Property Tax Capitalization in Real Estate Values: Evidences from São Paulo

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Resumo

Esse artigo se aproveita de uma oportunidade não usual para estimar a capitalização do imposto predial no preço dos imóveis. Em 2002 a cidade de São Paulo mudou a estrutura de imposto predial originalmente uniforme para uma estrutura progressiva com seis faixas distintas de cobrança. Essa é uma oportunidade única pois os gastos não mudaram em função das faixas. Em geral, é difícil estimar capitalização pois uma mudança na arrecadação é seguida por uma mudança nos gastos. Se houver de fato capitalização, a progressividade implica que o preço dos imóveis mais baratos deveria aumentar enquanto o preço dos imóveis mais caros deveria cair questionando se a política é de fato progressiva. Comparando o preço dos imóveis antes e depois da reforma do imposto predial por faixa de tributação, mostramos que houve de fato capitalização para o caso de São Paulo. Após testar se os resultados são robustos, discutimos as consequências desse achado para a política pública urbana.

Palavras Chave: Imposto Predial, Capitalização de Impostos, Diferenças em diferenças, Incidência Tributária, Progressividade.

Abstract

This paper uses an unusual opportunity to estimate the capitalization of the property tax on property value. In 2002 the city of São Paulo changed the property tax structure moving from uniform rate to progressive with six different brackets. This is a unique opportunity since expenditure has not changed accordingly. A typical difficulty in estimating capitalization is that a change in property tax is followed by a change in expenditures. If capitalization occurs, progressivity would increases prices for the low end of the market and decreases price for the high end questioning eventually how progressive is the policy indeed. We compare the prices before progressivity is implemented with prices after the fiscal reform for the low and high end of the market showing that there is indeed capitalization in the case of São Paulo. We test the robustness of this result and then discuss the consequences of such finding for urban policy.

Keywords: Property Tax, Tax Capitalization, Difference-in-Difference, Tax Incidence, Progressivity

Área Anpec: Economia do Setor Público

JEL: R31, R38

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Introduction

The goal of this project is to estimate the percentage of property tax capitalization in property value. To perform this estimation we use a policy decision that opens an opportunity for identification. São Paulo Municipality changed the tax rate schedule in 2002 from uniform to progressive. Since this change was not directly connected to a change in local expenditure, with some caution, it may be considered as exogenous to the problem at hand. Furthermore, we can precisely estimate the percentage change in the tax rate so we can analyze the magnitude of the incidence of the property tax on prices (capitalization). This is an old issue but it is still unresolved given the typical endogeneity between property tax rates and local expenditure (Palmon and Smith, 1998). Estimating property tax capitalization is key in managing and implementing local tax policy.

More than forty years ago, Oates (1969) did the first attempt to test the Tiebout Hypothesis (Tiebout, 1956). By gauging education spending per pupil and property tax capitalization on New Jersey municipalities, Oates showed that real estate prices rises more with public expenditures than it decreases with property taxes, a result that could be seen as an evidence in favor of Tiebout hypothesis. A well-know debate has emerged which doesn't seem to have a final conclusion yet. The main point is that it is not possible to decompose (negative) effect on prices given the higher rate from the (positive) effect given the higher level of expenditure. But, one great achievement of Oates' study that sometimes is set aside is to have been probably the first consistent evidence on the existence of property tax capitalization on real estate values, that is, the higher the tax on property, ceteris paribus, the lower is housing prices.

Recently, scholars on urban planning and urban economics have worried about property prices. Glaeser (2008), for example, argues that unaffordable housing prices could lead cities to inefficiency because it makes harder for some citizens to afford living standards. Since cities need human capital (both skilled and unskilled) to guide economic growth, the more expensive the average price of a dwelling, the less attractive the city is to these workers (McCann, 2001; Glaeser, 2005). Smolka and Biderman (2012) argue that high housing price is one of the causes of urban informality. This approach explains the high incidence of slums in Latin American cities as a mixed effect of high levels of immigration of poor families with unaffordable property prices, directing these families to precarious suburban dwellings. As several authors vastly explored, informality is a huge barrier to social mobility and access to rights (Smolka, 2003; Schechinger, 2004).

To fight back against the rise of unaffordable property prices, literature recommends cities to have several urban policies in order to reduce median property values, such as curtailment of building restrictions (Glaeser, 2009; Borrero and Schechinger, 2007; Green, 1999; Lall and da Mata, 2006). The main argument of these studies is that cheaper property prices cities reduce informality since formal market prices would approximate irregular property prices, discouraging informality.

Despite of the importance of reducing building restrictions, few scholars have considered the possibility of using property taxes to reduce real estate values (see Bahl and Lynn, 1992; and De Cesare and Smolka, 2010). Because property tax

reduces the expected future private yield on the land, it capitalizes into lower current land values (Bahl and Linn, 1992; Yinger et. al. 1988). Thus, as higher the property tax is, *ceteris paribus*, lower is the property value; and as lower the property tax is, higher the property price – as it was intensively discussed over the last four decades.

In this sense, property tax capitalization represents an important issue to urban planners: its possibility to reduce real estate values could be seen as a practical and effective tool to drive the average property prices to a lower level, avoiding these previously described undesirable effects. In other words, property taxes could be a very good tool to reduce housing prices and, consequently, of great value to Urban Planners, who would have only to understand the mechanism through property taxes capitalize into property prices to determine optimum levels of taxation both to local public finances and to average real estate values, contributing thus to reduce urban informality. On the other hand, property taxes exemptions to low assessed properties could be seen as a contradictory policy because it would make those properties more expensive for families who most need it. It is important to note that there are still very few considerations about this possibility among researchers and practitioners.

