market dependent mechanism. Therefore the SDR is subject to the operation and risks of land markets. Financing urban development using land is more effective in cities where fast urban growth takes place (see sections 2.4.4 and 2.5.2). The decrease in market activity in Curitiba from 2012 impaired the global revenue generation of the SDR and the performance of the CEPACs' auctions. Moreover, developers frequently did not fully upgrade parameters, phenomenon that could be a response to the risks of the land and real estate markets in the form of *costs' reduction*.

Therefore, measures to secure the complete purchase of the additional rights are important. The data of Curitiba showed that it is innocuous a good policy design without considering the demand of the market or other third factors that may lead developers to improve only a few building rights.

5.2.3.7. How much should SDR capture?

Another discussion addressed in sections 2.4 and 2.5 concerns how much should the LVC mechanism capture. The literature describes soft an aggressive policies. Curitiba did not position the SDR in an aggressive of soft approach – this apparently was not considered in the design of the tools and the data exposed both extreme results. The method of OODC charges the concession of rights according to the current use market value, but due to the formula, the capture could range between 18% and 225% depending on the zone. The empirical results, on the other hand, showed extreme captures between 2% and 37% of the current market value and up to 80% of the increment. The OODC-S, which ignores the market value of land and uses a flat rate, captured also variable results, between 0,3% and 61% in the most aggressive case. The CEPACs, which leaves part of the price formation to the market decision, in Curitiba captured between 0,77% and 67% of current value of land. Therefore, the amount of LVC might be very difficult to predict, then very difficult to classify the instrument's pretended level of approach.

5.2.3.8. The impact of LVC on land values

The timing of implementation of LVC tools might also determinate the effectiveness and the source of value capture. When the obligatory payment of charges or obligations is known beforehand by the developer, he may pass this cost to the landowner (see section 2.4.4). In Curitiba, areas where the SDR operates reflect lower land value increase than in other zones.

5.2.3.9. The importance of planning and long term vision

The SDR instrument should not be used indiscriminately. It demands long term vision planning, so allocating it to urgent demands or creating several variations of the same tool might impair its credibility and generate unnecessary competition among models, impacting the LVC results (see section 2.4.4). Moreover, some instruments demand a very careful construction and analysis of the possible consequences, like the CEPACs. The complexity and fierce competition of the CEPAC's process may exclude medium and small developers, impairing their projects (see section 2.5.3). The data from Curitiba exposed high rates of LVC even when the certificates were sold for the minimum price asked, suggesting that if the CEPACs' prices get too high in future auctions, small developments could be compromised.

5.2.3.10. The theoretical framework

The conceptual framework presented in section 2.7.6 drew the influence of the design, implementation and operation of the SDR in the amount of LVC from private land, also including impacts from contextual variables land markets, culture and property rights. These causal relations were confirmed by the data analyzed from the city of Curitiba. Different designs and implementation of the instrument outcome very different results of LVC. Moreover, the oscillation of the land and real estate markets affects the amount of LVC not only by reflecting the amount of developments constructed but also by restricting how much additional right is bought or even not bought at all. Cultural aspects, reflected by the tax payer resistance and political acceptability were observed through the perception of the SDR as a tax and penalty by developers, and also through the prejudice to new models, like the CEPACs. The legal separation of property rights is consolidated and allows the implementation of the SDR, but changes in the package of rights already assigned to land owners – like diminishment of building rights – is political sensible and hardly criticized by developers (see section 2.6.2).

5.2.4. Validity of the findings

In addition to the reflections on validity made in section 3.7, the theoretical framework which guided and was confirmed by the findings of the city of Curitiba can be generalized (external validity) to other municipalities in Brazil, since they are under the same general legal structure and the theoretical framework considers the causal relation between the variables on focus within the influence of context variables, like the land and real estate markets. Nine of the twelve cities studied by Furtado (2006) adopt variable base lines of development and all the twelve improve parameters between 3 and 6 FARs, similar situation to Curitiba. All municipalities exanimated in Furtado's work use different methods for calculation of charge, some based on land values, others on construction costs and fixed flat rates. The formulas usually encompass reduction indexes which impair conversion. The allocation of the revenues is also variable, possibly impacting LVC if punctual needs are financed through the tool. Therefore, the theoretical framework of this study can be used to deep analyze the amount of LVC in those cities studied and also other Brazilian municipalities.

