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Abstract

Negative demand shocks have afflicted many American cities in the 20th century and are the main explanation for their decaying housing markets. But what is the role of housing supply? Rational entrepreneurs should not invest in new buildings and renovation when home values are below replacement cost. Households with an investment motive should behave similarly. Empirically, we find that construction costs are not very sensitive to building activity but do vary with local income, unionization rates in the construction sector, the level of local regulation, and region. We also document that the variance in building costs generates substantial variance in renovation expenditures across cities. Owner-occupied homes with market values below replacement costs spend about 50 percent less on renovation than similar homes with market values above construction costs. We also report on the distribution of the ratio of house value-to-construction cost across markets. The distribution is relatively flat in a number of declining cities, especially older manufacturing areas. In these places, a relatively modest 10 percent decline in replacement costs would find between 7-15 percent of the local housing stock moving from being valued below cost to above cost. Even though modest declines in construction costs are unlikely to change basic urban trends, our results suggest they can be an important factor in determining whether various neighborhoods in declining cities will experience any significant reinvestment. In this respect, declining cities truly cannot afford to be expensive cities in terms of replacement costs: urban scholars and policy makers should begin to pay more attention to the cost side of cities.

JEL: R12, R31
Keywords: construction costs, city decline, renovation, unions

1. Introduction

The decline of once urban powerhouses such as Detroit, Buffalo, Cleveland, and Philadelphia is an outstanding feature of the evolution of American cities in the latter half of the 20th century. And, the American story is not unique, as the shift of manufacturing employment away from urban areas also foreboded decline for European cities such as Glasgow, Liverpool, Rotterdam, and Turin.

Negative demand shocks for metropolitan areas inevitably impact their local housing markets. While it is clear that home prices will be lower, there is no such certainty about what will happen to the number of people in the city or about how much reinvestment in their homes those people will undertake. Economists' fundamental guide to understanding the distribution of people and firms across places, the Rosen-Roback compensating differential model,[1] shows that negative demand shocks could result in low enough prices that there would be no population loss whatsoever. Recent results from Glaeser and Gyourko (2001) suggest that the short-run supply of housing is almost completely inelastic in declining cities and that, if housing prices are low enough, people will stay.

However, depreciation ultimately erodes the housing stock, and reinvestment is required to avoid decay over the long run. The reason it is not clear that reinvestment in the housing stock will fall (conditional on population) is that such investment in declining markets is not driven by low values *per se* but by whether values are low relative to replacement costs. Rational entrepreneurs should not invest in new buildings or renovation of existing ones when home values are below replacement or construction

[1] See Rosen (1979) and Roback (1982).

costs. Owner-occupiers with an investment motive should behave similarly.[2] However, if replacement costs are low enough, the present value of reinvestment can be positive even with low or declining home values.

That said, the fact is that we often do see decay in the housing markets of declining areas. In this paper, we ask whether this process is exclusively demand driven or whether the supply side of the housing market plays a meaningful role. Glaeser and Gyourko's (2002) findings that housing prices are close to replacement costs in most areas, with values below replacement costs in a number of declining cities highlights the potential empirical relevance of construction costs in investment and reinvestment decisions within and across cities. For houses in specific neighborhoods that are priced near construction costs, modest differences in replacement costs may be critical on the margin to determining whether fundamental decay sets in or reinvestment occurs in the face of a negative shock.

This leads us to begin our analysis with a careful look at construction costs, which need not be exogenous to the decay process. As already suggested, if they are flexible downward in response to negative demand shocks, then there need not even be a negative impact on housing investment. However, our analysis finds that construction costs are not very sensitive to construction levels. There is substantial between-city variation in costs that cannot be accounted for with a standard, upward-sloping supply schedule.

The key supply shifters that do explain the variance in costs are regional location, unionization rates in the construction sector, local income, and local government

[2] Given the primacy of investment motives in this story, we would expect the largest effects to be found among absentee landlords of rental housing. Owner-occupiers obviously may reinvest for non-financial reasons because they consume the service flow of their unit. While data availability requires us to focus on

spending on regulation and code enforcement (which we use as a proxy for the overall strictness of regulatory enforcement). Controlling for other factors, construction costs are from 10-14 percent lower in metropolitan areas within the South and Midwest regions, compared to those in the Northeast and West. Controlling for region, income, and construction activity, a one-standard-deviation increase in the unionization rate is associated with a 9 percent higher level of construction costs. A one-standard-deviation increase in the log of per capita metropolitan area income is associated with just over a 2 percent increase in construction costs. The standardized marginal effect of additional local spending on regulation and code enforcement also increases construction costs by about 2 percent.

