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Redevelopment Option Value for Commercial Real Estate

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Abstract

We analyze the impact of the redevelopment potential on commercial real estate transaction prices. First, using a probit model, we compute the fitted redevelopment potential. This potential is primarily determined by the difference in net operating income (NOI) per square foot of land (sql) to the potential highest and best use (HBU) of the property. This difference reflects the economic obsolescence of a property. Second, we run a 2SLS model with the fitted redevelopment potential as an instrument for the redevelopment dummy. We find that having a 100 percent redevelopment potential increases the property's price by nine to 17 percent.

Key words: Probability of redevelopment, Real Estate Pricing, Competing Risk.

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1. Introduction

Land is a fundamental input in production and store of wealth of a country. Land values are critical to understanding the development of urban economies, and they are an essential source of revenue for local governments. Therefore, it is imperative to advance our knowledge of what constitutes land values. Location, characteristics, and the redevelopment option value determine the land value. However, the latter is often disregarded. The redevelopment option value is the option, without obligation, of changing the use of land and the physical structure built on that land to the highest and best use (HBU). Thus, the redevelopment potential affects property prices and plays a crucial role in how cities evolve.

In this study, we investigate the impact of the *redevelopment potential* on the individual value of commercial real estate properties within more than 30 American cities. We proceed as follows. Using Real Capital Analytics (RCA) data, we first measure the redevelopment potential as the stated intention by buyers to buy a property for redevelopment. To deal with the potential reverse causality bias between redevelopment potential and transaction prices, we instrument the redevelopment dummy with the fitted redevelopment potential. In the next step, we thus run a probit model to predict the redevelopment potential of a given property. We find that the difference between the current net operating income (NOI) per square foot of land (sfl) and the one associated with the potential highest and best use (HBU) of the property is a strong predictor of the redevelopment potential. Finally, we determine the impact of the redevelopment potential on transaction prices. Results show that having a 100 percent redevelopment potential increases the property's price by nine to 17 percent.

Because the choice to redevelop by investors mimics an American call option[1], it can be analyzed in an option pricing framework. Titman (1985) uses the real options approach to develop a simple equation for pricing vacant land. He shows that under uncertainty about the optimal future building intensity, it is often beneficial to delay investment and maintain the option to develop in the future. This is because the development call option is a

[1] An American option can be exercised at any time up to the maturity date, whereas a European option can only be exercised at maturity.

levered derivative of the HBU, and this makes it very volatile. By applying a real option-pricing model to real estate development, Williams (1991) shows that the optimal date and intensity at which to develop a property depends on the uncertain future revenues it generates and on its costs of development. Quigg (1993) is the first study to assess the empirical validity of the real option-pricing model in the case of real estate assets. Using data on land transactions for Seattle, she finds that investors are willing to pay a six percent price premium for plots of land having a development option. Using a similar framework, Grovenstein et al. (2011) theoretically and empirically determine the real option values of development and delay for vacant land in the City of Chicago. They find that the magnitude of the option premium varies substantially across individual land-use types.

Clapp and Salavei (2010), Clapp et al. (2012a), and Clapp et al. (2012b) devise a smart technique to estimate the redevelopment option value within the standard hedonic framework developed by Rosen (1974). They do that by adding the call option to the net present value of a property and using a measure of development intensity as a proxy for the redevelopment option value.[2] With this approach, the redevelopment option value is separated from the value of the property in its current use. However, both values are related to the characteristics of the property. For example, the present value of the property in its current use decreases with age, but its redevelopment option value increases with age. The authors also point out that the quantity of structural capital increases the value of the property in its current use but decreases the redevelopment option value. In contrast, McMillen and O'Sullivan (2013) find that under uncertainty over the future price of structural capital, the redevelopment option value may increase with the quantity of structural capital.

Munneke and Womack (2018) estimate the redevelopment option value by introducing the probability of redevelopment into the hedonic model. More specifically, they estimate the probability of redevelopment with a probit model and include it as an explanatory variable in a hedonic regression. The

[2]As intensity measures the authors use the maximum floor space allowed minus the floor space already built, lagged assessed building value divided by assessed land value, and the ratio of the square footage of the property to the square footage of neighboring new constructions.

authors find that location is a significant determinant of redevelopment and that the redevelopment option values vary substantially across space.

We contribute to the literature in several ways. First, we estimate the redevelopment option value using a novel strategy relying on three different proxies for redevelopment. These proxies are the difference in NOI, floor-to-area ratio (FAR), and property type to those of surrounding properties developed at the HBU. Second, using these proxies, we investigate the determinants leading investors to buy a property for redevelopment. Third, we examine *renovations* as a competing risk to redevelopments. This helps us document the differences in depreciation channels of a property. Finally, we fill the existing gap in studies analyzing the redevelopment option value for commercial real estate. In doing so, we differentiate between residential, office, retail, and industrial properties.

The remainder of the paper is structured as follows. Section 2 illustrates the conceptual framework for the valuation of redevelopment options. Section 3 presents the empirical methodology and discuses the identifying assumptions. Section 4 describes the rich data on commercial real estate and the construction of the proxy variables. Section 5 analyzes the results for the different estimation models and Section 6 concludes.

2. Conceptual framework

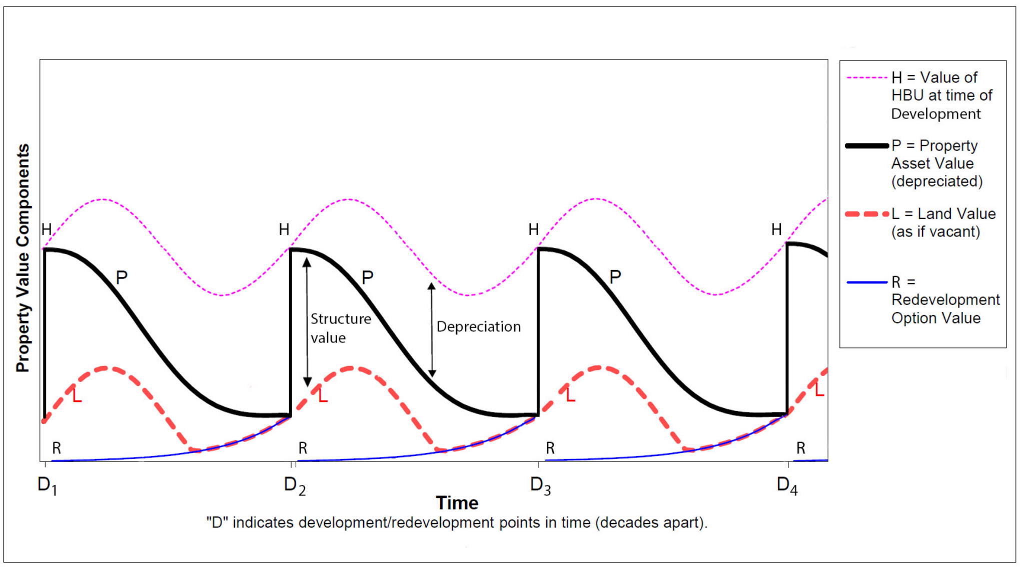
In this section, we lay out the fundamental mechanisms behind the valuation of redevelopment options. Figure 1 illustrates how the redevelopment option value is linked to land and property values over several real estate cycles. The horizontal axis shows the time, and the vertical axis shows the value of the property's components. At the points indicated by "D," the property is (re)developed. Each time this implies a large investment of capital to build a physical structure on a given plot of land.