To better understand this dilemma let us assume full capitalization. In this case the increase in taxes will be fully compensated by a reduction in price. However, taxes are paid annually while the property has to be paid at once. So, increasing property taxes is equivalent to giving a credit to the buyer. One of the main problems with social housing is credit that is usually supplied by the government. Consequently a progressive property tax makes it more difficult to the poor to get into the housing market. If the tax is also shifted forward to renters, it is also more expensive to rent. The political economy behind it is quite complex however. Property owners at the low end of the market increase their wealth (because their house worth more) and their income (since they have to pay less in taxes). The problem is with tenants: it is more difficult to enter the market and the rent increases. However, in a country with more tan 75% of property owners at any level of income like Brazil, it is difficult to change the policy back to a uniform rate.

This article has 6 sections including this introduction. We first describe the property tax reform that took place in São Paulo City in the early 2000s. Than we explain our estimation strategy that is a variant of the difference-in-difference approach because our treatment variable is continuous. In the forth section we present the results of our estimation. We found evidence of a strong capitalization, around 20% for a 1% decrease in the tax rate. The fifth section checks the robustness of the results and makes us suspicious about the magnitude found in the previous section. The final section concludes the article discussing the consequences of the findings.

São Paulo's Progressive Property Tax Rates

The São Paulo's Law 13.250, from December 2001, reform the property tax regime in São Paulo City introducing progressive tax rates depending on the property cadastral value. The law was enforced since January 2002. Previous legislation imposed a uniform tax-rate of 1.0% of the assessed value to be paid yearly with an option to a monthly payment. The new law created six different brackets with different rates according to the assessed value of the property, including exemptions for the first bracket. Actually, the law has exempted almost 1.5 million properties from paying

property taxes, from a total of 2.5 million. Table 1 presents the criteria to define the rate applied to each property.

Table 1: Property tax rates according to Assessed Value in São Paulo

Assessed Value (in reais)	Marginal Rate	Deduction	Average Rate
Until R$20,000	0%	-	0%
From R$20,00 to R$50,000	0.8%	-	0,8%
From R$50,000 to R$100,000	1.0%	R$100	0,8% to 0,899%
From R$100,000 to R$200,000	1.2%	R$300	0,9% to 1,049%
From R$200,000 to R$400,000	1.4%	R$700	1,05% to 1,224%
Above of R$400,000	1.6%	R$1500	1,225% to 1.600%

***Source**: São Paulo's Law 13.250/2001*

The criteria, as can be noticed, use lump-sum deductions on the tax return at each bracket. The idea of the deduction is to guarantee that the tax paid by property owners will not be discontinuous. Notice that a property assessed at R$50 thousand will pay R$400 per year using 0,8% tax rate or using 1% tax rate and deducting R$100. The exception is to the group taxed at 0.8% who doesn´t have deductions on the tax. This structure avoid taxpayers from paying very low values per month (this is one of the rationales) but it creates a discontinuity in the tax term. For instance, a property assessed at 19,999 in 2001 would not pay any tax while a property assessed at 20,001 would pay R$160. It is also straightforward that, given this structure, is incorrect to say that a real estate assessed at, for example, R$ 100,000.00 would be taxed at 1.2%. This will be the marginal rate but not the average. Before the property tax reform the marginal and average rates where evidently equal. The last column on Table 1 calculates the range of average rates for each bracket.

The assessed value in São Paulo is also defined by municipal law, which needs to be approved by the municipal council. Several attributes of the property are analyzed in this assessment, such as square meters, depreciation, construction materials and location. The later includes a research on market prices associated with property location. Reassessing property for tax purposes is evidently very unpopular. Before 2009 reassessment was done very seldom: since 1990 it was reassessed just on 1995, 2001 and 2010. When the property is not reassessed, the original prices are readjusted based on last year inflation. In 2011, a new municipal law made it mandatory to reassess property values (for tax purposes) every other year. However, the municipality fails to implement a massive reassessment in 2013[1].

Of course, the criteria for defining the brackets presented on Table 1 changes every year to incorporate at least previous inflation. Thus, for our purposes, we have to recalculate the average rate every year.

[1] São Paulo's Justice due to a legal process initiated by the opposition party and the São Paulo's Industry Federation prevented the municipality to introduce the reassessment. Given that, the mayor decided just to readjust the previous assessed values by inflation. This is a good example of how much reassessing property values for tax purposes have strong political consequences in Brazil and explains why reassessment are so infrequent.

Dataset and Empirical Strategy

This research combines three datasets. The first is the cadastral from the municipality of São Paulo, containing administrative records with housing values for property tax purposes. The second is a complete set of information (size, number of rooms, bathrooms, facilities in the building, etc.) from all new apartment buildings release in São Paulo's Metropolitan Region (such as number of rooms, selling price etc.) from Embraesp[2]. The advantage of working with new releases is that we do not have to worry about housing depreciation (Biderman, 2001). Furthermore, Embraesp has actual sale price that is better information than asking prices that are often used for analyzing housing prices. Finally, we use Brazilian Census of 2010 for some control variables.

To merge those datasets we have geo-referenced Embraesp dataset and spatially join it to the Digital Map of the City that has the "fiscal blocks". Fiscal blocks are defined for fiscal purposes. Within its perimeter the value of the square meter is uniform for fiscal purposes. Since we know where the building surveyed by Embraesp is located, we know to which fiscal block it belongs and consequently the price per square meter for fiscal purposes. Using the apartment[3] area we can estimate in which bracket the property is and consequently the average property tax rate associated with that property. We chose to analyze the period between 1995 and 2008 so we will have the same number of years before and after the tax change and will not have to deal with the monetary reform that took place in July 1994.