After accounting for the variance in construction costs, we proceed to answer the main question of the paper--by how much does investment and reinvestment in existing homes change when construction costs change? Our measure of "investment and reinvestment" includes all expenditures on renovation, maintenance, alterations, and additions as reported in the various files of the *American Housing Survey*. Throughout the remainder of the paper, we refer to the aggregate of these expenditures as "renovation" spending for simplicity.[3]

Two effects are estimated: (a) an own-price effect that reflects the average change in renovation spending across all units from a change in construction costs; and (b) the impact on renovation spending associated with home values changing from being above construction costs to below construction costs. We find the demand for renovation

owner-occupiers, the impacts we find for them are likely to reflect the lower bound of the effects for rental landlords.

[3] This is purely for ease of exposition, and one should keep in mind that this term encompasses all spending from routine maintenance to adding a bathroom.

services to be relatively price-inelastic, with our best estimate being –0.28 (i.e., a 10 percent higher level of construction costs is associated with 2.8 percent lower level of renovation spending). Using instrumental variables techniques to account for the endogeneity of home values to these expenditures and for measurement error, we find a very substantial impact of an owner's home value changing from being above to below construction cost. This effect is on the order of 50 percent of mean renovation spending, or about $900 on an annual basis.

The size of this effect suggests that differences in construction costs are likely to be economically relevant in determining the extent of revitalization versus decay in areas where many homes have values close to replacement costs. In the final section of the paper, we document that there is substantial heterogeneity in the distribution of home values across different market areas. In places with high house values, such as San Francisco, San Diego, Los Angeles, and New York, a 10 percent drop in construction costs would not change the fraction of homes with values above replacement costs. Land prices are so high in these areas that there are virtually no homes valued at less than 110 percent of construction costs.

In a host of other areas, many in relative or absolute decline, a 10 percent change in construction costs is associated with from 7-15 percent of the owner-occupied stock in the central city changing status from being below replacement cost to above cost. It is in places with relatively flat distributions of prices-to-construction costs that declines in construction costs have the greatest potential to generate substantial reinvestment in the local housing stock. These areas, which include many older and Rust Belt cities ranging from Philadelphia to Milwaukee, are in decline, but their values have not fallen so far that modest drops in construction costs cannot lead many houses to have values in excess of costs.

In other declining cities such as Detroit, the impact is much smaller and virtually indistinguishable from that found in growing places such as Phoenix. In both of these areas, the change in costs does not change the fraction of units valued above costs. Of course, in Phoenix very few units are priced below cost anyway, while in Detroit the ratio of value-to-cost is so far below one for most units that modestly lower construction costs do not change the fundamental status of many homes.

While we certainly would not argue that modest declines in construction costs can change basic urban trends, their level does appear to be an economically meaningful factor in determining whether various parts of declining cities will experience any significant reinvestment. The moral to this story appears to be that declining cities truly cannot afford to be expensive cities in terms of replacement costs. For both urban scholars and policymakers, much greater attention needs to be paid to the cost side of declining cities in particular.

The remainder of the paper is organized as follows. In the next section we discuss the potential importance of the supply side in the decline process. Section 3 describes the various data sources we employ. Section 4 empirically documents the determinants of construction costs in a metropolitan area. This is followed in Section 5 with an analysis of the relationship between construction costs and renovation expenditures. Section 6 then details how many homes in different markets are likely to have values close to construction costs. This density is key to determining where lower construction costs might have a large impact on housing reinvestment. A brief summary concludes the paper.

2. The Supply Side of City Decline

The potential impact of the supply side on decline can be examined within the framework of a simple, traditional urban model. To illustrate this, we begin by considering the people who live in a given city. All consumers are identical, and each person consumes one unit of housing. Individuals have well-defined preferences over consumption (C) and the quality of the housing location (Q) such that

(1) $U = U(C, Q)$, with $U_1 > 0, U_2 > 0$

(2) $C = Y - R(Q)$

(3) $U = U(Y - R(Q), Q)$,[4]

where Y is income and $R(Q)$ is the rent corresponding to quality Q. Spatial equilibrium requires consumers to be indifferent between living in the city versus the rest of the country. The utility level elsewhere is denoted by ϖ. The spatial equilibrium then defines the implicit bid-rent function, $\psi(Q, Y, \varpi)$ so that equation (4) holds

(4) $U(Y - \psi(Q, Y, \varpi), Q) = \varpi$.[5]

[4] This is more general than, and certainly inclusive of, the monocentric Alsonso-Muth-Mills model, where quality takes the form of proximity to the CBD. We do not follow that tradition strictly because we want to avoid the counterfactual implication that decay always occurs in the suburbs.