As Geltner et al. (2014) persuasively show with a real option value model, land is always developed or redeveloped at its HBU as-if-vacant. In other words, the developer builds the most profitable structure possible for that location at that point in time.[3] The dotted pink line "H" shows the HBU

[3] Note that the developer takes the construction and demolition costs into account.

value over time. This value depends on the location's surroundings, secular trends, and capital flows that affect the property value. In our stylized figure, the fluctuations in H represent the volatility and cyclicality in the real estate market.

Figure 1: Property and location value components over time



This figure is based on Figure 1 from Geltner et al. (2018)

The solid black line "P" depicts the property asset value. This is the value the property would sell for in a well-functioning market. The dashed red line "L" illustrates the land value as if it were vacant. Following the residual theory of land value, this must equal the value of current HBU minus the cost of the physical structure required to attain this HBU.[4] The jumps in the property asset value at times D reflects the investment of financial capital to develop or redevelop the physical structure.

Over time, the property depreciates due to physical, functional, and/or economic obsolescence. Physical obsolescence refers to the physical wear down of property, e.g., the chipping or fading of the paint. Functional ob-

[4]In this figure, we assume that the construction costs remains approximately constant over time.

solescence refers to changes in technology, tastes, and user requirements, e.g., building's sustainability has become increasingly important. Lastly, economic obsolescence refers to the case when the building's structure is no longer suitable to the HBU, and therefore is the wrong type. As pointed out by Geltner et al. (2018), this last type of obsolescence reflects the redevelopment option value.[5] When the value of the existing structure and land is equal (or less) to the value of vacant land and the demolition costs, the property is redeveloped. Brueckner (1980) and Wheaton (1982) outline this discernment theoretically.[6]

The solid blue line "R" shows the redevelopment option value. Note that the redevelopment option value is not a separate asset or legal claim, but it is embedded in the land value. This call option can be exercised at any time upon payment of the physical structure to attain the HBU. The strike price of the redevelopment call option includes the demolition cost and the opportunity cost of the existing structure. This opportunity cost is the loss in NOI during the redevelopment. Right after a (re)development, the redevelopment option value is very low, because the opportunity cost of the new existing structure is very high. As time elapses and the HBU evolves, the redevelopment option value gets deeper in the money.

3. Empirical analysis

We build on Clapp and Salavei (2010) and express the (log) price per square foot P of a property as a linear function of redevelopment potential r and a vector of market and physical characteristics X:

$$P = \beta_0 + \beta_1 r + \beta_2 X + \epsilon, \tag{1}$$

[5] Note that the redevelopment option value increases, over time, as the building structure depreciates, and the HBU evolves away from the current building structure.

[6] In bust periods, the HBU may be so low that it is not profitable to redevelop. This was the case, e.g., in certain areas in Detroit after the Great Recession. In such cases, the redevelopment option value is zero. The right without obligation of the redevelopment option value means it cannot be negative.

where ϵ is the error term.[7] The sale price P includes the price of land and the value of the existing structure.

To consistently estimate (1) with OLS, the assumption $E[r\epsilon|X] = 0$ must hold. However, the literature tells us that the redevelopment potential r is a function of the price per sf P, implying that OLS estimates are plagued by reverse causality bias. Since, *ceteris paribus*, we expect that a higher price reduces the redevelopment potential, the OLS estimate $\hat{\beta}_{1,OLS}$ is biased downwards.

Typically, reverse causality is dealt with 2SLS models, instrumenting for the endogenous variable. However, we do not observe redevelopment potential r (a continuous variable). We only observe a binary variable r_d indicating whether or not a property was bought to be redeveloped. Since our variable of interest is an **endogenous dummy** (Vytlacil and Yildiz, 2007), we follow Heckman (1978), Angrist and Krueger (2001), and Adams et al. (2009), and employ the following procedure. First, we estimate a probit model of the determinants of redevelopment r_d. The model is given by:

$$Pr(r_d = 1|X, Z) = \Phi(\theta_0 + \theta_1 X + \theta_2 Z + \rho), \tag{2}$$

where $\Phi(.)$ is the cumulative standard normal distribution function, Z defines proxies for the determinants of redevelopment not included in (1), and ρ is the error term. After estimating (2), we derive a continuous redevelopment potential $\hat{r_p}$ by predicting fitted values according to the considered variables.

In the next step, we estimate a 2SLS model using the continuous fitted redevelopment potential $\hat{r_p}$ as an instrument for the redevelopment dummy r_d. More precisely, we estimate the equation

$$P = \beta_0 + \beta_1 r_d + \beta_2 X + \epsilon, \tag{3}$$

where the first stage is given by

$$r_d = \gamma_0 + \gamma_1 \hat{r_p} + \gamma_2 X + \epsilon', \tag{4}$$

where ϵ' is the error term. Our procedure is valid if our proxies Z only affect price P through the redevelopment option value. Note that this is different from just plugging in the fitted potential $\hat{r_p}$ directly into Equation (3) and

[7] We omit property-level subscripts for readability.

running an OLS, i.e., regressing P on $\hat{r_p}$ and X directly. As pointed out by Angrist and Krueger (2001) this could lead to misspecification and inconsistent estimates. Our specification has several advantages. First, the IV standard errors are still asymptotically valid (Kelejian, 1971). Second, we take the nature of the endogenous redevelopment dummy r_d into account. Third, we transform the redevelopment dummy r_d into a continuous redevelopment potential $\hat{r_d}$, which allows us to estimate the redevelopment option value for all the properties according to their characteristics.

4. Data and stylized facts

We rely on RCA georeferenced transaction data on commercial properties from 2001 to 2018. RCA captures over 90 percent of all commercial real estate transactions in the institutional investor space. This unique data set covers more than 30 American cities. It features property characteristics such as sales prices, NOI, size of land, FAR, year of sale, property type, location, and construction year. The data also contains information on the intent of purchase, i.e., whether it is used as an investment, or if the property will be redeveloped (see Bokhari and Geltner (2018)).