Moreover, the methodology used in this work can be adopted by local governments to evaluate the results of their LVC policies. As long as municipalities have some sort of control and data registered regarding the operation of the urban instruments, the methods of this study can be used to create a reliable real time thermometer of the performance of the tools, allowing forward adjustments.

5.3. Recommendations for Curitiba

Curitiba could possibly adjust the instrument SDR in order to make it more aligned to specific realities of each piece of land and eliminate the competition created by the several models implemented. This would simplify the understanding to the market, raising opportunity for debates around the ideological and social principles of the tool to increase its performance, instead of losing energy with justification and management of many unproductive models.

The model of OODC-S is inefficient to capture land values and it impairs the operation of the OODC and the CEPACs. The OODC-S could be readjusted in the model of the OODC and assigned long term goals of urban development instead of punctual interventions.

Reducing the boundary of the Urban Operation Green Line or better adjusting the equivalence factors could improve the performance of the CEPACs in converting land values, aligning the charge to the particular conditions of each development.

Finally, it is important to promote dialogue and debate with the players of the market, in order to improve the acceptability and consciousness regarding the property of increments in value of land and the importance of this source for the maintenance of sustainable urban development.

5.4. Suggestions for further research

This study does not answer all the questions related to the LVC mechanism of the Sale of Development Rights and although it tries to clarify one causal relation, more questions were posed. There is room for investigation of the competition of the SDR with other urban instruments in Curitiba, like the Transfer of Development Rights, for example.

Moreover, it is not clear and more focused studies are necessary to evaluate why not all available development rights are purchased in the city. Also, how much impact does the SDR has on the profit of developers? This answer could help understand if the cost of building rights is being transferred to land, to the final consumer or even being absorbed by the investors.

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Annex 1: Basic and maximum FAR for OODC, OODC-S and CEPACs