[5] Differentiating (4) with respect to Q: $-\frac{\partial U}{\partial C} \cdot \psi'(Q) \cdot dQ + \frac{\partial U}{\partial Q} \cdot dQ = 0$, from which: $\psi'(Q) = \frac{\partial U / \partial Q}{\partial U / \partial C} > 0$

For simplicity, we assume that the only use for land is residential. Further, construction costs for a unit of housing are given by κ. Depreciation takes the form that the probability of the house falling down equals δ each period. If we let β be the discount rate, the value of redeveloping an empty lot at time t is given by

$$V_t(Q) = \psi(Q) - \kappa + \beta V_{t+1}(Q). \tag{5}$$

where V_{t+1} is the value of the home in the next period. At time t+1 the home will be standing with probability $1-\delta$, and the owner will face the decision to redevelop again with probability δ. Thus,

$$V_t = \psi(Q) - \kappa + \beta \cdot \left\{(1-\delta)\left(\psi(Q) + \beta V_{t+2}\right) + \delta V_t\right\}. \tag{6}$$

It is easy to see that $V_{t+1} = V_{t+2}$. Using this and equation (1) yields

$$\beta V_{t+2} = V_t - \psi(Q) + \kappa \tag{7}$$

Combining (2) and (3) we can derive

$$V_t(Q) = \frac{1}{1-\beta} \cdot \left(\psi(Q) - [1-\beta(1-\delta)]\kappa\right). \tag{8}$$

For the value of redeveloping to be positive we need

$$\frac{\psi(Q)}{[1-\beta(1-\delta)]} > \kappa. \tag{9}$$

The option to redevelop is thus valued as

$$\Theta = Max\left\{0, \frac{1}{1-\beta} \cdot \left(\psi(Q) - [1-\beta(1-\delta)]\kappa\right)\right\}. \tag{10}$$

Finally, the home price ($P(Q)$) capitalizes the future stream of rents from the housing unit and incorporates the capitalized value of the redevelopment option. This is given by the somewhat convoluted term,

$$P(Q)=\psi(Q)+\beta\cdot(1-\delta)\cdot\psi(Q)+\beta\cdot\delta\cdot\Theta+\beta^2\cdot(1-\delta)^2\cdot\psi(Q)+\beta^2\cdot\delta^2\cdot\Theta+...=\frac{\psi(Q)}{1-\beta\cdot(1-\delta)}+\frac{\Theta\cdot\beta\cdot\delta}{1-\beta\cdot\delta}$$

It is easy to see that $\frac{\Theta\cdot\beta\cdot\delta}{1-\beta\cdot\delta}=0$ if $\frac{\psi(Q)}{[1-\beta(1-\delta)]}\leq\kappa$. Thus, there is no reinvestment if and only if $P(Q)\leq\kappa$, or housing prices are below construction costs.[6]

Figure 1 then illustrates how the relationship between P(Q) and κ determines the size of the city in equilibrium. The maximum location quality is denoted as $\overline{Q}$, and the number of locations with quality Q is given by $\phi(Q)$,[7] with support $\left[0,\overline{Q}\right]$. The minimum quality that will be developed/redeveloped is given by $Q^{\min}$ such that $P\left(Q^{\min}\right)=\kappa$ or, equivalently, $Q^{\min}=\psi^{-1}\left(\left[1-\beta(1-\delta)\right]\kappa\right)$. The population in the city in steady state then is $N=\int_{Q^{\min}}^{\overline{Q}}\phi(Q)\cdot dQ$. Our quality measure in Figure 1 reflects the difference from the maximum quality level $\overline{Q}$. Thus, higher qualities are closer to the origin, with lower qualities (i.e., moving toward the right) corresponding to further development of the city.

The supply side can influence the nature of decline in two ways. One is by how it affects the response to a negative demand shock. As we show just below, this is determined largely by whether construction costs themselves are an increasing function of the level of building activity. The second avenue of influence is more direct—namely,

[6] While it is clear that a rational entrepreneur will never redevelop units when prices are below construction costs, it is not clear that owner-occupiers will behave similarly for a number of reasons. First, they may view expenditures on renovation as current consumption as opposed to being purely financially motivated in our model. In addition, the private valuation of a home may be above the current market price, which corresponds to the valuation of the second highest bidder for the house. Finally, construction costs may not be the relevant prices for all types of renovation. We address these issues more directly below in the empirical work.

by construction costs changing independently of demand. The remainder of this section models these demand and supply shocks within the context of our model.