First, we split the data into two subsets. The first subset is data on newly developed properties, defined as everything built after 2001. This data is used to construct the proxies Z and is further discussed in Section 4.1. The second subset, are all the properties built before 2001 and is described in this Section. After filtering out extreme values and dropping missing values, we are left with almost 46,000 transactions between 2001 and 2018 of properties built before 2001. Of these nearly 46,000 properties, over five percent were purchased with the intent to be redeveloped, see Table 1. We split our data in 2001 because of two reasons. First, the data covers transaction prices from 2001 onwards. Second, commercial real estate cycles can span decades (Wheaton, 1999).

All data comes directly from RCA, except for the NOI per sfl for the redevelopment properties. In approximately 70 percent of the cases, these properties have either missing or zero NOI, as the properties were already vacated for redevelopment.[8] Given that we are interested in the potential NOI

[8] As is apparent from the data, the structure of properties with missing or zero NOI is

per sfl of the existing structure, we impute the missing and zero NOIs as follows. First, we find the closest ten properties that are not being redeveloped, were built within ten years, were sold within five years, are within five kilometers, and are the same property type as the target property. Subsequently, we impute the weighted average NOI per sfl. The weight is determined by the inverse of the distance to the target property. We use market and property type-specific NOI indexes provided to us by RCA to correct the imputed NOIs if the year of sale of the "comparable" is different from the year of sale of the target property. Note that we only allow for a five-year difference and that we impute the NOI per square foot of **land** (sfl) and not structure. This is because investors want to maximize the income per sfl when they redevelop. The top panel of Table 1 shows descriptive statistics of all the transactions in this data set. The middle panel shows the same descriptive statistics of redevelopment properties, and the bottom panel shows the descriptive statistics of non-redevelopment properties.

Table 1 contains some interesting stylized facts. There are some clear differences between redevelopment properties and non-redevelopment properties. Note that the NOI and sales price per sfl for redevelopment properties are both approximately double the ones for non-redevelopment properties, while the FAR is only slightly larger. The FAR is 0.9 for non-redevelopment properties and 1.2 for redevelopment properties, whereas the NOI is \$12 and \$24 per sfl, respectively. Sales prices per sf are slightly less than double for redevelopment properties (\$390) than for non-redevelopment properties (\$215). Redevelopment properties are, on average, also closer to the central business district (CBD). All of this is consistent with the literature, i.e., redevelopments are triggered by high land values. As expected, the age of redevelopment properties is also higher than for non-redevelopment properties. This is because the redevelopment option value increases with age.

In our estimations, we include matrix X to control for the differences between redevelopment and non-redevelopment properties. This matrix contains the property's current NOI per sfl, which captures most of the unobserved heterogeneity; current $FAR = \frac{\text{Structure size}}{\text{Land size}}$; the property type; the age

still standing. We exclude development sites from the data.

Table 1: **Descriptive statistics of data set**

variable	**mean**	**SD**	**lower 10%**	**higher 90%**
		Full sample (45,732 obs.)		
Redevelopments	0.055	0.227	0.000	0.000
Sales price per square foot of land	$ 225.347	$ 538.199	$ 15.089	$ 525.123
NOI per square foot of land	$ 12.560	$ 28.487	$ 1.190	$ 29.194
Distance to closest CBD (km)	24.464	30.583	5.190	50.056
Age	38.823	23.663	16.000	81.000
Floor area ratio (FAR)	0.940	1.383	0.217	2.410
		Redevelopment properties (2,494 obs.)		
Sales price per square foot of land	$ 389.875	$ 823.417	$ 14.954	$ 980.137
NOI per square foot of land	$ 24.038	$ 45.162	$ 1.576	$ 69.154
Distance to closest CBD (km)	19.217	23.502	2.315	44.855
Age	47.561	26.812	18.000	91.000
Floor area ratio (FAR)	1.232	1.795	0.215	3.232
		Non redeveloped properties (43,238 obs)		
Sales price per square foot of land	$ 215.857	$ 515.385	$ 15.100	$ 504.606
NOI per square foot of land	$ 11.898	$ 27.069	$ 1.174	$ 27.431
Distance to closest CBD (km)	24.767	30.915	5.371	50.290
Age	38.319	23.369	16.000	79.000
Floor area ratio (FAR)	0.923	1.354	0.217	2.350

All data provided to us by Real Capital Analytics (RCA) for the years 2001 until 2018, for properties built before 2001. SD is the standard deviation, lower is the 10^{th} quantile quantile and higher is the 90^{th} quantile. NOI is the Net Operating Income of the property. The floor area ratio is the amount of square foot divided by the square foot of land. CBD is the Central Business District, as defined by RCA. Age is the construction year of a property minus the year sold. The middle panel gives the descriptive statistics of a subset of our full sample (top panel) of redevelopment properties. The bottom panel gives the descriptive statistics of the subset of non-redevelopment properties.

of the property[9]; time dummies; and location dummies. Thus, including X

[9] Note that most of the depreciation is captured by the current NOI of the property. What is left is the deprecation of the capitalization rate. This is sometimes also referred to as the “caprate creep”.

addresses the selection bias.

4.1. Constructing our proxies

As explicated in Section 3 the decision to redevelop is endogenous to the price of the property. To address the reverse causality we construct three proxies for redevelopment (relevance) that only affect prices through an increase in redevelopment potential (exogeneity).

We start by looking at the potential HBU of every property in our data. We construct the HBU, by assessing newly developed properties, making the (non-controversial) assumption, that developers always maximize their profits and thus, built according to the location's HBU. Therefore, we use the sample of newly constructed properties (constructed after 2001) to construct HBU metrics for our target properties (constructed before 2001). Our primary variable of interest is the NOI per sfl of the HBU property. We use this variable to compute the difference between the current (imputed) NOI of the existing structure, and the current (imputed) NOI of the HBU structure. This difference is a perfect proxy, as it is not affected by the property, nor the investor itself. The assumption is that the higher the potential gains of redevelopment, the higher the redevelopment potential.

For every property constructed before 2001 in our data, we match the closest ten newly developed properties (properties constructed after 2001), as long as they are within five kilometers, and are sold and built within five years of the target property's transaction. To compute the potential NOI of these properties, we use the same weighted averaging approach as previously described. We also correct the imputed NOIs of the newly developed properties using the RCA NOI index if their transaction year differs the one of comparable properties. Note that the RCA NOI index are market and property type specific. Our first proxy variable is labeled N, and is defined as;

$$N = \left(\frac{\overline{NOI}^{\text{hbu}}}{\overline{LS}^{\text{hbu}}} \right) - \left(\frac{NOI^{\text{current}}}{LS^{\text{current}}} \right), \tag{5}$$

where LS is the land size. Note that in theory NOI should capture all the characteristics of the property. Thus, the difference in NOI to the HBU is an excellent proxy for redevelopment.