Table 2: Average Prices* and Number of Observations by Bracket Group in the Sample

Bracket Group	1995-2008		1995-2001			2002-2008		
	Obs	Share	Obs	Share	Average Price*	Obs	Share	Average Price*
Exempt	2167	33%	1102	40%	224.940	1065	30%	178.150
0.8%	1668	25%	810	29%	380.640	858	24%	335.032
1.0%	1252	19%	530	19%	644.521	722	20%	557.409
1.2%	645	13%	182	7%	1.227.524	463	13%	1.032.421
1.4%	405	6%	109	4%	1.944.463	296	8%	1.844.165
1.6%	205	3%	43	2%	4.644.880	162	5%	3.838.572
Total	6342	100%	2776	100%	569.726	3566	100%	721.268

*Market Prices in January 2014 reais deflated by IGPM
Source: Embraesp and São Paulo Cadastral Office

The decision to use average tax rates is because the relevant tax for capitalization is the average. It is well known that the relevant tax for making decisions is the marginal. For instance, the decision to buy a larger apartment will depend on the marginal rate. However, the extra value expended (saved) by an increase (decrease) in the tax depends on the average rate. For example, a property that is assessed to

[2] On this database there isn't information about new houses, except those which are part from a larger launch of a gated community.
[3] From now on we will use the terms apartment and property interchangeably when referring to our sample of analysis since it includes just apartments.

value R$250 thousand will pay R$2,800 per year in taxes after the reform compared to R$2,500 before the reform. Those R$300 extra per year may be (partially) capitalized into prices. If we use the marginal tax, we would say that R$1,000 (3,500-2,500) would be expected to be capitalized into prices. However, the property owner does not face R$1,000 extra per year but R$300. Table 2 compare prices by group before and after the tax reform.

We can notice that exempt apartments represent the vast majority among groups. Although our sample is composed just by new building releases, it is close to the total stock of housing since the city estimate in 2001 that around 30% of the housing stock would exempt from taxation after the reform. It is interesting to note though that the share of the exempted group is declining. This is true also for the following two groups (brackets 0.8% and 1%). The share of the 1.2% group remained stable while the share of the most expansive apartments increased. This is probably reflecting that the market is offering more apartments in the high end of the spectrum. On the other hand average prices in each bracket is going down. However, since there are more apartments in the more expansive brackets, average price for the whole sample has increased. It is important to notice that cadastral records define the bracket while the market price is calculated using Embraesp information. This is the reason why average prices are not consistent with Table 1.

An ideal experiment to assess the level of capitalization would randomly select properties and changes their tax rate. After a period of time it would be possible to compare the price change in properties that were randomly selected with the price change in properties that were not selected. This price difference would be the impact (on prices) of the tax rate change. We do not have the ideal experiment because properties that have their tax rate changed were not randomly selected. It may be the case that the demand for the low end of the market was not immediately satisfied by supply but this was not happening at the high end of the market, for instance. The way we will control for other sources of variation will be using a set of control variables. More specifically we will be running regressions with (variations of) the following specification:

$$ln(p_{it}) = \alpha + \delta_1 y_t + \delta_2 \tau_i + \delta_3 y_t \tau_i + \boldsymbol{\beta}_x \boldsymbol{X}_{it} + \boldsymbol{\beta}_h \boldsymbol{H}_{it} + \varepsilon_{it} \qquad (1)$$

Where $\ln(p_{it})$ is the natural logarithm of price of housing i at year t; y_t is a dummy variable that takes value 1 if the year t is 2002 or more recent; τ_i is 1 minus 100 times the tax rate associated to housing i **after** progressivity was implemented; $\boldsymbol{X}_{it}$ is a set of socio-demographic attributes of housing i at year t in the census block where the building is located; $\boldsymbol{H}_{it}$ is a set of housing attributes of housing i at year t; αs, δs and βs are parameters to be estimated by the regression and ε_{it} is a spherical error clustered by census blocks since there might be more than one building released in the same block.

Notice that specification (1) represents essentially the *difference-in-difference* approach except that it is slightly more cumbersome because the treatment variable (τ_i) is continuous. To better understand this (crucial) variable one has to keep in mind that it defines the counter factual in a subtle way. It gives the average tax rate of the

property even before progressivity was implemented as if progressivity was implemented. In other words, a property that worth 25 thousand in 2001 would have τ_i =0.8 although this property would be paying 1% at that point. With this strategy we construct a continuous of treatment groups. If the property average rate is bellow 1% the treatment variable will be negative; if it is above 1% the treatment variable will be positive. To make it clearer, let us compare the change in price for a property that got exempt after progressivity was implemented with the change in price for a property that (theoretically) is paying 1% in average. Formally we are comparing the following:

$$E[\ln(p_{it})/y_t=1;\ \tau_i=-1;\ \boldsymbol{X}_{it};\ \boldsymbol{H}_{it}] - E[\ln(p_{it})/y_t=0;\ \tau_i=-1;\ \boldsymbol{X}_{it};\ \boldsymbol{H}_{it}]$$

$$-\{E[\ln(p_{it})/y_t=1;\ \tau_i=0;\ \boldsymbol{X}_{it};\ \boldsymbol{H}_{it}] - E[\ln(p_{it})/y_t=0;\ \tau_i=0;\ \boldsymbol{X}_{it};\ \boldsymbol{H}_{it}]\} = -\delta_3 \qquad (2)$$

Where E[•] is the expectancy operator. Because the (uniform) tax rate before progressivity was implemented was set at 1%, properties that were still paying 1% are our "traditional" control group and that is the reason why we take off one from the (100 times) tax rate. This is a strategy for keeping the treatment equal to zero to this hypothetical control group. Since the tax rate is not discontinuous, except for the exempt group (compared to the 0.8% group) there are very few properties that actually stayed at 1% (a property with cadastral value identical to R$150 thousand would be the only case). But this is not an issue. What the expected values on (2) are showing is that $-\delta_3$ estimates the percentage price change due to capitalization (from a 1% decrease in tax) even if there is no property paying exactly 1% tax rate.