A Negative Demand Shock

We now consider a negative demand shock in which income decreases in the city. Recall that, in equilibrium, rents are a function not only of quality but of income and the utility level elsewhere: $U\left(Y_i - \psi\left(Q, Y, \varpi\right), Q\right) = \varpi$. Differentiating with respect to Y_i yields $U_1 \cdot \left\{1 - \frac{\partial \psi\left(Q, Y, \varpi\right)}{\partial Y}\right\} = 0$, from which we derive $\frac{\partial \psi\left(Q, Y, \varpi\right)}{\partial Y} = 1$. Thus, lower rents exactly compensate city dwellers for the lower income.

We endogenize construction costs by assuming that they are a function of the number of units being redeveloped at each point in time $\kappa = \kappa\left(\delta N\right)$, with $\kappa'\left(\bullet\right) \geq 0$. With respect to redevelopment activity, the relevant condition at the fringe of the city is given by

(11) $$\psi\left(Q^{\min}\left(Y\right), Y, \varpi\right) = \kappa\left(\delta \int_{Q^{\min}(Y)}^{\bar{Q}} \phi\left(Q\right) \cdot dQ\right) \cdot \left[1 - \beta(1-\delta)\right].$$

Differentiating this with respect to *Y* yields

(12) $$\frac{\partial \psi}{\partial Q} \cdot \frac{\partial Q^{\min}}{\partial Y} + \frac{\partial \psi}{\partial Y} = -\kappa'\left(\bullet\right) \cdot \delta \cdot \phi\left(Q^{\min}\right) \cdot \frac{\partial Q^{\min}}{\partial Y} \cdot \left[1 - \beta(1-\delta)\right].$$

After some rearranging of terms, we can solve for

(13) $$\frac{\partial Q^{\min}}{\partial Y} = \frac{-1}{\left\{\frac{\partial \psi}{\partial Q} + \kappa'\left(\bullet\right) \cdot \delta \cdot \phi\left(Q^{\min}\right) \cdot \left[1 - \beta(1-\delta)\right]\right\}} \leq 0.$$

[7] In the case of the monocentric city, $\phi\left(Q\right)$ simply takes the value of the perimeter at each distance.

When income decreases, the minimum developed quality goes up. Redevelopers will withdraw from "fringe" lower qualities, and these "fringe" areas will experience decline. In fact these areas will disappear at an annual rate equal to the depreciation parameter δ.

Note that decline is reduced if construction costs are sensitive to construction levels. More specifically, if the supply of physical structures is completely elastic so that $\kappa'(\bullet) \to \infty$, then $\frac{\partial Q^{\min}}{\partial Y} \to 0$. Thus, if construction costs fall when there are negative demand shocks, that should reduce city decline. Figure 2 illustrates this conclusion. If construction supply is very inelastic as given by the κ' schedule, the minimum quality in the new equilibrium ($Q'^{\min}_1$) is higher, so that a bigger area of the city must have decayed. However, if costs fall with the decline in demand (i.e., the κ'' schedule is the relevant one), then the extent of decay is reduced. Thus, determining just how sensitive construction costs are to decline is an important empirical question that needs to be addressed.

A Negative Supply Shock

Changes in the supply side also could directly induce decay and shrink the city. This is illustrated in Figure 3 in which an upward shift in construction costs generates a reduction in the area that is developed. Just how important the impact of changes in construction costs is on the long-run housing stock depends on the distribution of housing location qualities $\phi(Q)$. If the density of units with amenity levels at or near the fringe level is high (so that $\int_{Q_1^{\min}}^{Q_0^{\min}} \phi(Q)$ is big), small changes in construction costs may be associated with substantial city decline. Thus, the distribution of housing prices near the "fringe" redevelopment quality ($Q^{\min}$) will be an important determinant of whether changes in construction costs could have a meaningful impact on city decline.

This simple framework demonstrates that we need the answers to at least four questions in order to better understand the role of the supply side in city decline. First, how responsive are construction costs to construction levels and decline? Second, what are the determinants of construction costs across cities? Third, how do construction costs influence the redevelopment/renovation of owner-occupied homes. In particular, does reinvestment decline when home values fall below replacement costs? Finally, what is the empirical distribution of units that are close to the redevelopment fringe?

3. Data

The *American Housing Survey* (*AHS*) is our primary data source on housing prices and renovation expenditures. The metropolitan files of the *AHS* from 1983-1994 not only provide house price data but also contain information on investments and reinvestments by owner-occupiers.[8] Data on 10 categories of expenditures are available.[9] We aggregate spending across all categories into a single sum that we term "renovation" expenditures.[10] The Urban Consumer Price Index (CPI-U) less its shelter component is used to convert all monetary values into 2001 dollars. Average annual renovation expenditures per household were $1,945 (with a standard deviation of $3,117) over the

[8] We are not able to use data from later surveys because of a change in the structure of the maintenance and renovation questions. After 1994, data are reported for very different categories of housing-related expenses. Hence, the 1983-1994 responses are not readily comparable to those from 1995-onward.