We also construct two additional proxies, which are similar. The first one is related to the FAR of HBU properties. If newly constructed properties have higher densities compared to the target property, the land can achieve higher sales prices. This density proxy is similar to the intensity measures used in previous redevelopment option value literature for single-family housing, see Clapp et al. (2009); Clapp and Salavei (2010); Clapp et al. (2012a) among others. This variable, labeled F, is given by:

$$F = \left(\frac{\overline{SS}^{\text{hbu}}}{\overline{LS}^{\text{hbu}}} \right) - \left(\frac{SS^{\text{current}}}{LS^{\text{current}}} \right), \tag{6}$$

where SS is the structure size.

The second auxiliary proxy compares the type of the property, to the comparable HBU type of properties and takes a value between zero and one. RCA differentiates between four property types: residential, retail, industrial, and office. For example, if the comparable HBU properties are 80 percent residential and 20 percent retail, and the corresponding property is residential, the variable takes the value 0.8. If the corresponding property were retail, the value of the variable would be 0.2. A value of zero (one) for the property type variable indicates that none (all) of the newly developed properties are of the same property type. That is, the higher the value, the less economic obsolete is the property. In this case, we assume that the HBU use of the site can change. All three proxies capture the economic obsolescence channel that reflects the redevelopment option value. Table 2 shows some descriptive statistics of the proxies.

The descriptive statistics in Table 2 give a clear picture. The difference of NOI to the HBU is, on average, \$40 per sfl for redevelopment properties. In contrast, it is only \$20 per sfl for non-redevelopment properties. Note that the magnitude of these differences are large, considering that the average NOI per sfl for the existing (redevelopment) property is \$24 (revisit Table 1). For our FAR variable, we find similar magnitudes. Newly constructed properties have a FAR that is 1.2 higher compared to the existing redevelopment properties, as opposed to “only” 0.5 higher FARs compared to the existing non-redevelopment properties. The descriptive statistics of our property type proxy show that of all the newly built properties, 27 percent (36 percent) are of the same property type as the target redevelopment (non-redevelopment) properties. This indicates that when the HBU property type changes in an area, the amount of redevelopments increase.

Table 2: **Descriptive statistics of our constructed proxies**

variable	**mean**	**SD**	**lower 10%**	**higher 90%**
Full sample (45,732 obs.)				
$N = \left(\frac{NOI^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{NOI^{\text{current}}}{LS^{\text{current}}}\right)$	\$ 22.603	\$ 45.595	\$ 1.014	\$59.186
$F = \left(\frac{SS^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{SS^{\text{current}}}{LS^{\text{current}}}\right)$	0.504	1.511	-0.254	1.651
HBU property type similarity	0.354	0.259	0.000	0.700
Redevelopment properties (2,494 obs.)				
$N = \left(\frac{NOI^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{NOI^{\text{current}}}{LS^{\text{current}}}\right)$	\$ 39.190	\$ 61.628	\$ 1.410	\$ 124.204
$F = \left(\frac{SS^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{SS^{\text{current}}}{LS^{\text{current}}}\right)$	1.207	2.657	-0.298	4.252
HBU property type similarity	0.273	0.249	0.000	0.600
Non redeveloped properties (43,238 obs)				
$N = \left(\frac{NOI^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{NOI^{\text{current}}}{LS^{\text{current}}}\right)$	\$ 21.646	\$ 44.306	\$ 0.997	\$ 55.537
$F = \left(\frac{SS^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{SS^{\text{current}}}{LS^{\text{current}}}\right)$	0.463	1.406	-0.252	1.530
HBU property type similarity	0.359	0.259	0.000	0.700

All variables are the difference between the current existing structures, and the newly constructed HBU (highest and best use) structures. NOI is the net operating income, LS is the land size (in square foot), and SS is the size of the structure (in square foot). The "HBU property type similarity" is computed by looking at what percentage of the HBU properties is the same as the target property. The middle panel gives the descriptive statistics of a subset of our full sample (top panel) of redevelopment properties. The bottom panel gives the descriptive statistics of the subset of non-redevelopment properties.

We argue that our three proxies satisfy the exclusion restriction because these measures epitomize "call options" that only materialize if the property is redeveloped. These proxies do not have a direct effect on prices. The higher the value of these "call options" the higher the redevelopment potential. Thus, they only affect the prices through the redevelopment potential.

5. Results

5.1. Determinants of redevelopment

Table 3 shows the results for our (reduced form) probit Equation (Equation 2).

Table 3: **Probit model: Determinants of redevelopments**

Variable	**(i)**	**(ii)**	**(iii)**
(Intercept)	-2.632***	-2.291***	-2.306***
	(-11.56)	(-10.24)	(-10.06)
$\ln N = \ln\left(\left(\frac{\overline{NOI}^{\text{hbu}}}{\overline{LS}^{\text{hbu}}}\right) - \left(\frac{NOI^{\text{current}}}{LS^{\text{current}}}\right)\right)$	0.037***		0.003
	(4.20)		(0.30)
$\ln F = \ln\left(\left(\frac{\overline{SS}^{\text{hbu}}}{\overline{LS}^{\text{hbu}}}\right) - \left(\frac{SS^{\text{current}}}{LS^{\text{current}}}\right)\right)$		0.091***	0.090***
		(10.06)	(9.19)
HBU property type similarity		-0.681***	-0.681***
		(-14.93)	(-14.93)
$\ln \frac{\text{NOI}}{\text{LS}}$	0.298***	0.276***	0.276***
	(15.02)	(13.70)	(13.68)
ln Distance to closest CBD	-0.119***	-0.097***	-0.096***
	(-7.71)	(-6.36)	(-6.16)
Age	0.027***	0.023***	0.023***
	(13.70)	(11.54)	(11.52)
Age^2	0.000***	0.000***	0.000***
	(-11.24)	(-9.16)	(-9.15)
$\ln \frac{\text{SS}}{\text{LS}}$ (FAR)	-0.333***	-0.294***	-0.294***
	(-14.00)	(-12.36)	(-12.36)
Time fe	Yes	Yes	Yes
Metro fe	Yes	Yes	Yes
Property type fe	Yes	Yes	Yes
AIC	17,125	16,773	16,775

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Dependent variable is a 1/0 dummy indicating whether or not the property was bought with the intent of redeveloping it. NOI is the properties net operating income, LS is the size of the land (in square foot), and SS is the size of the structure (in square foot). CBD is the closest central business district, as defined by RCA. HBU is the highest and best use, measured by looking at newly developed properties surrounding the target property. The HBU property type similarity is computed by looking at what percentage of the HBU properties is the same as the target property. AIC is the Akaike Information Criterium.