The expectancy calculated in (2) is important to interpret the magnitude of δ_3. To understand it better let us call p_{11} the price of an apartment after the tax reform that was exempt; p_{10} the price of an apartment before the tax reform that would be exempt; p_{01} the price of an apartment after the tax reform that has an average tax rate equals to 1% and; p_{00} the price of an apartment before the tax reform that has an average tax rate equals to 1%. Assuming that:

$$\{p_{it},\ y_t,\ \tau_i/\boldsymbol{X}_{it};\ \boldsymbol{H}_{it}\} \text{ are independent} \qquad (3)$$

we can write (2) as:

$$E[\ln\{(p_{11}/p_{10})/(p_{01}/p_{00})\}/\boldsymbol{X}_{it};\ \boldsymbol{H}_{it}] = -\delta_3 \rightarrow E[(p_{11}/p_{10})/(p_{01}/p_{00})/\boldsymbol{X}_{it};\ \boldsymbol{H}_{it}] = \exp\{-\delta_3\} \qquad (2')$$

So, the neperian exponential of $-\delta_3$ is the expected value of the relation between (one plus) the change in price for apartments exempt and (one plus) the change in price for apartments taxed at 1%. We can interpret it as the additional percent change in price associated with a 1% reduction in tax. Considering the hypothesis of independency (3) the price change in apartments exempt in excess to the price change in apartments at 1% rate might be caused by the tax reform[4]. Consequently,

[4] Typically the causal effect in a difference-in-difference framework would be given by the change in the treatment group minus the change in the control group. In the notation proposed above, this would mean: $[p_{11}- p_{10}-(p_{01}- p_{00})]$. We are measuring a "composed" impact compared to a "simple" impact that is the usual measure in this framework.

if exp{-δ_3}=1.01, we would have full capitalization. So we can identify (and measure) capitalization with specification (1).

The advantage of using a continuous treatment is that we compare all groups simultaneously. We can think about this treatment variable as measuring the intensity of treatment. As it gets more negative (down to -1) the higher will be the treatment. As it gets more positive (up to 0.6) the lower will be the treatment. An analogy would be with the doses of a medicine. The result using a continuous treatment is more trustable since there might be a continuous difference in housing demand and supply to confound the impact we are observing with something that was happening in time. Batista (2014), comparing the brackets as if they were discontinuous, found evidence of capitalization, but, in this case, it is possible that there was a difference by income group since low-income classes increased their income at a faster rate than high-income classes in the last 15 years.

The main point of this empirical strategy is the assumption of conditional independence in (3). Although this is not so demanding as in Wales and Wiens (1974) or King (1977) because of the difference-in-difference specification adopted in this paper, it is still possible that we may be confounding our results with some other phenomenon. When we use the difference-in-difference we are automatically correcting for factors that are not changing over time. However it is still possible that some elements were changing over time exactly at the same time that the tax reform was implemented.

The second point to be noticed is assumption (3) is that we are claiming conditional independence. Conditional independence is almost always true: if you can control for all other sources of variation the relation between dependent and independent variable might be the causal effect of the later on the former. The problem is controlling for all sources of variation. More technically, we are worried about variables that would impact differently the groups with the same timing as the property tax reform.

So, it is very important which variables we use to control. If we do not consider a variable that is correlated to housing price and simultaneously to the group and timing, our estimation would be biased. Compared to cross section estimation we do not have to worry with variables that are correlated to housing prices and groups if it is not correlated with the timing of the tax reform. By the same token, we do not have to worry with variables that are correlated with housing prices and the tax reform timing but are not correlated with the groups. In this sense we are better off than we would be using time series. But there are still some variables that might be correlated with the three key variables in the model and we should attempt to control for those sources of bias in the estimation. We can also control for variables that are just correlated with prices to reduce the variance of the estimator. Table 3 presents a list of the control variables chosen in this study.

Table 3: List of Control Variables

Variables	Description
Rooms	Number of rooms of the apartment
Garage	Number of Garages available for each apartment
Elevator	A dummy equal to 1 if the building has one or more elevators
Common Area	The common area of the building (in m²)
Floor Area	The floor area of the apartment (in m²)
CBD Distance	The (log of) distance from the building to the Center Business District
CEPAC Area	A dummy equal to 1 if there was a public intervention nearby
Local Income	Average income in the Census Block
Rail Station	A dummy equal to 1 if, on the launch year, there was a rail station nearby
Density	Density in the Census Block
Price System	A dummy equal to 1 if the price is defined by building costs
Interest Rate	The SELIC rate at the time that the building was launched
GDP growth	The PIB growth of the previous trimester of building launch

The number of rooms, parking spots, elevators floor area, and distance to the CBD evidently affect housing prices and do not need to be further clarified. Common area includes all building area for common use, such as ballrooms, pools, halls etc. It is also straightforward that this variable affect price. It is not clear if those variables are connected to the group and simultaneously to the tax reform timing. However we kept them to increase the precision of the estimates.

The distance from the Center of Business District is a classical variable in property prices studies. For this, we use the intersection between Bandeirantes Avenue and Marginal Pinheiros where the property price is the highest in the metropolitan area (Biderman, 2001)[5]. Regarding the Urban Operation Consortium variable, we refer ourselves to the regions where, after 2004, have received a large investment through the sale of building rights. Biderman, Sandroni and Smolka (2006) show that prices on this perimeter and their boundaries have increased faster than average prices in São Paulo City. So, this variable is certainly correlated with price and timing and it is likely to be correlated with groups since this an area concentrated in the high end of the market.

“Local Income” is the average per capita income of all the families living in the census block where the building is located. This is connected to the groups and may be connected to housing price if there is segregation or if it is a proxy for building quality. Density usually reduces price and is correlated with the groups as well. We are not sure if those two demographic variables are connected to the timing of the tax reform or not.