[9] These are routine maintenance, roof repair or replacement, kitchen remodeling or addition, bathroom remodeling or addition, siding replacement, storm windows or doors added or replaced, insulation added or replaced, major equipment added or replaced, other major additions, and other repairs in excess of $500. Reported spending in all categories except routine maintenance is for a two-year period. Annual figures are obtained by dividing by two.

1983-94 period. The distribution was skewed with a median of $793. The interquartile range was $152-$2,417, with 17 percent of the observations reporting zero renovation spending. Conditional on expenditures being greater than zero, the mean was $2,387.

We are able to match house price and renovation spending to construction cost data for all 43 metropolitan areas in the 1983-94 metropolitan AHS samples.[11] Our source for construction costs is the R.S. Means Company. Briefly, the Means Company monitors construction costs in numerous American and Canadian markets. We match the markets to the corresponding MSA.[12] Local construction costs per square foot of living area are reported. Construction costs include material costs, labor costs, and equipment costs for four different qualities of single-unit residences. No land costs are included.[13] The Means data contain information on four qualities of homes—economy, average, custom, and luxury. The data are broken down further by the size of living area (ranging from 600 sq. ft. to 3,200 sq. ft.), the number of stories in the unit, and a few other differentiators, such as the presence of a basement.[14]

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[10] We also worked with individual expenditure categories, but doing so yielded no key insights beyond those found using the aggregate data. See the discussion below and footnote 34 for those details.

[11] See Appendix Table 1 for a list of these areas.

[12] We recognize that construction costs can vary somewhat within a metropolitan area (for example, between city and suburbs). However, our results are not sensitive to dividing the sample into units in the central city versus suburban parts of the metropolitan areas.

[13] Two publications are particularly relevant for greater detail on the underlying data: *Residential Cost Data*, 19th annual edition (2000) and *Square Foot Costs*, 21st annual edition (2000), both published by the R.S. Means Company.

[14] Somerville (1999) has critiqued the Means data, documenting that the evolution of a particular hedonic estimate of construction costs for a sample of new buildings in Baltimore, Cincinnati, and Houston between 1979 and 1991 exhibits an evolution different from that of the Means data for those places. There is no doubt that the data are imperfect. However, they are available for a broad set of areas, and they have passed an important market test in that they are widely used in the construction sector for budgeting purposes. Perhaps more relevant than the revealed preference of firms' willingness to pay money for such data is the fact that any measurement error in this series should have its usual effect—namely, to bias toward zero the estimated relationship between construction costs and renovation spending. Given the absence of any reason to suspect the data would bias us toward finding a significant relationship, the issue of quality literally is an empirical one. And it turns out that the variable performs quite well empirically. See below for more on that.

The *AHS* and Means data are combined to create the ratio of price to construction cost. We focus on costs for a basic, economy-quality house with the average cost associated with four possible types of siding and building frame. Generally, our choices reflect low to modest construction costs.[15] We also use unit traits from the *AHS* to help us identify the relevant costs for each unit (e.g., whether the proper costs are those associated with there being a basement or not).

To obtain comparable values for homes "as if new," we made a number of adjustments to the *AHS* data prior to constructing this ratio. While the data appendix goes into the details, it is noteworthy that prices are adjusted to account for depreciation, for general inflation, and for the fact that research shows owners overestimate the value of their homes.[16]

We also collected information on a variety of other variables, including housing permits from the U. S. Bureau of the Census Series C-40 reports and per capita MSA-level income from the Bureau of Economic Analysis (BEA). Total local government expenditures involved in regulating and inspecting private establishments for the protection of the public or to prevent hazardous conditions (which include building code enforcement) at the metropolitan level are obtained from the 1992 Census of Governments. We always use 1999 MSA and NECMSA definitions when matching these data to particular areas.

A final variable is the extent of unionization in the construction sector, which we compute from various issues of the Current Population Survey. Because there typically

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[15] This strategy will tend to overstate the true ratio of price to cost for all but the lower quality homes. The implications of this are discussed more fully below.