ZONE		BASIC F.A.R.	BASIC N. FLOORS	OODC Social Housing			OODC Envir. Protection			OODC-S Historical Buildings (Residential Use)				OODC-S Public facilities (Residential Use)				CEPACs Infra & P.S.			
				ADDITIONAL F.A.R.	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	INDEX	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	INDEX	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	CEPAC x m²	ADDITIONAL N. FLOORS	CHANGE USE
I - Zona Central – ZC;		5,0	U	-	-	-	-	-	-	2	1,25	-	N	2	1,25	-	N	-	-	-	-
	I - Zona Residencial de Ocupação Controlada – ZR-OC;	0,4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	I - Zona Residencial de Ocupação Controlada – ZR-OC (Áreas Verdes);	0,4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	I - Zona Residencial de Ocupação Controlada – ZR-OC (Áreas Verdes > 50%);	0,4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	I - Zona Residencial de Ocupação Controlada – ZR-OC (Vias Setoriais);	0,4	2	1,1	2	Y (1)(2)	-	-	-	1,1	0,3	2	Y (1)(2)	1,1	0,3	2	Y (1)(2)	-	-	-	-
	I - Zona Residencial de Ocupação Controlada – ZR-OC (Vias Coletoras 1);	0,4	2	1,1	2	Y (1)(2)	-	-	-	1,1	0,3	2	Y (1)(2)(3)	1,1	0,3	2	Y (1)(2)(3)	-	-	-	-
	I - Zona Residencial de Ocupação Controlada – ZR-OC (Vias Coletoras 2);	0,4	2	1,1	2	Y (1)(2)	-	-	-	1,1	0,3	2	Y (1)(2)	1,1	0,3	2	Y (1)(2)	-	-	-	-
	II - Zona Residencial Um – ZR-1;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona Residencial Um – ZR-1 (Áreas Verdes)(Dec. 194/00);	1,0	4	-	-	-	-	2	Y (1)	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona Residencial Um – ZR-1 (Áreas Verdes)(Dec.246/14);	1,0	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III - Zona Residencial Dois – ZR-2;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III - Zona Residencial Dois – ZR-2 (Áreas Verdes);	1,0	4	-	-	-	0,2	2	Y (1)(2)(4)	-	-	-	-	-	-	-	-	-	-	-	-
	III - Zona Residencial Dois – ZR-2 (Vias Setoriais);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)(3)	0,5	0,3	2	Y (1)(2)(3)	-	-	-	-
	III - Zona Residencial Dois – ZR-2 (Vias Coletoras 1);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)(3)	0,5	0,3	2	Y (1)(2)(3)	-	-	-	-
	III - Zona Residencial Dois – ZR-2 (Vias Coletoras 2);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)	0,5	0,3	2	Y (1)(2)	-	-	-	-
	IV - Zona Residencial Três – ZR-3;	1,0	3	0,5	1	Y (2)	-	-	-	0,5	0,3	1	Y (2)	0,5	0,3	1	Y (2)	-	-	-	-
	IV - Zona Residencial Três – ZR-3 (Áreas Verdes > 2000m²);	1,0	4	-	-	-	0,2	2	Y (1)(2)	-	-	-	-	-	-	-	-	-	-	-	-
	IV - Zona Residencial Três – ZR-3 (Áreas Verdes > 10.000m²);	1,0	4	-	-	-	-	4	Y (1)(2)	-	-	-	-	-	-	-	-	-	-	-	-
	IV - Zona Residencial Três – ZR-3 (Vias Setoriais);	1,0	3	0,8	3	Y (2)	-	-	-	0,8	0,3	3	Y (2)(3)	0,8	0,3	3	Y (2)(3)	-	-	-	-
	IV - Zona Residencial Três – ZR-3 (Vias Coletoras 1);	1,0	3	0,8	3	Y (2)	-	-	-	0,8	0,3	3	Y (2)(3)	0,8	0,3	3	Y (2)(3)	-	-	-	-
	IV - Zona Residencial Três – ZR-3 (Vias Coletoras 2);	1,0	3	0,5	1	Y (2)	-	-	-	0,5	0,3	1	Y (2)	0,5	0,3	1	Y (2)	-	-	-	-
	IV - Zona Residencial Três - ZR-3 (Rebouças/ Prado Velho)	1,0	3	1,5	5	Y (2)	-	-	-	1,5	0,3	5	Y (2)(3)	1,5	0,3	5	Y (2)(3)	-	-	-	-