[5] The CBD is often designed as been the place where the property prices (and, thus, the income) are the highest in the city. See the Alonso-Muth-Mills model (1964). We also have tried our regressions using Praça da Sé (zero ground for São Paulo) and the middle of the Paulista Avenue – another focus of business activity – and the results were almost identical.

The Rail System dummy is equal to one if, on a 1 Km radius, there is a subway or commuter rail station at the time the building was released. It is well known that the proximity to stations impact housing prices. The “Cost System” consists in a specific model of housing sale where the buyer agrees to pay by the construction cost of the apartment. Usually it results in a sharply cheaper price. Once again we have no idea if those variables are correlated to groups or the tax reform timing.

Finally, we have basic macroeconomic variables: GDP growth in the last trimester previous to the building release and reference interest rate (SELIC), released by the Central Bank of Brazil. Those variables change in time exclusively and, consequently, they also work as trend variables. This is important since those variables may avoid us to confound the impact of the tax reform with a macroeconomic trend.

Results

Table 4 presents the estimation of capitalization due to a 1% decrease in the tax rate for four different specifications. We start with a basic model just estimating the impact with no controls and then gradually we add controls. Detailed results are presented in the appendix on Table A1. We report $\exp\{-\delta_3\} - 1$ since this is the percentage change in price due to a 1% decrease in taxes as discussed in the previous section and presented in (2´).

It is clear that not controlling for other variables bias the results overestimating capitalization. On the other hand, after controlling for building and location attributes the capitalization estimated is quite stable around 20%. The coefficient of interest is always significant at 0.1%. We have to be careful in interpreting this magnitude. Reducing the tax rate in 1% means that the owner will not have to pay 1% every year forever. Consequently, the tax exemption is like wining a perpetuity that worth 1% of the property value. As it is well known, the present value of a perpetuity is its face value over the interest rate. Consequently, assuming that our estimation is correct, to have full capitalization, the market would be discounting the value of the exemption at 5% per year.

Table 4: Capitalization estimated (%) for different specifications

Results for different specifications	**Specification Model**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Capitalization	48%***	20%***	19%***	21%***	20%***
Building/Location Attributes	No	Yes	Yes	Yes	Yes
Neighborhood Attributes	No	No	Yes	Yes	Yes
Demographic Attributes	No	No	No	Yes	Yes
Macroeconomic variables	No	No	No	No	Yes

** p<0.05, ** p<0.01, *** p<0.001*

Source: *Embraesp, São Paulo Cadastral Office and IBGE*

The capitalization estimated is reasonable[6] except that the cadastral value is often below the market value and our estimation use market value. It is possible that the cadastral value is more precise for new apartments and our sample has just new apartments as discussed before. However, in this case, the buyer would be not taking into account that the real value of property tax will go down in time so we would need to add an hypothesis of monetary illusion. It is also possible that we are overestimating the impact of the tax reform on property prices.

If our estimation is still biased is a major issue and we have to attempt to improve it. This is important because we are not only worried about the significance of the tax rate on housing prices but we are also concerned about the size of capitalization. Full capitalization has consequences for policy that are not the same as partial capitalization. Furthermore, even the significance may depend on the magnitude of the coefficient. If the standard deviation estimated for δ_3 (see Table A.1) is constant, a magnitude of δ_3 bellow 0.035 in absolute terms would imply that the coefficient is not significant (at 5%). The next section deals with this possibility attempting to see how robust our results are.

Robustness Check

We adopt two strategies to check the robustness of our results. The first one is using a shorter term of analysis. So we run regressions using specification (5) above reducing the years covered by our sample getting closer to the tax reform year. We were inspired by Regression Discontinuity Design (RDD) in the sense that we are getting closer and closer to the discontinuity point (before and after the tax reform). Table 5 shows the capitalization estimated for different periods.

As we reduce the sample the precision diminishes, as expected. This is the traditional tradeoff between precision and bias that exists in a RDD framework. At the same time the magnitude is reduced threefold. Looking at Table A.2 it is possible to see that if the standard deviation was constant, capitalization would be significant at 5% even constricting the sample just to two years (before and after the tax reform). It means that we are more convinced that there is indeed capitalization from the property tax into housing prices.

Table 5: Capitalization estimated (%) for different periods

Results	Period Analyzed					
	1996-2007	1997-2006	1998-2005	1999-2004	2000-2003	2001-2002
Capitalization	21%***	19%***	16%***	12%***	8%**	6%

** p<0.05, ** p<0.01, *** p<0.001*

Source: *Embraesp, São Paulo Cadastral Office and IBGE*

On the other hand, the magnitude is going down as we constrain the sample. There are two possible interpretations for that result. The first is that we were overestimating the magnitude of capitalization. In other words, we were confounding

[6] Quang Do and Sirmans (1994) estimate the discount rate for tax capitalization in California to be around 8% but other studies quoted in this paper such as Yinger et al (1988) inter alia, assume the discount rate to be between 3 and 6%.

capitalization with some other phenomenon that was happening in time and our control variables were not able to catch such element. The second interpretation is that buyers were not totally convinced that progressivity would stay for a long time. As a matter of fact there were some legal disputes over progressivity in the beginning. As courts were accepting progressivity, it was probably more credible and households incorporate it as perpetuity. It makes sense also that households would be more positive about progressivity after 2005 since there was a change in the mayor party administration and the property tax term was not changed.

Table 6: Capitalization estimated (%) using placebo for the tax reform year

Control Variables	Specification Model				
	(1)	(2)	(3)	(4)	(5)
Capitalization	21%***	12%***	11%***	10%***	10%***
Building/Location Attributes	No	Yes	Yes	Yes	Yes
Neighborhood Attributes	No	No	Yes	Yes	Yes
Demographic Attributes	No	No	No	Yes	Yes
Macroeconomic variables	No	No	No	No	Yes

** p<0.05, ** p<0.01, *** p<0.001*

Source: *Embraesp, São Paulo Cadastral Office and IBGE*

The problem with the second interpretation is that this robustness test might be questioned. If it is correct that households were not positive that progressivity would prevail, results on Table 5 would be underestimating capitalization. In other words, we would be confounding capitalization with households' expectancy. So we need another way to check for the robustness of our results. The second strategy adopted was using a placebo for the date of the tax reform. We constrain our sample to the period between 1995 and 2001 and define 1998 as the "fake" year of the tax reform. We run regressions with the 5 specifications used before. Table 6 presents the results.