In the first column of Table 3 we show the results of the probit model for redevelopments when we include the log difference between the HBU NOI and the current NOI of every property (log$N$). Our two other proxies also have the expected sign, see the second column of Table 3. The redevelopment potential increases with the HBU density measure (variable F) and decreases with the property type similarity proxy. In the third column, we combine all the proxies. Because of the high collinearity between NOI and square footage of the structure, combining the variables N and F results in insignificant estimates for N. Still, looking at our proxies separately, we find t-statistics of 4.2 for N in the first column, and 10.1 and -14.9 for the proxies in the second column. Thus, we conclude that our proxies not only move the redevelopment variable in the predicted direction but also that they are relevant. Note that the second model (ii) is the one with the best fit in terms of the Akaike information criterion (AIC).

The estimates of the remaining determinants X also have the expected sign. First, higher NOI per sfl increases the potential of the redevelopment. This is because higher NOI entails higher land values (higher economic activity), which in turn increases the redevelopment potential. However, note that holding NOI (and other variables) constant, an increase in density (FAR) results in a lower redevelopment potential. This is because it is more costly to demolish large structures. The further away a property is from the CBD, the lower the redevelopment potential, even after controlling for property level NOI and HBU variables. Similarly, age and age squared are also significant after controlling for property level NOI and HBU variables. It is well established that most depreciation is embedded into the NOI (which we control for); see Bokhari and Geltner (2018). Thus, the fact that we still find significant estimates for distance to closest CBD, age, and age squared, is most likely caused by “cap rate creep” (the depreciation of the cap rate). In other words, investors **expect** that older properties will generate less NOI in the future, therefore increasing the redevelopment potential.

The fixed effects for year of sale, property types, and MSAs are shown in Tables A.8 – A.9 in the Appendix. The year of sale dummies control for the macro-economic environment, which is not explained by the NOI. The highest redevelopment potential was in 2005, with an estimate of 0.995. The results show a similar redevelopment potential at the beginning and the end of our data sample. Although, as previously noted, we control for NOI, and the average NOI increased considerably between 2000 – 2018. Of all the property types, *ceteris paribus*, industrial properties are the most likely to be redeveloped, followed by retail, office, and residential properties. Since industrial properties are typically cheaper to demolish, this result is unsurprising. Finally, the MSA dummies control for local zoning, and the competitiveness of the development industry. Most of these estimates are not significant. Interestingly, all coefficients for MSAs in Florida are positive and significant, indicating that there is more development in Florida than can be explainable by NOI alone. The MSA with the least development, *ceteris paribus*, is Portland, Oregon. This is unsurprising, given that Portland is known to have stringent zoning and geographic restrictions (Saiz, 2010).

5.2. Redevelopment option value

Table 4 shows the estimates of the redevelopment option value model.

The first column of Table 4 shows the OLS results, where redevelopment is a dummy indicating if a property was bought to be redeveloped. This estimation ignores the reverse causality between redevelopment and prices. We find a significant and negative price-redevelopment elasticity of -0.072. However, as argued throughout this paper, we do not believe this to be a causal relationship. To estimate the causal relationship between prices and redevelopment, we apply our methodology described in Section 3, and use the fitted values for the redevelopment potential from Table 3 as an instrument. The second to the fourth column of Table 4 shows these results. When instrumenting for redevelopments, we find a strong and positive coefficient for redevelopment. In the second column we find that whenever a property has a 100 percent redevelopment potential, the price of the property, *ceteris paribus*, increases by 17 percent. Using the other proxies slightly attenuates this effect. A 100 percent redevelopment potential increases the price of the property by nine percent. From the Hausman (1978) test (not shown here, but available upon request), we conclude that the difference between the IV model estimates (second to fourth column) and the standard OLS model (first column) estimate are statistically significant. The first IV model (second column) features the largest t-statistic, although the fit is equal between the models. See the adjusted R^2 and the root mean squared errors (RMSE) at the bottom of Table 4.

Table 4: **Redevelopment option value model**

Variable	**OLS**	**IV (i)**	**IV (ii)**	**IV (iii)**
(Intercept)	3.122***	3.122***	3.122***	3.122***
	(99.29)	(99.19)	(99.19)	(99.19)
Redevelopment	-0.072***	0.173***	0.094**	0.105***
	(-9.19)	(3.68)	(2.43)	(2.70)
$\ln \frac{\text{NOI}}{\text{LS}}$	0.788***	0.776***	0.780***	0.780***
	(220.71)	(184.46)	(194.53)	(194.40)
ln Distance to closest CBD	-0.034***	-0.030***	-0.031***	-0.031***
	(-13.71)	(-11.49)	(-12.18)	(-12.11)
Age	-0.011***	-0.012***	-0.012***	-0.012***
	(-34.04)	(-32.94)	(-33.25)	(-33.35)
Age^2	0.000***	0.000***	0.000***	0.000***
	(31.28)	(31.14)	(31.18)	(31.26)
$\ln \frac{\text{SS}}{\text{LS}}$ (FAR)	0.267***	0.281***	0.276***	0.277***
	(60.03)	(54.84)	(56.29)	(56.41)
Time fe	Yes	Yes	Yes	Yes
Metro fe	Yes	Yes	Yes	Yes
Property type fe	Yes	Yes	Yes	Yes
R^2	0.93	0.93	0.93	0.93
RMSE	0.37	0.37	0.37	0.37

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Dependent variable is log of transaction price per sfl $\ln P$. NOI is the properties net operating income, and SS is the size of the structure (in square foot). CBD is the closest central business district, as defined by RCA. For the IV models we instrument for the redevelopment dummy with the fitted redevelopment potential. In the first IV (i) model we only use the fitted redevelopment potential estimated with the log difference in NOI of the HBU properties and the target property, or $\ln N$. In the second model we use the fitted redevelopment potential estimated with the log difference in FAR between the HBU and the current property, or $\ln F$, and the percentage of properties built within our defined area that are of the same property type as the target property. In the third IV (iii) we use the fitted redevelopment potential estimated with all proxies.

The remaining estimates have the expected sign and magnitude and hardly change between the models. Higher NOI and more square feet result in higher prices. We also find evidence of "cap rate creep", i.e., the depreciation of cap rates. Even when controlling for NOI the distance to the CBD is still significant. This means, that properties further away from the

CBD trade with a higher cap rate, resulting in lower prices.

The year fixed effects (see Table A.10 in the Appendix) reveal that prices increased until 2007/2008, then dropped, and subsequently increased again after 2011. Given that we already control for NOI, we interpret the year fixed effect estimates as the inverse of cap rates. As such, cap rates are at its lowest at the end of our sample in 2018. Furthermore, the property type fixed effects (see Table A.10 in the Appendix) show that apartments trade with the lowest cap rates, followed by retail, office, and industrial properties. Comparing the MSAs with each other (see Table A.11 in the Appendix), we conclude that most West coast MSAs trade with a relatively low cap rate (San Francisco, Los Angeles, San Diego, but also Seattle), as well as New York, Boston, and Washington DC. We find the highest cap rate in Jacksonville.