	IV - Zona Residencial Três - ZR-3 (Rebouças/ Prado Velho)(Vias Setoriais)	1,0	3	-	-	-	-	-	-	1,0	0,3	5	Y(3)	1,0	0,3	5	Y(3)	-	-	-	-
	IV - Zona Residencial Três - ZR-3 (Rebouças/ Prado Velho)(Vias Coletoras)	1,0	3	-	-	-	-	-	-	1,0	0,3	5	Y(3)	1,0	0,3	5	Y(3)	-	-	-	-
	V - Zona Residencial Quatro – ZR-4;	2,0	6	0,5	2	N	-	-	-	0,5	0,6	2	N	0,5	0,6	2	N	-	-	-	-
	V - Zona Residencial Quatro – ZR-4 (Áreas Verdes > 2000m²);	2,0	8	-	-	-	0,4	2	Y (3)(4)(5)	-	-	-	-	-	-	-	-	-	-	-	-
	V - Zona Residencial Quatro – ZR-4 (Áreas Verdes > 10.000m²);	2,0	8	-	-	-	-	4	N	-	-	-	-	-	-	-	-	-	-	-	-
II - Zonas Residenciais – ZR	V - Zona Residencial Quatro – ZR-4 (Vias Setoriais);	2,0	6	-	-	-	-	-	-	0,5	0,6	2	N	0,5	0,6	2	N	-	-	-	-
	V - Zona Residencial Quatro – ZR-4 (Vias Coletoras 1);	2,0	6	-	-	-	-	-	-	0,5	0,6	2	N	0,5	0,6	2	N	-	-	-	-
	V - Zona Residencial Quatro – ZR-4 (Vias Coletoras 2);	2,0	6	-	-	-	-	-	-	0,5	0,6	2	N	0,5	0,6	2	N	-	-	-	-
	V.I - Zona Residencial Quatro - Alto da XV	2,0	6	0,5	4	N	-	-	-	0,5	0,6	4	Y(3)	0,5	0,6	4	Y(3)	-	-	-	-
	V.I - Zona Residencial Quatro - Alto da XV (Vias Setoriais)	2,0	6	-	-	-	-	-	-	-	0,6	4	Y(3)	-	0,6	4	Y(3)	-	-	-	-
	V.I - Zona Residencial Quatro - Alto da XV (Vias Coletoras)	2,0	6	-	-	-	-	-	-	-	0,6	4	Y(3)	-	0,6	4	Y(3)	-	-	-	-
	V.II - Zona Residencial Quatro - Rebouças	2,0	6	0,5	2	N	-	-	-	0,5	0,6	2	Y(3)	0,5	0,6	2	Y(3)	-	-	-	-
	V.II - Zona Residencial Quatro - Rebouças (Vias Setoriais)	2,0	6	-	-	-	-	-	-	-	0,6	2	Y(3)	-	0,6	2	Y(3)	-	-	-	-
	V.II - Zona Residencial Quatro - Rebouças (Vias Coletoras)	2,0	6	-	-	-	-	-	-	-	0,6	2	Y(3)	-	0,6	2	Y(3)	-	-	-	-
	V.III - Zona Residencial Quatro - Batel	2,0	6	0,5	4	N	-	-	-	0,5	0,6	4	N	0,5	0,6	4	N	-	-	-	-
	V.III - Zona Residencial Quatro - Batel (Vias Setoriais)	2,0	6	-	-	-	-	-	-	-	0,6	4	Y(3)	-	0,6	4	Y(3)	-	-	-	-
	V.III - Zona Residencial Quatro - Batel (Vias Coletoras 1)	2,0	6	-	-	-	-	-	-	-	0,6	4	Y(3)	-	0,6	4	Y(3)	-	-	-	-
	VI - Zona Residencial Batel – ZR-B;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	VI - Zona Residencial Batel – ZR-B (Áreas Verdes);	1,0	4	-	-	-	-	2	Y (1)(2)(4)	-	-	-	-	-	-	-	-	-	-	-	-
	VI - Zona Residencial Batel – ZR-B (Vias Setoriais);	1,0	2	-	-	-	-	-	-	0,5	0,3	2	Y (3)	0,5	0,3	2	Y (3)	-	-	-	-
	VI - Zona Residencial Batel – ZR-B (Vias Coletoras 1);	1,0	2	-	-	-	-	-	-	0,5	0,3	2	Y (3)	0,5	0,3	2	Y (3)	-	-	-	-
	VII - Zona Residencial Mercês – ZR-M;	1,0	2	1,5	6	Y (1)(2)	-	-	-	1,5	0,3	6	Y (1)(2)	1,5	0,3	6	Y (1)(2)	-	-	-	-
	VIII - Zona Residencial Alto da Glória – ZR-AG;	1,0	2	1,5	6	Y (1)(2)	-	-	-	1,5	0,3	6	Y (1)(2)	1,5	0,3	6	Y (1)(2)	-	-	-	-
	IX - Zona Residencial Santa Felicidade – ZR-SF;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	IX - Zona Residencial Santa Felicidade – ZR-SF (Áreas Verdes);	1,0	4	-	-	-	0,2	2	Y (1)(2)(3)(5)(6)	-	-	-	-	-	-	-	-	-	-	-	-
	IX - Zona Residencial Santa Felicidade – ZR-SF (Vias Setoriais);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)(3)	0,5	0,3	2	Y (1)(2)(3)	-	-	-	-
	IX - Zona Residencial Santa Felicidade – ZR-SF (Vias Coletoras 1);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)(3)	0,5	0,3	2	Y (1)(2)(3)	-	-	-	-