[16] The net effect of the adjustments on average is to increase prices above those reported. Even after deflating prices by 6 percent to account for overvaluation by owners (see Goodman and Ittner (1992)), the

are too few usable observations by year and metropolitan area, we calculate unionization rates in the construction sector by pooling all observations in the 1984-2000 CPS files by metro area. The results for the 47 metropolitan areas with populations of at least 1 million in 1992 are listed in Appendix Table 2. There is a very wide range of unionization rates in the construction sector, ranging from zero (San Antonio) to well over 50 percent (Buffalo and Chicago). In 14 of these areas, unionization rates are below 10 percent;[17] in another 20, they exceed 30 percent.[18]

4. Construction Costs Across Metropolitan Areas

Data on construction costs per square foot and selected other variables were successfully matched for a panel of 146 metropolitan areas. In 1992, the year for which we report on our analysis of the cross-sectional variation in construction costs, the unweighted mean cost of physical construction of a small, economy-quality home was $49.64 per square foot, with a standard deviation of $5.95.[19] The interquartile range runs from $45.12/sq. ft. to $52.93/sq. ft. Costs of a very modest quality home were lowest in Columbus, Georgia, ($40.95/sq. ft.) and highest in Anchorage, Alaska ($69.34/sq. ft.).[20]

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mean adjusted value still is 32 percent higher than the unadjusted mean due to the importance of age and vintage effects (which are described more fully in the Data Appendix).

[17] From lowest to highest rates, they are San Antonio, Greensboro, Fort Lauderdale, Charlotte, Fort Worth, Nashville-Davidson, Dallas, Orlando, Tampa, Atlanta, Salt Lake City, Phoenix, Houston, and Memphis.

[18] Again in increasing order, they are Rochester (NY), Sacramento, Pittsburgh, Hartford, Portland (OR), Boston, Newark, Philadelphia, Seattle, Indianapolis, San Francisco, Cleveland, St. Louis, New York City, Milwaukee, Paterson, Detroit, Minneapolis, Buffalo, and Chicago.

[19] All values are in 2001 dollars. Information on other years is available upon request. None of our key findings is sensitive to the choice to report results for the year 1992.

[20] Appendix Table 1 provides a more detailed look at construction costs for the smaller group of 43 metropolitan areas that can be matched to our metropolitan area panel from the *AHS*. The reported prices correspond to the year in which the MSA is first sampled and are in 2001 dollars. The unweighted mean cost for the *Metro AHS* sample was $56.31, with a standard deviation of $5.85. The interquartile range runs from $52.08/sq. ft. to 60.32/sq. ft., with Norfolk, VA, having the lowest cost (46.29$/sq. ft.) and San Francisco, CA, the highest (72.88/sq. ft.).

We begin our analysis by explaining the cross-sectional variance in construction costs. We are especially interested in whether construction costs are sensitive to shifts in demand. Knowing the elasticity of the supply side of the market is critical for declining areas as was illustrated in Figure 2. If construction costs fall in these areas, maintaining existing structures or building new ones need not be so unattractive financially.

Table 1 provides the answer to this question in the form of regression results from a specification in which the logarithm of construction costs for a 2,000-square-foot economy-quality home in 1992 is the dependent variable. The independent variables include a proxy for the demand for structures in the area along with other control variables. The log of total housing permits issued in the previous year serves as the proxy for demand.[21] We also include the log of MSA per capita income, the share of construction workers that are unionized in the MSA, local government expenditures on regulation and inspection, and regional dummies.

Ordinary least squares (OLS) estimates are reported in the first column.[22] Note that building costs are not very sensitive to the number of housing units built, suggesting that the supply of structures is quite elastic. However, the OLS specification suffers from a classic identification problem—namely, in areas with higher construction costs, the demand for new building is likely to be lower. Hence, we perform an instrumental variables (IV) estimation in which we use the log of population and the log of cooling

[21] Other obvious candidates are renovation and rehabilitation themselves. However, they are strongly correlated with the level of new housing construction. Hence, using lagged permits avoids the endogeneity associated with *expenditures* on renovation, which by construction are proportional to the price of renovation.

[22] Some MSAs only have a few usable CPS observations in the construction sector. Naturally, unionization rates are estimated with more noise, the smaller the number of complete observations. To address this issue, we weight the observations by the number of valid CPS responses. Results for the other variables are not sensitive to this weighting.

degree-days as instruments for the demand for housing.[23] We report these results in column 2 of Table 1. As expected, the IV estimates are substantially larger, but they still suggest a very elastic supply of physical structures.[24]

If variation in the amount of building activity cannot account for the variation in construction costs, what does? It turns out that the supply shifters themselves are very powerful, accounting for over three-quarters of the variance. For example, per capita income at the metropolitan area level is statistically and economically important, with an elasticity near 0.15 in the IV results.

