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Option value and the price of teardown properties

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ABSTRACT

The introduction of uncertainty over the future price of structural capital into a model of teardowns implies a value to delaying the demolition vs. preservation decision, and that the market price of a redeveloped property may increase with its quantity of structural capital. Using data from an active teardown market, we test the model's prediction that hedonic price function coefficients depend on the expected time between sale and demolition. As predicted, structural variables have significant effects on the sales prices of both teardown and non-teardown properties, and the effects are generally much larger the lower the estimated teardown probability.

1. Introduction

Previous work on the redevelopment decision by Brueckner (1980), Wheaton (1982), and Rosenthal and Helsley (1994) suggests that the market price of a property destined for demolition and redevelopment is independent of the quantity of structural capital on the property. This prediction is sensible for an instant teardown because the structural capital has no value except in recycling. However, there are several possible sources of uncertainty in the willingness to pay for structural capital. First, preferences may change over time, and styles that are currently out of fashion may regain their allure. Second, variations in the prices of household inputs (e.g., energy) and housing inputs (e.g. wood, bricks) may change the relative attractiveness of older dwellings. Third, variation in income may affect the underlying demands for old and new dwellings.

In this paper, we introduce uncertainty over the future price of structural capital and explore the implications for the market price of redeveloped property. Given the irreversibility of the demolition decision, there is a value in delaying the demolition vs. preservation decision, and the market price of a redeveloped property may increase with the quantity of its structural capital. The relationship is positive if the net cost of demolition is small relative to future price of structural capital and the probability of realizing it.

As explained by Dixit and Pindyck (1994), the combination of uncertainty and irreversibility of investment generates a value of waiting – an option value – that provides an incentive to delay investment to make better-informed decisions. In the normal investment environment, the option value generates a hurdle rate for investment that exceeds the cost of capital. A similar option value arises in the price of undeveloped land due to uncertainty over future house prices and the value of heterogeneous site characteristics (Guthrie, 2010). In the redevelopment environment, there is uncertainty in the future price of structural capital and demolition is irreversible. The delay of the demolition vs. preservation decision allows an agent to observe the future price before deciding to demolish or preserve. The option value increases the market value of a property that may eventually be demolished, and the market value may increase with the quantity of old structural capital.[1]

The introduction of uncertainty has significant implications for empirical estimates of hedonic house price functions. Existing stud-

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[1] Our model includes several simplifying assumptions that make the model less general than the conventional option-value model, but lead more directly to our empirical work. The key simplifying assumptions are (i) the future price of old structural capital is unknown in the current period but then known with certainty thereafter, (ii) uncertainty takes the form of either a positive or negative price for old structural capital, (iii) redevelopment does not change the size of the structure, and (iv) the cost of new structural capital is incorporated as an annualized amount.

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ies such as Clapp and Salavi (2010), Dye and McMillen (2007), Munneke (1996), and Rosenthal and Helsley (1994) assume that properties can be classified as being teardowns or non-teardowns at the time of sale. Each of these studies estimates a separate function for the two regimes.[2] In practice, sales are rarely followed immediately by demolitions, and lags of many months are quite common. Our theoretical model implies that structural characteristics will account for a larger proportion of the sale price the longer the time between purchase and demolition. If a home is demolished immediately after a sale, structural characteristics will have no effect on sales prices because the property is being purchased solely for its lot; indeed structural characteristics may *lower* sales prices if they increase the demolition cost. Thus, our model implies that all of the coefficients in a hedonic house price function are themselves functions of the expected time between purchase and demolition.

We test this prediction using data on house sales in eight suburbs of Chicago. The Chicago metropolitan area had a remarkably active teardown market during the housing boom of the early 2000s, leading the National Trust for Historic Preservation to declare it the "epicenter of teardowns" in 2006. Using data on sales and demolitions for 1997–2008, we test the model's prediction that hedonic price function coefficients depend on the expected time between sale and demolition. Using data on all single-family residential properties in the suburbs in our sample, we use a parametric duration model to estimate a home's hazard rate at the time of sale, i.e., the probability that the structure is demolished at the time of sale given that it has not yet been torn down. We then estimate hedonic price functions for the full set of sales using both parametric and nonparametric approaches to allow the hedonic coefficients to vary with the hazard rate. The results provide strong support for the theory: structural variables have significant effects on the sales prices of both teardown and non-teardown properties, and the effects are generally much larger the lower the estimated teardown probability.