	IX - Zona Residencial Santa Felicidade – ZR-SF (Vias Coletoras 2);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)	0,5	0,3	2	Y (1)(2)	-	-	-	-
	X - Zona Residencial Umbará – ZR-U;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	X - Zona Residencial Umbará – ZR-U (Áreas Verdes);	1,0	4	-	-	-	0,2	2	Y (1)(2)(3)(4)(5)	-	-	-	-	-	-	-	-	-	-	-	-
	X - Zona Residencial Umbará – ZR-U (Vias Setoriais);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)(3)	0,5	0,3	2	Y (1)(2)(3)	-	-	-	-
	X - Zona Residencial Umbará – ZR-U (Vias Coletoras 1);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)(3)	0,5	0,3	2	Y (1)(2)(3)	-	-	-	-
	X - Zona Residencial Umbará – ZR-U (Vias Coletoras 2);	1,0	2	0,5	2	Y (1)(2)	-	-	-	0,5	0,3	2	Y (1)(2)	0,5	0,3	2	Y (1)(2)	-	-	-	-
	XI - Zona Residencial Passaúna – ZR-P.	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	I - Zona de Serviço 1 – ZS-1;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
III - Zonas de Serviços – ZS	I - Zona de Serviço 1 – ZS-1 (Áreas Verdes);	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona de Serviço 2 – ZS-2;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona de Serviço 2 – ZS-2 (Áreas Verdes);	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III - Zona Especial de Serviços – ZES.	1,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	I - Zona de Transição da Av. Mal. Floriano Peixoto – ZT-MF;	1,0	2	0,5	2	N	-	-	-	0,5	0,3	2	N	0,5	0,3	2	N	-	-	-	-
	II - Zona de Transição Nova Curitiba – ZT-NC (vias externas);	1,0	6	0,8	2	Y (2)	-	-	-	0,8	0,3	2	Y (2)	0,8	0,3	2	Y (2)	-	-	-	-
IV - Zonas de Transição – ZT	II - Zona de Transição Nova Curitiba – ZT-NC (vias externas)(ÁV>2000m²);	1,0	8	-	-	-	0,8	2	Y (2)(3)(4)(5)(6)	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona de Transição Nova Curitiba – ZT-NC (vias externas)(ÁV>10.000m²);	1,0	8	-	-	-	-	4	Y (2)	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona de Transição Nova Curitiba – ZT-NC (demais terrenos);	1,0	4	0,5	2	Y (2)	-	-	-	0,5	0,3	2	Y (2)	0,5	0,3	2	Y (2)	-	-	-	-
	II - Zona de Transição Nova Curitiba – ZT-NC (demais terrenos)(ÁV>2000m²);	1,0	6	-	-	-	0,5	2	Y (2)(3)(4)(5)(6)	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona de Transição Nova Curitiba – ZT-NC (demais terrenos)(ÁV>10.000m	1,0	6	-	-	-	-	6	Y (2)	-	-	-	-	-	-	-	-	-	-	-	-
	III - Zona de Transição – BR-116 – ZT-BR-116	1,0	4	0,8	2	N	-	-	-	0,8	0,3	2	N	0,8	0,3	2	N	-	-	-	-
V - Zonas Industriais – ZI (Indústrias);		1,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V - Zonas Industriais – ZI (Habitação e Comércio);		0,6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VI - Zonas de Uso Misto – ZUM;		1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	ZONE	BASIC F.A.R.	BASIC N. FLOORS	OODC Social Housing			OODC Envir. Protection			OODC-S Historical Buildings (Residential Use)				OODC-S Public facilities (Residential Use)				CEPACs Infra & P.S.			
				ADDITIONAL F.A.R.	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	INDEX	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	INDEX	ADDITIONAL N. FLOORS	CHANGE USE	ADDITIONAL F.A.R.	CEPAC x m²	ADDITIONAL N. FLOORS	CHANGE USE