5.3. Auxiliary Regressions

As robustness, we estimate two additional models. In the first one, we sightly change our redevelopment option value proxies. In our primary model we use the log absolute differences in NOI and FAR per sfl between the HBU and the current property. For this model, we use the log relative difference in NOI and FAR per sfl between the HBU and the current property. The additional two variables ΔN and ΔF are given by[10]:

$$\Delta N = \ln\left(\frac{\overline{NOI}^{\text{hbu}}}{\overline{LS}^{\text{hbu}}}\right) - \ln\left(\frac{NOI^{\text{current}}}{LS^{\text{current}}}\right),$$
$$\Delta F = \ln\left(\frac{\overline{SS}^{\text{hbu}}}{\overline{LS}^{\text{hbu}}}\right) - \ln\left(\frac{SS^{\text{current}}}{LS^{\text{current}}}\right).$$

We omit the discussion of the results of the probit model and the fixed effects here. These are available upon request. Table 5 shows the results of our auxiliary redevelopment option value model. We find that all the estimates remain robust. The price of a property with 100 percent redevelopment potential increases between 11 percent and 21 percent. The fit does not change according to the adjusted R^2, and root mean squared error (RMSE) (see bottom of Table 5).

[10]Note that our proxy HBU property type similarity remains identical.

Table 5: **Auxiliary redevelopment option value model**

Variable	**IV (i)**	**IV (ii)**	**IV (iii)**
(Intercept)	3.122***	3.122***	3.122***
	(99.21)	(99.19)	(99.20)
Redevelopment	0.206***	0.108***	0.138***
	(5.53)	(2.74)	(3.48)
$\ln \frac{NOI}{LS}$	0.772***	0.780***	0.778***
	(183.63)	(193.42)	(193.10)
ln Distance to closest CBD	-0.029***	-0.031***	-0.031***
	(-10.93)	(-12.07)	(-11.87)
Age	-0.012***	-0.012***	-0.012***
	(-33.77)	(-33.28)	(-33.57)
Age^2	0.000***	0.000***	0.000***
	(31.81)	(31.23)	(31.45)
$\ln \frac{SS}{LS}$ (FAR)	0.285***	0.277***	0.279***
	(55.80)	(56.22)	(56.55)
Time fe	Yes	Yes	Yes
Metro fe	Yes	Yes	Yes
Property type fe	Yes	Yes	Yes
R^2	0.93	0.93	0.93
RMSE	0.37	0.37	0.37

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Dependent variable is log of transaction price per sfl $\ln P$. NOI is the properties net operating income, and SS is the size of the structure (in square foot). CBD is the closest central business district, as defined by RCA. For the IV models we instrument for the redevelopment dummy with the fitted redevelopment potential. In the first IV (i) model we only use the fitted redevelopment potential estimated with the log relative difference in NOI of the HBU properties and the target property, or ΔN. In the second model we use the fitted redevelopment potential estimated with the log relative difference in FAR between the HBU and the current property, or ΔF, and the percentage of properties built within our defined area that are of the same property type as the target property. In the third IV (iii) we use the fitted redevelopment potential estimated with all proxies.

For our second auxiliary model, we utilize RCA data on renovations. RCA's definition of renovation is widely defined, and can be anything from a new lobby area to an entirely new interior for a property. Still, there are many similarities between renovations and redevelopments. Most importantly, they both entail considerable capital expenditures that are not related to the day to day maintenance of the property. However, there are also extensive differences. Renovations cannot redress economic obsolescence. If HBU densities and property type use change, the property owner will need to redevelop. Rather, renovations redress physical and functional obsolescence (Francke and Van de Minne, 2017), meaning modernizing the existing structure in such a way that they match current day tastes and preferences (without changing property type). Therefore, we see renovations as a **competing risk** to redevelopments. In other words, at any time, an investor can decide whether to renovate or redevelop a property (or sell it as an investment property obviously), but not both simultaneously. This does not mean we expect similar signs or magnitudes with this model. For example, properties that are very economically obsolete might not be worth renovating. In contrast, more expensive properties - in the right area - are expected to be renovated instead of redeveloped.

In our data, we find that approximately six percent of the properties were bought to be renovated, slightly more than to be redeveloped (which is 5.5 percent, see Table 1). We use the same procedures and proxies (i.e., the log of the absolute differences in NOI and FAR to the HBU) as in our primary model. In general, we expect that properties that are more disparate from their potential HBU, are not worth renovating.

5.3.1. Determinants of renovations

Table 6 shows the results of the probit model for renovations. Comparing the results from the probit model for redevelopments (Table 3) with the one for renovations (Table 6) yields some interesting insights. Compared to the redevelopment model, the renovation model estimates flip sign, are attenuated, or are insignificant altogether. Remarkably, our NOI proxy (log N) does not impact the renovation potentials. Nor does the current NOI. FAR has a positive effect on the renovation potential, whereas it was negative on the redevelopment potential. Larger structures are more costly to redevelop, and as such, the only way to increase NOI is by renovating the current property. An increase in the difference of FAR to the HBU decreases the renovation potential. The competing risk of redevelopment most likely causes this. If an investor can considerably increase its NOI by increasing the FAR through redevelopment, she will likely not deem any renovations worth it. Our third proxy, the proxy, HBU property type similarity, remains significant and negative, although the effect is attenuated (compared to rede-

Table 6: **Probit model: Determinants of renovations**

Variable	**(i)**	**(ii)**	**(iii)**
(Intercept)	-1.948***	-1.836***	-1.884***
	(-9.53)	(-9.14)	(-9.14)
$\ln N = \ln\left(\left(\frac{NOI^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{NOI^{\text{current}}}{LS^{\text{current}}}\right)\right)$	-0.004		0.009
	(-0.45)		(1.03)
$\ln F = \ln\left(\left(\frac{SS^{\text{hbu}}}{LS^{\text{hbu}}}\right) - \left(\frac{SS^{\text{current}}}{LS^{\text{current}}}\right)\right)$		-0.018**	-0.021***
		(-2.36)	(-2.57)
HBU property type similarity		-0.261***	-0.265***
		(-6.16)	(-6.23)
$\ln \frac{\text{NOI}}{\text{LS}}$	0.007	0.022	0.022
	(0.33)	(1.06)	(1.03)
ln Distance to closest CBD	0.003	-0.006	-0.002
	(0.21)	(-0.39)	(-0.16)
Age	0.005***	0.005**	0.005**
	(2.60)	(2.52)	(2.45)
Age^2	0.000***	0.000***	0.000***
	(-5.10)	(-4.92)	(-4.90)
$\ln \frac{\text{SS}}{\text{LS}}$ (FAR)	0.056**	0.061**	0.061**
	(2.16)	(2.37)	(2.35)
Time fe	Yes	Yes	Yes
Metro fe	Yes	Yes	Yes
Property type fe	Yes	Yes	Yes
AIC	19,368	19,325	19,326

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Dependent variable is a 1/0 dummy indicating whether or not the property was bought with the intent of renovating it. NOI is the properties net operating income, LS is the size of the land (in square foot), and SS is the size of the structure (in square foot). CBD is the closest central business district, as defined by RCA. HBU is the highest and best use, measured by looking at newly developed properties surrounding the target property. The HBU property type similarity is computed by looking at what percentage of the HBU properties is the same as the target property. AIC is the Akaike Information Criterium.

velopment). If the current structure has the same use as the HBU property, the renovation potential decreases. Given that our NOI proxy (log N) is insignificant in all renovation models, we can conclude that it is not relevant. For the sake of consistency, we still report the results when using this proxy in the renovation model.