2. The model

Consider a property with two components, land and structural capital. The annual rent on the property bundle in period t is

$$R_t = r + p_t s \tag{1}$$

where r is the exogenous annual land rent, s is the quantity of the existing (old) structural capital, and p_t is the consumer willingness to pay per unit of old capital. The willingness to pay for capital is certain in period 1 (equal to p_1), but is uncertain for later periods. For all future periods, the willingness to pay takes the value p_H with probability ρ and $p_L < 0$ with probability $(1-\rho)$. In other words, the future willingness to pay for old capital is revealed at the end of period 1.

The property owner can either preserve the old structural capital or demolish it. At the beginning of period 1, the present value of the rent stream of the bundle with the old capital is

$$V_M^1 = \sum_{t=0}^{\infty} \frac{sp_t + r}{(1+i)^t} \tag{2}$$

If the agent demolishes the old capital, the property is redeveloped at a cost of $p_k k$ where p_k is the (annualized) cost per unit of new structural capital and $k = s$ is the quantity of new capital. We assume that the consumer willingness to pay for new capital equals the unit cost p_k, so the net rental stream from redevelopment is simply r. The present value of redevelopment is

$$V_D^1 = \sum_{t=0}^{\infty} \frac{r}{(1+i)^t} - c \tag{3}$$

where c is the net demolition cost, equal to gross demolition cost minus the resale value of recycled materials.

Consider a property bundle whose expected income stream from the old structural capital is negative. Specifically, the expected willingness to pay for old capital is negative, and the period-one willingness to pay equals the expected future willingness to pay:

$$p_1 = \rho p_H + (1-\rho) p_L < 0 \tag{4}$$

The negative value of structural capital reduces income from the land-capital bundle, so if an agent demolishes the structure, the bundle rent increases to r. In this case, demolition and redevelopment increases the expected present value of the income stream if

$$sp_1 \sum_{t=0}^{\infty} \frac{1}{(1+i)^t} < -c \tag{5}$$

i.e., if the expected negative stream from old capital dominates the cost of demolition. If this condition is satisfied (if net demolition cost is low relative to the absolute value of sp_1, a narrow application of present-value analysis will trigger demolition and redevelopment at the beginning of period 1.

2.1. Demolish or wait?

At the beginning of period 2, the agent observes the future willingness to pay for old capital, the price that will prevail forever after. If the old structure has been preserved, the agent then can either demolish or continue to preserve the structural capital. Consider first the implications of realizing the low willingness to pay for old capital. If $p_L < p_1 < 0$, demolition is the rational choice because by (5) the negative rent stream from old capital dominates the demolition cost. If redevelopment occurs in period 2, the present value of the income stream is

$$V_D^2 = sp_1 + \sum_{t=0}^{\infty} \frac{r}{(1+i)^t} - \frac{c}{1+i} \tag{6}$$

where the first term incorporates the (negative) structure rent in period one and the period-one land rent is included in the second term. The demolition cost is incurred in the second period, so it is discounted.

Consider next the implications of realizing the high willingness to pay for old structural capital, p_H. The present value of preserving the property forever is

$$V_M^2 = sp_1 + sp_H \sum_{t=1}^{\infty} \frac{1}{(1+i)^t} + \sum_{t=0}^{\infty} \frac{r}{(1+i)^t} \tag{7}$$

Preserving rather than demolishing the old capital will be the rational choice if $V_M^2 > V_D^2$.

$$sp_H \sum_{t=1}^{\infty} \frac{1}{(1+i)^t} + \frac{c}{1+i} > 0 \tag{8}$$

e.g., if both p_H and c are positive. The economic logic is simple: if $p_H > 0$, the property owner earns a surplus from old capital, while new capital (with a willingness to pay equal to the unit cost) does not generate a surplus but requires costly demolition.

Consider next the decision in period one to either instantly demolish or delay the demolish/maintain decision until the future price is observed in period 2. The expected value of waiting is

$$EV_W = \rho V_M^2 + (1-\rho) V_D^2 \tag{9}$$

$$EV_W = sp_1 + \sum_{t=0}^{\infty} \frac{r}{(1+i)^t} + \rho sp_H \sum_{t=0}^{\infty} \frac{1}{(1+i)^t} - c\frac{1-\rho}{1+i} \tag{10}$$

[2] An exception is Clapp et al. (2012) who include a measure of "redevelopment potential" – the ratio of assessed structure value to assessed land value – as an explanatory variable in a hedonic price equation. Their approach is designed to identify areas with high redevelopment potential rather than to estimate the contribution of structural characteristics to the price of homes with high redevelopment potential.