VII - Zonas Especiais – ZE	I - Zona Especial Educacional – ZE-E;	0,5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	II - Zona Especial Desportiva – ZE-D;	0,5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	III - Zona Especial Militar – ZE-M.	0,5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VIII - Zona de Contenção – Z-CON;		0,4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IX -Áreas de Proteção Ambiental – APA;		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IX -Áreas de Proteção Ambiental – APA Iguaçú (Áreas Verdes);		0,4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X - Setores Especiais – SE	I- Setor Especial Estrutural (Via Central);	4,0	U	-	-	-	-	-	-	2	1,25	-	N	2	1,25	-	N	-	-	-	-
	I- Setor Especial Estrutural (Outras Vias);	4,0	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	I- Setor Especial Estrutural (Vias Externas);	4,0	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	II - Setor Especial da Av. Marechal Floriano Peixoto – SE-MF;	1,0	4	1,5	6	N	-	-	-	1,5	0,3	6	N	1,5	0,3	6	N	-	-	-	-
	III - Setor Especial da Av. Comendador Franco – SE-CF;	1,0	4	1,5	6	N	-	-	-	1,5	0,3	6	N	1,5	0,3	6	N	-	-	-	-
	IV - Setor Especial da Av. Pres. Wenceslau Braz – SE-WB;	1,0	4	1,5	6	N	-	-	-	1,5	0,3	6	N	1,5	0,3	6	N	-	-	-	-
	V - Setor Especial da Av. Pres. Affonso Camargo – SE-AC;	1,0	4	1,5	6	N	-	-	-	1,5	0,3	6	N	1,5	0,3	6	N	-	-	-	-
	VI - Setor Especial da Rua Engenheiro Costa Barros – SE-CB.	1,0	4	0,8	2	N	-	-	-	0,8	0,3	2	N	0,8	0,3	2	N	-	-	-	-
	III - Setor Especial Conectoras;	1,5	4	0,5	4	N	-	-	-	0,5	0,4	4	N	0,5	0,4	4	N	-	-	-	-
	III - Setor Especial Conectoras (Áreas Verdes > 2000m²);	1,5	6	-	-	-	0,5	4	Y (6)	-	-	-	-	-	-	-	-	-	-	-	-
	III - Setor Especial Conectoras (Áreas Verdes > 10.000m²);	1,5	6	-	-	-	-	6	N	-	-	-	-	-	-	-	-	-	-	-	-
	III - Setor Especial Conectoras (Vias Setoriais);	1,5	4	-	-	-	-	-	-	0,5	0,4	4	N	0,5	0,4	4	N	-	-	-	-
	III - Setor Especial Conectoras (Vias Coletoras 1);	1,5	4	-	-	-	-	-	-	0,5	0,4	4	N	0,5	0,4	4	N	-	-	-	-
	IV - Setor Especial do Centro Cívico (Cândido de Abreu);	5,0	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	IV - Setor Especial do Centro Cívico (demais vias);	2,0	6	0,5	4	N	-	-	-	0,5	0,6	4	N	0,5	0,6	4	N	-	-	-	-
	IV - Setor Especial do Centro Cívico (demais vias) (Áreas Verdes > 2000m²);	2,0	8	-	-	-	0,4	2	N	-	-	-	-	-	-	-	-	-	-	-	-
	IV - Setor Especial do Centro Cívico (demais vias) (Áreas Verdes > 10.000m²)	2,0	8	-	-	-	-	4	N	-	-	-	-	-	-	-	-	-	-	-	-
	V - Setor Especial do Sistema Viário Básico (Priorit., Setoriais e Coletoras);	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	VI - Setor Especial Histórico;	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	VII - Setor Especial Preferencial de Pedestres;	3,6	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	VIII - Setor Especial Comercial do Umbará;	1,0	2	-	-	-	-	-	-	0,5	0,3	2	Y(3)	0,5	0,3	2	Y(3)	-	-	-	-