5.3.2. Price of renovation properties

In Table 7 we present the estimates for the renovation model.

Table 7: **Renovation model**

Variable	**OLS**	**IV (i)**	**IV (ii)**	**IV (iii)**
(Intercept)	3.123***	3.121***	3.139***	3.133***
	(99.25)	(98.64)	(99.29)	(99.07)
Renovation	-0.032***	0.037	-0.441***	-0.280***
	(-4.24)	(0.45)	(-5.50)	(-3.49)
$\ln \frac{\text{NOI}}{\text{LS}}$	0.785***	0.785***	0.786***	0.785***
	(220.83)	(220.51)	(220.87)	(220.73)
ln Distance to closest CBD	-0.033***	-0.033***	-0.033***	-0.033***
	(-13.22)	(-13.23)	(-13.13)	(-13.16)
Age	-0.011***	-0.011***	-0.011***	-0.011***
	(-34.82)	(-34.61)	(-33.85)	(-34.11)
Age^2	0.000***	0.000***	0.000***	0.000***
	(31.79)	(30.75)	(29.19)	(29.74)
$\ln \frac{\text{SS}}{\text{LS}}$ (FAR)	0.272***	0.271***	0.274***	0.273***
	(61.19)	(60.82)	(61.41)	(61.21)
Time fe	Yes	Yes	Yes	Yes
Metro fe	Yes	Yes	Yes	Yes
Property type fe	Yes	Yes	Yes	Yes
R^2	0.93	0.93	0.93	0.93
RMSE	0.37	0.37	0.37	0.37

Standard errors in parentheses $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Dependent variable is log of transaction price per sfl $\ln P$. NOI is the properties net operating income, and SS is the size of the structure (in square foot). CBD is the closest central business district, as defined by RCA. For the IV models we instrument for the renovation dummy with the fitted renovation potential. In the first IV (i) model we only use the fitted renovation potential estimated with the log difference in NOI of the HBU properties and the target property, or $\ln N$. In the second model we use the fitted renovation potential estimated with the log difference in FAR between the HBU and the current property, or $\ln F$, and the percentage of properties built within our defined area that are of the same property type as the target property. In the third IV (iii) we use the fitted renovation potential estimated with all proxies.

Note that the variable "renovation" is a binary variable indicating properties that were bought to be renovated and not properties that were recently renovated. The OLS model (which ignores the endogeneity issues) yields a small but significant negative effect of renovations on prices (see first column of Table 7). The results for the first IV model (IV (i)) are insignificant. This is hardly surprising, given that the proxy used in this column (log N) is insignificant in the probit model (see Table 6). Using the highly significant proxies in the second IV model (IV (ii)) we find that a property that needs to be renovated (100 percent renovation potential) trades with a 44 percent discount compared to a newly renovated property (zero percent renovation potential). Since the renovation model captures the physical and functional obsolescence channels, this is hardly surprising. This discount represents the investment of financial capital needed to bring to reverse the physical and functional depreciation. The final column shows the results if we use all the proxies, including the insignificant one (log N). These results indicate that a 100 percent renovation renovation potential decreases the price by 28 percent. All other estimates remain mostly unchanged compared to our earlier findings with the redevelopment option value model. The fixed effects estimates (for both the probit and renovation model) are available upon request.

6. Conclusion

As urban areas age, redevelopment and renovation become ever more critical. To analyze how the redevelopment potential affects commercial property prices, we employ a novel strategy that addresses the reverse causality and sample selection bias. Moreover, we provide information on the determinants of redevelopment and renovation.

We find that a larger difference to the HBU in NOI and FAR, as well as being the wrong type of property, significantly increase the redevelopment potential for commercial real estate. These three proxies capture the economic obsolescence channel. Moreover, the redevelopment potential increases with the property's NOI, age, and proximity to the CBD. In contrast, higher FAR decreases the redevelopment potential because it leads to higher demolition costs. Industrial properties are most likely to be redeveloped, followed by retail, office, and residential properties. Our estimations suggest that having a 100 percent redevelopment potential increases the property's price by nine to 17 percent. We also find that the redevelopment option value is very heterogeneous across American cities.

Further, we find that neither the difference to the HBU in NOI nor the property's NOI drives the renovation potential. Property's FAR has a positive impact on the renovation potential, while the difference to the HBU in FAR has a negative one. As with redevelopments, being the wrong property type increases the renovation potential, although the effect is much smaller. On average, a property that needs to be renovated trades with a 28 to 44 percent discount compared to a newly renovated property. This reflects the physical and functional obsolescence of the property.

Our results hold essential lessons for the understanding of the development of urban economies. First, potential NOI is one of the main drivers of redevelopment for commercial real estate. Second, high land values trigger redevelopments.

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Appendix A. Tables

Table A.8: **Probit model: Year and property type fixed effects**

Variable	**(i)**	**(ii)**	**(iii)**	**Obs.**
Year of Sale				
2000 (Ref.)	0.000	0.000	0.000	574
2001	0.062	0.064	0.064	730
2002	0.055	0.059	0.059	899
2003	0.199	0.193	0.194	1,127
2004	0.610***	0.603***	0.604***	1,775
2005	0.995***	0.994***	0.994***	3,893
2006	0.789***	0.806***	0.807***	3,888
2007	0.533***	0.549***	0.549***	3,675
2008	0.408***	0.432***	0.433***	1,815
2009	0.295*	0.322*	0.323*	833
2010	0.251	0.281*	0.281*	1,282
2011	0.424***	0.431***	0.431***	2,204
2012	0.431***	0.452***	0.452***	2,998
2013	0.631***	0.660***	0.661***	3,278
2014	0.402***	0.418***	0.418***	3,557
2015	0.300**	0.310**	0.310**	3,819
2016	0.227	0.241	0.241	3,464
2017	0.105	0.106	0.106	3,085
2018	-0.019	-0.019	-0.019	2,836
Property type				
Apartment (Ref.)	0.000	0.000	0.000	23,491
Industrial	0.635***	0.549***	0.549***	6,623
Office	0.214***	0.149***	0.149***	8,038
Retail	0.224***	0.211***	0.212***	7,580

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. This table shows the year fixed effects results for the Probit model in Table 3. The frequency of the variables is also given by Obs. Ref. gives the reference (omitted) category.