The results from this placebo analysis reveal that we are probably over estimating capitalization using the empirical strategy proposed in this paper. The property tax rate was uniform in the period analyzed and we can find significant impacts on housing prices. So, there is likely some process happening in time, not observable by us, that we are confounding with capitalization due to property tax. The robustness tests make us less confident with our previous results.

On the other hand, the magnitude of the impact is much lower, about half of the magnitude found using the real date of the tax reform. If we assume that the non observable element that is confounding our estimations is captured by the placebo regression, we could speculate that capitalization can be measured by our previous estimation less the placebo estimation. In other words, the placebo estimation would be measuring the bias in our estimator. In this case capitalization would be around 10% what is more reasonable than 20% estimated before.

Conclusions

In this paper we explore an opportunity to identify if property tax capitalize into housing prices. In São Paulo City the property tax was reformed in 2001 (effective on 2002) changing from uniform to progressive rate. It is a good identification opportunity because there is no reason to believe that the change in the tax structure was connected to local expenditure. In other words, there is no reason to believe that at the same time expenditures were changed in terms of income groups. So, in theory, we do not face the traditional problem of identification: it is not possible to decompose the effect on housing prices from the change in taxes and the effect from the change in expenditure (Yinger et al, 1988).

The analysis adapts the difference-in-difference approach using a continuous treatment variable. We need to adopt such a strategy because the change in the tax rate was not continuous except for the lowest brackets. Part of the properties was exempt and another part reduced their rate from 1% to 0.8%. For rates above 0.8% the average rate increases continuously although the marginal rate changes in steps (up to 1.6%).

We could have analyzed just the first two brackets comparing properties that were exempt with properties that reduced the tax rate to 0.8% and use the more traditional difference-in-difference approach with a control group and a treatment group. However the idea of using a continuous treatment is attractive since it is more unlikely that something would be happening in time for each different group that would lead us to confound the impact from the tax reform with something not observable by us. However, we have to keep in mind that those two groups in the first brackets will have a larger weight on the estimation because 1. they represent 58% of the sample (see Table 2) and 2. The difference in the rate is more pronounced for the exempt group.

Proceeding with the econometric approach we found strong evidence of capitalization of the property tax on housing prices. The coefficient are highly significant and the magnitude very large. The later was a bit of a problem because it seemed too high to us. Our estimations pointed to a 20% capitalization for a 1% reduction in tax. This magnitude is compatible with full capitalization discounted at 5% real rate. This is a reasonable discount factor except that cadastral values are usually well below market value in São Paulo City. So, we were not very confident with our results.

Testing for robustness of our results revealed that we have indeed to be careful with them. Constraining the sample to years closer to the tax reform reveals capitalization going down as we reduce the sample. This was a first sign that we might be overestimating capitalization. Using a placebo for the year of the reform reinforce our feeling that our estimate was biased. The placebo did affect housing price something that shows that we may be confounding the impact of changing property tax with something else that we were not able to observe. However, the placebo impact was much lower than the impact of the real reform. This result makes us believe that there might be a capitalization effect lower than originally estimated but significant.

Assuming that there is capitalization, the welfare gain of the poor with progressivity is debatable. A family that does not own its house is probably worse off with exemption than with the uniform rate. This family will have to pay in advance, let us say, 10% more for the house instead of paying a equivalent perpetuity. Even in a world with no credit restriction there is no loan that will have to be repaid in such a long term. It is true that a loan with a 30 years term is similar to perpetuity. But we do not live in credit-unconstrained word. This is actually the main problem in social housing, the lack of credit for low-income households. Even ambitious programs such as Minha Casa Minha Vida are facing big problems to reach the very poor. So, exemptions in property tax may hurt the very group it is intending to benefit.

The difficulty in reversing this policy is that in Brazil (and São Paulo is not an exception), 75% of the households declare to live in their own house. This proportion is more or less uniform for any income class. So, Brazil is country of landowners. From a landowner perspective, she gained 10% in wealth with the exemption. So, progressivity in property tax may be hurting poor tenants and those families attempting to enter the real estate market but those are the minority even among the poor.

There are two interrelated problems with this way of reasoning. The first is that declaring to live in their own house does not mean that the family has a tile of the land. Actually a considerable part of the poor declaring to live in their own house, live in an informal settlement. Households living in informal settlements in theory are not enforced to pay property taxes although there are some anecdotes about households that do not have a title but yet pay property taxes. If this group does not pay taxes they are not affected by progressivity and consequently gain nothing from the policy. Second, although poor families attempting to enter the housing market may be the minority, those families will be forced into the informal market if the formal market price has increased. Consequently exemption may be contributing to the growth of informal settlements exactly those that do not benefit from the policy.

In short, with significant capitalization it is difficult to believe that progressivity in property tax is a sound policy. Notice that we have not considered the dead weight loss connected to the substitution effect for the group that had its (marginal) tax rate increased (and for the substitution effect the relevant tax is the marginal). The possible benefit for equality is simply vanished with capitalization. Actually it may be even worse for the poor. So, with capitalization, progressivity might be perverse. Local governments might be aware of these facts before deciding to reform their property tax structure.

References

Alonso, W. “Location and Land Use.” *Journal of Public Economics*, 1964.

Angrist, J., e J-S Pischke. *Mostly Harmless Econometrics.* Princeton University Press, 2008.