	VIII - Setor Especial Comercial do Umbará (Áreas Verdes);	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	IX - Setor Especial Comercial de Santa Felicidade;	1,0	2	-	-	-	-	-	-	0,5	0,3	2	Y(3)	0,5	0,3	2	Y(3)	-	-	-	-
	IX - Setor Especial Comercial de Santa Felicidade (Áreas Verdes);	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	X - Setor Especial Nova Curitiba;	2,0	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	XI - Setor Especial Institucional;	1,0	3	0,5	1	N	-	-	-	0,5	0,3	1	N	0,5	0,3	1	N	-	-	-	-
	XII - Setor Especial dos Pontos Panorâmicos;	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	XIII - Setor Especial de Habitação de Interesse Social;	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	XIII - Setor Especial de Habitação de Interesse Social (Áreas Verdes);	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	XIII - Setor Especial de Habitação de Interesse Social (Vias Coletoras 3);	1,0	2	0,5	2	Y (1)	-	-	-	0,5	0,3	2	Y (1)(2)	0,5	0,3	2	Y (1)(2)	-	-	-	-
	XIV - Setor Especial Linhão do Emprego (vias específicas);	1,0	4	0,5	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	XIV - Setor Especial Linhão do Emprego (demais vias);	1,0	2	0,5	2	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	XV - Setor Especial do Pólo de Software;	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUC Linha Verde	Pólo da Linha Verde - POLO-LV (Norte)	1,0	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,0	0,95	U	Y
	Pólo da Linha Verde - POLO-LV (Central)	1,0	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,0	0,65	U	Y
	Pólo da Linha Verde - POLO-LV (Sul)	1,0	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,0	0,90	U	Y
	Setor Especial da Linha Verde - SE-LV (Norte)	1,0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,0	1,00	U	Y
	Setor Especial da Linha Verde - SE-LV (Central)	1,0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,0	0,60	U	Y
	Setor Especial da Linha Verde - SE-LV (Sul)	1,0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,0	0,80	U	Y
	Zona de Transição da Linha Verde - ZT-LV (Norte)	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,5	1,40	4	Y
	Zona de Transição da Linha Verde - ZT-LV (Central)	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,5	1,00	4	Y
	Zona de Transição da Linha Verde - ZT-LV (Sul)	1,0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,5	1,35	4	Y
	Zona Residencial Quatro - ZR-4 (Norte)	2,0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,5	1,40	2	Y
	Zona Residencial Quatro - ZR-4 (Central)	2,0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,5	1,00	2	Y
	Zona Residencial Quatro - ZR-4 (Sul)	2,0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,5	1,35	2	Y
	Zona Especial Desportiva - ZED (Central) (Hab. Transitória 1 e 2)	0,5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,0	0,85	4	Y
	Zona Especial Desportiva - ZED (Central) (Comunitário, Sport)	0,5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,5	0,85	4	Y
	Zona Especial Desportiva - ZED (Central) (Comércio)	0,5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,5	0,85	6	Y
	Zona de Serviço 2 - ZS-2 (Sul)	1,0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