Table A.9: **Probit model: Metro area fixed effects**

Variable	**IV (i)**	**IV (ii)**	**IV (iii)**	**Obs.**
Metro area				
Atlanta (Ref.)	0.000	0.000	0.000	2,221
Baltimore	0.059	0.075	0.076	375
Boston Metro	0.208**	0.228**	0.227**	580
Charlotte	0.100	0.117	0.118	512
Chicago	0.215***	0.257***	0.257***	1,098
Co Springs	0.151	0.120	0.124	253
Dallas	0.036	0.006	0.007	1,289
Denver	-0.128	-0.067	-0.066	1,475
Houston	-0.089	-0.130	-0.129	832
Jacksonville	0.294**	0.354***	0.356***	435
Los Angeles	-0.107	-0.067	-0.068	7,990
Las Vegas	-0.061	-0.046	-0.046	910
Miami/So Fla	0.489***	0.457***	0.457***	2,041
Minneapolis	0.176*	0.176*	0.176*	515
Nashville	0.105	0.079	0.080	383
New York	0.054	0.060	0.059	3,897
Orlando	0.309***	0.339***	0.340***	605
Philly Metro	0.042	0.053	0.053	545
Phoenix	0.200***	0.200***	0.202***	2,669
Portland	-0.252**	-0.288**	-0.287**	658
Raleigh/Durham	-0.185	-0.192	-0.190	526
Rest	0.009	0.023	0.025	5,434
San Diego	0.099	0.110	0.110	1,476
Seattle	0.081	0.067	0.066	1,943
San Francisco	-0.092	-0.115	-0.118	4,043
St Louis	0.207	0.200	0.203	200
Tampa	0.335***	0.317***	0.318***	1,059
Tucson	0.036	0.042	0.044	388
Washington DC	-0.081	-0.016	-0.018	1,380

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. This table shows the metro area fixed effects results for the Probit model in Table 3. The frequency of the variables is also given by Obs. Ref. gives the reference (omitted) category. We only include Metro areas with at least 10 redevelopments. The remaining ones are are combined in the "rest" category.

Table A.10: **Redevelopment option value model: Year and property type fixed effects**

Variable	**OLS**	**IV (i)**	**IV (ii)**	**IV (iii)**	**Obs.**
Year of Sale					
2000 (Ref.)	0.000	0.000	0.000	0.000	574
2001	0.085***	0.084***	0.084***	0.084***	730
2002	0.127***	0.127***	0.127***	0.127***	899
2003	0.210***	0.209***	0.209***	0.209***	1,127
2004	0.329***	0.321***	0.324***	0.323***	1,775
2005	0.476***	0.456***	0.463***	0.462***	3,893
2006	0.540***	0.527***	0.531***	0.530***	3,888
2007	0.573***	0.567***	0.569***	0.569***	3,675
2008	0.531***	0.529***	0.530***	0.529***	1,815
2009	0.326***	0.325***	0.325***	0.325***	833
2010	0.287***	0.287***	0.287***	0.287***	1,282
2011	0.354***	0.350***	0.351***	0.351***	2,204
2012	0.381***	0.378***	0.379***	0.378***	2,998
2013	0.455***	0.447***	0.449***	0.449***	3,278
2014	0.543***	0.541***	0.542***	0.541***	3,557
2015	0.629***	0.629***	0.629***	0.629***	3,819
2016	0.681***	0.683***	0.682***	0.683***	3,464
2017	0.716***	0.721***	0.719***	0.719***	3,085
2018	0.780***	0.788***	0.785***	0.786***	2,836
			Property type		
Apartment (Ref.)	0.000	0.000	0.000	0.000	23,491
Industrial	-0.243***	-0.261***	-0.255****	-0.256***	6,623
Office	-0.160***	-0.163***	-0.162***	-0.162***	8,038
Retail	-0.029***	-0.032****	-0.031***	-0.031***	7,580

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. This table shows the year fixed effects results for the 2SLS model in Table 4. The frequency of the variables is also given by Obs. Ref. gives the reference (omitted) category.

Table A.11: **Redevelopment option value model: Metro area fixed effects**

Variable	**OLS**	**IV (i)**	**IV (ii)**	**IV (iii)**	**Obs.**
Metro area					
Atlanta (Ref.)	0.000	0.000	0.000	0.000	2,221
Baltimore	0.108***	0.110***	0.110***	0.110***	375
Boston Metro	0.279***	0.272***	0.275***	0.274***	580
Charlotte	0.032*	0.032*	0.032*	0.032*	512
Chicago	0.076***	0.072***	0.073***	0.073***	1,098
Co Springs	-0.029	-0.028	-0.028	-0.028	253
Dallas	-0.003	-0.005	-0.004	-0.004	1289
Denver	0.132***	0.139***	0.137***	0.137***	1,475
Houston	-0.015	-0.015	-0.015	-0.015	832
Jacksonville	-0.061***	-0.065***	-0.063***	-0.064***	435
Los Angeles	0.446***	0.452***	0.450***	0.451***	7,990
Las Vegas	0.030**	0.034**	0.033	0.033	910
Miami/So Fla	0.260***	0.248***	0.252***	0.251***	2,041
Minneapolis	0.050***	0.048***	0.049***	0.049***	515
Nashville	0.006	0.004	0.005	0.005	383
New York	0.331***	0.331***	0.331***	0.331***	3,897
Orlando	0.055***	0.051***	0.052***	0.052***	605
Philly Metro	0.104***	0.106***	0.106***	0.106***	545
Phoenix	0.081***	0.079***	0.079***	0.079***	2,669
Portland	0.151***	0.157***	0.155***	0.155***	658
Raleigh/Durham	0.079***	0.083***	0.082***	0.082***	526
Rest	-0.012	-0.012	-0.012	-0.012	5,434
San Diego	0.400***	0.402***	0.401***	0.401***	1,476
Seattle	0.310***	0.310***	0.310***	0.310***	1943
San Francisco	0.498***	0.505***	0.503***	0.503***	4,043
St Louis	-0.004	-0.006	-0.005	-0.005	200
Tampa	0.046***	0.040***	0.042***	0.042***	1,059
Tucson	-0.015	-0.015	-0.015	-0.015	388
Washington DC	0.259***	0.265***	0.263***	0.263***	1,380

Standard errors in parentheses $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. This table shows the metro area fixed effects results for the 2SLS model in Table 4. The frequency of the variables is also given by Obs. Ref. gives the reference (omitted) category. We only include Metro areas with at least 10 redevelopments. The remaining ones are are combined in the "rest" category.

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