Bai, ChongEn, Qi Li, e Min Ouyang. “Property Taxes and Home Prices: A Tale of Two Cities.” *Waterloo University Website.* Outubro de 2012. https://uwaterloo.ca/economics/sites/ca.economics/files/uploads/files/QiLi2012.pdf.

Biderman, Ciro. *Forças de Atração e Expulsão na Grande São Paulo.* São Paulo: Tese de Doutorado Apresentada ao Curso de Pós-Graduação da EESP/FGV, 2001.

Biderman, Ciro, Paulo Sandroni, e Martim O. Smolka. "Large-scale Urban Interventions." *Lincoln Institute of Land Policy Land Lines*, 2006.

Borrero, Oscar, e Carlos Morales Schechinger. "Impacts of Regulations on Undeveloped Land Prices: A Case study of Bogotá." *Lincoln Institute of Land Policy Land Lines*, Outubro de 2007.

Chinloy, P. "Effective Property Taxes and Tax Capitalization." *The Canadian Journal of Economics*, 1978.

Church, A. M. "Capitalization of the Effective Property Tax Rate on Single Family Residences." *National Tax Journal*, 1974.

Dusansky, R., Melvin I., e N. Karatjas. "The Impact of Property Taxation on Housing Values and Rents." *Journal of Urban Economics*, 1981.

Glaeser, E. *Cities, Agglomeration and Spatial Equilibrium.* Oxford, The Lindahl Lectures., 2008.

Glaeser, E., e A. Warda. "The causes and consequences of land use regulation: Evidence from Greater Boston." *Journal of Urban Economics*, 2009: 265-278.

Glaeser, E., J. Gyourko, e R. Saks. "Why Have Housing Prices Gone Up?" *Harvard Institute of Economic Research: Discussion Paper Number 2061*, 2005.

Green, R. K. "Land Use Regulation and the Price of Housing in a Suburban Wisconsin County." *Journal of Housing Economics*, 1999: 144-159.

King,. "Estimating Property Tax Capitalization." *Journal of Political Economy*, 1977.

Lall, S. V, H. G. Wang, e D. Mata. "Do urban land regulations influence slum formation?" *Journal of Housing Economics*, 2006.

McCann, P. *Urban and Regional Economics.* New York: Oxford University Press, 2001.

Oates, W. "The Effect of Property Taxes and Local Public Spending on Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hypothesis." *Journal of Political Economy*, 1969.

—. "The Effects of Property Taxes and Local Public Spending on Property Values: A Reply and Yet Further Results." *Journal of Political Economy*, Agosto de 1973.

Quang Do, A. and C.F. Sirmans "Residential Property Tax Capitalization: Discount Rate Evidence from California". *National Tax Journal*, 1994.

Palmon, Oded, e Barton Smith. "A New Approach for identifying the Parameters of a Tax Capitalization Model." *Journal of Urban Economics*, 1998.

Pollakowski, Henry. “The Effects of Property Taxes ad Local Public Spending on Property Values: A comment and Further Results.” *Journal of Political Economy*, 1973.

Reinhard, Raymond. “Estimating Property Tax Capitalization: a Further Comment.” *Journal of Political Economy*, Dezembro de 1981.

Richardson, David, e Richard Thalheimer. “Measuring the extent of property tax capitalization for single family residences.” *Southern Economic Journal*, 1981.

São Paulo. “Lei Nº13.430 de 13 de setembro de 2002.” s.d.

Schechinger, Carlos Morales. “Elementos Principales para Definir una Política Fiscal del Impuesto a la Propiedad en America Latina.” *Financiamiento de las ciudades latinoamericanas con suelo urbano*, 2004.

—. “Apuntes sobre conceptos desarrolados por Martim Smolka respecto del mercado del suelo y el impuesto a la propriedad en America Latina. Documento de Trabajo.” *Material Apresentado no curso Tributación Inmobiliaria y Financiamiento Urbano do Lincoln Institute of Land Policy*, 2005.

Smolka, Martim. “Informalidad, Pobreza Urbana y Precios de la Tierra.” *Lincoln Institute of Land Policy Land Lines*, Janeiro de 2003.

Smolka, Martim, e Claudia de Cesare. “El impuesto predial y la propiedad informal: El desafío de las ciudades del Tercer Mundo Martím.” *Lincoln Institute of Land Policy Land Lines*, 2010.

Stull, William, e Judith Stull. “Capitalization of Local Income Taxes.” *Journal of Urban Economics*, 1988.

Tiebout, Charles. “A Pure Theory of Local Expenditures.” *Journal of Political Economy*, 1956: 416-424.

Wales, T., e E. Wiens. “Capitalization of Residential Property Taxes: An Empirical Study.” *The Review of Economics and Statistics*, 1974.

Apendix: Detailed results from regressions

Table A1: Detailed Regression Results for Different Specifications

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	b/se	b/se	b/se	b/se	b/se
δ_3	-0.392***	-0.180***	-0.177***	-0.189***	-0.186***
	(0.034)	(0.017)	(0.017)	(0.018)	(0.018)
δ_2	-1.284***	-0.503***	-0.420***	-0.415***	-0.423***
	(0.025)	(0.015)	(0.015)	(0.015)	(0.015)
δ_1	0.059**	-0.096***	-0.090***	-0.081***	-0.040***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.012)
Room		0.246***	0.145***	0.145***	0.145***
		(0.005)	(0.006)	(0.006)	(0.006)
Floor Area		0.004***	0.003***	0.003***	0.003***
		0	0	0	0
Distance to CBD		-0.195***	-0.172***	-0.178***	-0.172***
		(0.007)	(0.007)	(0.007)	(0.007)
Price System		-0.023	-0.120***	-0.121***	-0.123***
		(0.02)	(0.019)	(0.019)	(0.019)
Garages			0.237***	0.235***	0.233***
			(0.007)	(0.007)	(0.007)
Common Area			-0.000**	-0.000**	-0.000***
			0	0	0
Elevator			0.271***	0.272***	0.264***
			(0.02)	(0.02)	(0.02)
CEPAC Area				-0.093***	-0.079***
				(0.019)	(0.019)
Rail Station				0.017	0.021
				-0.013	-0.013
Density				0	0
				0	0
National Interest Rate					0.006***
					(0.001)
National GDB growth					0.024
					(0.091)
Constant	13.444***	12.375***	12.017***	12.045***	11.902***
	-0.016	-0.018	-0.027	-0.03	-0.036
R-sqr	0.561	0.894	0.911	0.911	0.912
N	6562	6558	5349	5346	5344
BIC	11721.3	2423	843.9	843	815.3