LEGEND

Changes in uses:

1 Habitação Coletiva
2 Habitação Transitória 1
3 Habitação Transitória 2
4 Comunitário 1
5 Comunitário 2
6 Comunitário 3

U Unlimited number of floors

Source: Municipality of Curitiba. Compilation: the author.

Annex 2: Case Study protocol

The study of the cases of SDR basically followed the next protocol:

1. Collection of land use plan legislation and other regulations regarding the instrument;
2. Analysis of the basic and maximum lines of development (FARs);
3. Location of areas where the instrument is used (zoning);
4. Analysis of the calculation methods;
5. Analysis of the price charged (fixed, variable);
6. Analysis of timing variable: transparency to developers and time of payment
7. Analysis of the earmarking of the instrument, purposes, goal;
8. Analysis of embedment of the instrument usage in long term planning;
9. Analysis of the assessments methods of land value;
10. Analysis of administrative capacity and control of information of the local government;
11. Collection of revenues collected from real estate projects that bought DR;
12. Collection of land values per neighbourhood and year – location in GIS;
13. Analysis of amount of value increase captured;
14. Analysis of value captured over current use of land;
15. Analysis of expectation of collection and amount collected;
16. Checking of the political acceptability and tax payer resistance (interviews);
17. Checking of the legal separation of property rights (through legislation analysis);
18. Checking of the influence of fluctuations in land markets.

Annex 3: Interview guides

In order to support the research strategy Multiple Case Study explained in Chapter 3, the method of interviews filled the gaps of desk research and triangulated information. The semi-structured interviews with key informants followed this guide:

a) Interview with experts and professionals involved with SDR

Data triangulation

1. Data from the city hall shows that only between around 18% and 30% of real estate projects use 100% of the additional building potential possible. Most just add floors without changing the FAR or add just a little more area. Is this really a pattern? Why does it happen? Is it economically feasible to build on several plots, or is the available coefficient enough?
2. For the *OODC Social Housing*, what happens when both extra rights are purchased (FAR and extra floors)?
3. Is there a limit of allowed construction in a zone? Can every plot construct the maximum allowed?
4. It is remarkable the predominance of the use of the model *OODC-S Public Facilities*, why does that happens?

Design of SDR

1. How is the calculation of the charges made for each case of SDR?
2. How was the process to construct the OU project and the design of the CEPACs?
3. What is the Municipality's reaction to the market response to the CEPACs?
4. How is the initial price of the CEPACs stablished?
5. How were the equivalence factors of the CEPACs stablished?

Operation of SDR

1. How is the assessment of values of land done?
2. What are the steps of the process of using the SDR?
3. In general, are the expectations regarding time of collection of the revenues fulfilled? If not, what are the obstacles?
4. How is the operation of the stock markets handled?
5. Is there a competition between the CEPACs and other models of SDR in the city?
6. Is there resistance inside the municipality to the use of SDR? Does this affect the operation of the tool?
7. Is there resistance from developers to pay for additional DR? How is this managed?

b) Interview with developers who buy DR

Data triangulation

1. Data from the city hall shows that only between around 18% and 30% of real estate projects use 100% of the additional building potential possible. Most just add floors without changing the FAR or add just a little more area. Is this really a pattern? Why does it happen? Is it economically feasible to build on several plots, or is the available coefficient enough?
2. A drop in the number of projects that have upgraded development rights happened from 2011 until 2016. Did the market diminished its activity?
3. It seems that Curitiba offers many options for acquiring building potential. What do think about that? Do you take that into account to choose one model or another?

Design of SDR

1. Do you consider the cost of the option / obligation to buy building rights before buying land to implement a project?
2. Do you consider the cost of building rights to be an expense related to the purchase of the land, that is, to the land value, or to the construction process, to be compensated in the sale of units?

Operation of SDR

1. Would you tell me, briefly, what are basically the steps you take to buy constructive potential? Do you consider the process easy or too bureaucratic?
2. Among the SDR options, there are the OODC and the OODC-S. Do you see options between the two, advantages of one over the other?
3. What is your opinion about the sale of building rights through the stock market (CEPACs)? Do you feel comfortable working this way?

Political acceptability and tax payer resistance

1. Do you agree to pay for additional building rights beyond the basic parameters?
2. Do you consider that the amount charged by the potential, in any of the modalities, is fair, very high or very low?
3. When faced with the need to acquire additional building rights, do you consider other alternatives to the project? For example, to build in smaller density in more plots or to use other models as TDR?

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