Interestingly, the share of construction workers that are unionized is an especially strong predictor of higher construction costs. Given the highly significant coefficient of 0.45 (IV specification in column 2), a one-standard-deviation higher unionization share (of about 20 percent) is associated with construction costs that are 9 percent higher (i.e., .2*.45=.09). Union wage premia (Freeman, 1984) or the costs of restrictive work rules certainly could be directly related to higher construction costs.[25] It is also interesting that many declining cities have a strongly unionized construction sector. The correlation between population growth during both the 1980s and 1990s with the unionization variable is just over –0.5. Yet, one should not necessarily confer a causal interpretation to the higher costs of unions for the entire effect of this variable. The impact of unions

[23] Population seems a natural instrument because depreciation and turnover will be higher in bigger cities, generating a stronger demand for new units. The weather, and warm weather especially, has been shown to be highly correlated with metropolitan growth in recent decades. Glaeser, Kolko and Saiz (2001) and Glaeser and Shapiro (2003) provide the details on how this amenity has become an important driver of the demand for metropolitan location.

[24] We also estimated specifications to test for nonlinearities in the relationship between prices and quantities. Models that included polynomials of construction costs or a series of 10 dummies for housing permit deciles were rejected in favor of the linear relationship.

[25] For example, Freeman and Medoff (1981) demonstrate that a 1-percentage-point increase in the unionization rate in the construction sector is associated with a 0.3 percent increase in union wages. Unions also have effects on productivity and the organization of labor within firms (Freeman and Medoff, 1983).

on local economies is likely to be complex. And the extent of unionization may be associated with other factors such as stricter building codes or some other omitted political factors that themselves influence building costs.[26]

The variable controlling for local expenditures per capita on inspection and regulation should help control for these factors. These expenditures cover spending on housing code enforcement and inspection, among other things. We believe such expenditures are a proxy for the strictness with which local regulations are enforced. The positive coefficient on this variable is consistent with this view, as when spending on regulatory enforcement doubles (which is approximately a one-standard-deviation change or a log change of one unit), construction costs increase by about 2 percent.

It is also noteworthy that these effects hold within region, especially given the strong spatial correlation of unionization rates.[27] The Northeast (which is the omitted region) and West census regions are relatively expensive, since the same quality house can be built for at least 10 percent less in the South and Midwest.

[26] For example, Burby et al. (2000) report a negative correlation between how strictly building codes are enforced and the level of new construction in a city. In addition, the broader point about unions possibly thriving in environments conducive to high costs is amply illustrated by a recent event in our hometown of Philadelphia. The September 9, 2002, *Philadelphia Inquirer* contained an article entitled "Board no longer granting variances from PVC pipe" (see the front page of the newspaper from that day). The article claimed that Philadelphia's mayor, in response to appeals from the local plumbers' union, had pressured building officials to stop issuing variances for a money-saving construction material called PVC pipe. PVC pipe is a plastic sewer pipe that is substantially cheaper and easier to install than the standard cast iron pipe. The article also noted that PVC pipe cost from $10-$15 per 10-foot length versus about $100 for the same length of cast iron pipe. Essentially, the plumbers' union believed that allowing the cheaper and more flexible sewer pipe would hurt their members economically—largely because less time would be required on such jobs. The *Inquirer's* reporter claimed that this issue was relevant for at least 1,500 sewer repair jobs in the city each year that cost homeowners an average of $3,000. Using PVC pipe was estimated to save between $200-$600 per job. This particular issue is part of a broader debate in Philadelphia to modernize the building code. Thus far, the local building trades unions have successfully defeated efforts at modernization that would result in lower construction costs. Thus, Philadelphia provides a particularly apt example of how the presence of a strong union is associated with local political and regulatory environments that themselves are conducive to high costs.

[27] Regional dummies alone account for 51 percent of the variance in construction costs across metropolitan areas.

Finally, it is useful to emphasize that our focus here has been on the cross-sectional variation in construction costs. Our results do not imply that *national* increases in construction activity would not result in higher average input prices nationally, as they well may (Somerville, 1999). Rather, our conclusion is that relative changes in construction activity across areas do not change relative construction costs across the same areas--given the national level of construction. That is what really matters for decaying cities in the long run (i.e., independent of the business cycle) because it implies that one should not expect construction costs to fall much and dampen the impact of a negative demand shock on housing decay.

5. Expenditures on Renovation and Construction Costs

We are now ready to address the core issue of the paper—namely, the impact of changing construction costs on renovation expenditures. We have already shown that, in a strictly financial sense, if the cost of replacing capital is above the value of the newly installed capital, then it does not make sense to maintain. However, a potentially important prior question is whether the relevant cost of capital for reinvestment is that associated with the average building cost. Following Henderson (1977) and Margolis (1981), we assume construction and renovation technologies are similar.[28] However, it is at least hypothetically possible that the true cost of renovation is determined more by the prices Home Depot charges for materials than it is by local building costs for new units.