** p<0.05, ** p<0.01, *** p<0.001*

Source: *Embraesp, São Paulo Cadastral Office and IBGE*

Table A2: Detailed Regression Results for Different Samples

Variables	1996-2007	1997-2006	1998-2005	1999-2004	2000-2003	2001-2002
	b/se	b/se	b/se	b/se	b/se	b/se
δ_3	-0.188***	-0.176***	-0.145***	-0.109***	-0.075**	-0.055
	(0.017)	(0.019)	(0.02)	(0.022)	(0.026)	(0.038)
δ_2	-0.429***	-0.431***	-0.425***	-0.485***	-0.509***	-0.576***
	(0.015)	(0.017)	(0.019)	(0.021)	(0.025)	(0.037)
δ_1	-0.036**	-0.021	-0.027*	-0.01	0.049*	
	(0.012)	(0.013)	(0.013)	(0.014)	(0.025)	
Room	0.173***	0.167***	0.150***	0.149***	0.136***	0.155***
	(0.006)	(0.007)	(0.007)	(0.008)	(0.01)	(0.014)
Floor Area	0.003***	0.002***	0.003***	0.003***	0.003***	0.003***
	0	0	0	0	0	0
CBD Distance	-0.203***	-0.215***	-0.211***	-0.204***	-0.192***	-0.169***
	(0.007)	(0.008)	(0.009)	(0.01	(0.012	(0.019
Price System	-0.104***	-0.080***	-0.095***	-0.111***	-0.091*	-0.109*
	(0.02)	(0.023)	(0.024)	(0.028)	(0.036)	(0.054)
Garages	0.195***	0.205***	0.162***	0.147***	0.161***	0.136***
	(0.007)	(0.007)	(0.008)	(0.009)	(0.012)	(0.018)
Common Area	0.000***	0.000**	0.001***	0.001***	0.001***	0.001***
	0	0	0	0	0	0
Density	0	-0.000*	0	0	-0.000**	0
	0	0	0	0	0	0
Rail Station	0.019	0.009	0.014	0.007	0.017	0.032
	(0.014)	(0.015)	(0.016)	(0.018)	(0.022)	(0.033)
CEPAC Area	-0.073***	-0.135***	-0.120***	(omitted)		
	(0.02)	(0.024)	(0.034)			
Interest Rate	0.006***	0.008***	0.007***	0.004**	-0.015**	0.008
	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)	(0.013)
GDB growth	0.027	0.042	0.115	0.22	0.182	0.356
	(0.091)	(0.102)	(0.109)	(0.124)	(0.151)	(0.216)
constant	12.187***	12.168***	12.193***	12.293***	12.640***	12.157***
	-0.031	-0.035	-0.036	-0.041	-0.092	-0.253
R-sqr	0.912	0.913	0.922	0.924	0.925	0.932
N	5536	4480	3578	2772	1895	894
BIC	1238.3	1146.9	611.6	519.2	387	191.7

** p<0.05, ** p<0.01, *** p<0.001*

Source: *Embraesp, São Paulo Cadastral Office and IBGE*

Table A3: Detailed Regression Results for Different Specifications Restricting the Sample to Years Before the Tax Reform (1995-2002) and Placebo for the Tax Reform Year (1998)

	Model 1	Model 2	Model 3	Model 4	Model 5
	b/se	b/se	b/se	b/se	b/se
δ_3	-0.188***	-0.114***	-0.101***	-0.096***	-0.094***
	-0.047	-0.023	-0.022	-0.022	-0.021
δ_2	-1.178***	-0.482***	-0.379***	-0.380***	-0.380***
	-0.035	-0.02	-0.019	-0.019	-0.019
δ_1	-0.017	-0.053***	-0.074***	-0.080***	-0.053***
	-0.03	-0.015	-0.013	-0.014	-0.014
Room		0.204***	0.119***	0.120***	0.117***
		-0.008	-0.008	-0.008	-0.008
Floor Area		0.005***	0.003***	0.003***	0.003***
		0	0	0	0
CBD Distance		-0.127***	-0.114***	-0.112***	-0.111***
		-0.01	-0.009	-0.009	-0.009
Price System		-0.071**	-0.124***	-0.125***	-0.132***
		-0.025	-0.023	-0.023	-0.023
Garage			0.186***	0.186***	0.188***
			-0.011	-0.011	-0.011
Common Area			0.001***	0.001***	0.001***
			0	0	0
Elevator			0.365***	0.364***	0.356***
			-0.03	-0.029	-0.029
Rail Station				0.060*	0.068**
				-0.026	-0.026
Density				0	0
				0	0
GDP Growth					-0.088
					-0.117
Interest Rate					0.009***
					-0.001
constant	13.452***	12.336***	11.881***	11.883***	11.659***
	-0.022	-0.025	-0.038	-0.041	-0.049
R-sqr	0.515	0.887	0.911	0.911	0.913
dfres	2846	2842	2519	2517	2515
BIC	4690.7	563.2	-162.3	-152.2	-198.5

Source: *Embraesp, São Paulo Cadastral Office and IBGE*