We address this issue in Table 2 which reports results from random effects specifications that regress the logarithm of mean renovation expenditures on the log of

[28] Other models, such as in Arnott, Davidson, and Pines (1983), have assumed different technologies for construction and maintenance. Whether construction costs are good proxies for the cost of renovation is an empirical matter.

construction costs. We use the MSA panel of average house prices from the *Metro AHS* files and construction costs from the R.S. Means Company. There is a very strong relationship between renovation expenditures and constructions costs even when we control for city average income, year fixed effects (which capture the national evolution in inflation and the price of raw materials), and MSA random effects that account for location-specific, time-invariant heterogeneity.

The results from column two, which control for local income, imply that a 1 percent increase in construction costs is associated with a 0.72 percent increase in maintenance/renovation expenditures. The fact that this elasticity is below one suggests a non-zero substitution effect.[29] To see this, note that total renovation expenditures are the product of the price of renovation (p - proxied by building costs) and the quantity of renovation ($q(p)$). The coefficient reported in the top row of Table 2 can be defined as

$$(14) \qquad \frac{\partial \ln\left(p \cdot q(p)\right)}{\partial \ln p} = 1 + \frac{\partial q(p)}{\partial p} \cdot \frac{p}{q(p)} = 1 + \varepsilon_p ,$$

from which we can retrieve an implied price-elasticity of renovation equal to -0.28 using the results from the preferred specification in column two. Even if we assume the impact of construction costs to be at the bottom end of the 95 percent confidence interval for the coefficient on construction costs in column two, the consumption of renovation services still is relatively price-inelastic.[30]

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[29] However, we cannot be confident that the coefficient on construction costs is significantly different from one. We are confident that the results are not driven by omitted variable bias: a fixed effects model reaches similar results, although the variance of the estimates increases substantially when we discard the cross-sectional variation (because there are at most three observations over time per metropolitan area in the panel).

[30] In that case, a 1 percent higher level of costs is associated with a 0.38 percent higher level of renovation expenditures (i.e., 0.38 = 0.72 – (2*0.168), where 0.72 is the coefficient point estimate and 0.168 is the standard error about that point estimate). Using the formula from equation (2), the implied price elasticity increases only to –0.62.

Table 3 then reports our findings on how sensitive renovation expenditures are to house values being below building costs. To help answer this question, we created a dichotomous dummy variable that takes on a value of one if the reported home value is below what it would cost to replace the entire structure with "economy-quality" materials and labor.[31] This cost is the product of the unit square footage reported in the *AHS* and the Means Company estimate of economy-quality construction cost per square foot in the relevant metropolitan area and year.

Many households report zero renovation expenditures. However, it is possible that the desired or actual level of renovation expenditures is negative, as some owners may be deliberately running down the capital in their homes. Because the renovation variable in the *AHS* is censored at zero, we propose the following Tobit model,

(15) $$R^*_{ikt} = A_k + Y_t + \beta \cdot Bel_{ikt} + \lambda \cdot Val_{ikt} + \Phi X_{ikt} + \varepsilon_{ikt}$$

with $R_{ikt} = 0 \quad if \quad R^*_{ikt} \le 0$,

and $R_{ikt} = R^*_{ikt} \quad if \quad R^*_{ikt} > 0$,

where R_{ikt} is renovation expenditure, R^*_{ikt} is an uncensored latent variable for renovation expenditures, A_k a MSA fixed effect, Y_t a year fixed effect, Bel_{ikt} is a dummy that takes on a value of one if the unit is valued below construction cost, Val_{ikt} is the home value, and X_{ikt} is a vector of household variables (home age, number of rooms, household

[31] Strictly speaking, prices need not be below construction costs for owners to want to depreciate their housing capital. For example, if value is above cost, but the land is worth more in an alternative (non-residential) use, letting the physical structure deteriorate can be optimal. Thus, being below cost is a sufficient, but not necessary, condition for lack of reinvestment. As we compare a group with values below cost (the treatment) with the rest of the owner-occupiers (the control), we will understate the impact on renovation.

income, unit square footage, and a dummy for the presence of a porch). The subscripts are i for the household, k for the metropolitan area, and t for the year.

Column 1 of Table 3 reports our baseline Tobit results. They include MSA fixed effects that account for time-invariant, city-specific variables such as tastes, municipal codes, or disamenities that influence city decline and could be correlated with renovation expenditures. Year fixed effects control for the fact that the observations are from different years and for national changes in tastes or renovation quality. We control for unit-specific variables that are suggested in the renovation literature and for household income.[32] Finally, because a given unit can appear multiple times in the different waves of the metropolitan sample, standard errors are clustered by unit.

The results indicate a significantly negative impact of -$240 on renovation expenditures from being below cost.[33] This is about 12 percent of the mean annual

[32] For instance, see Mendelsohn (1977), Boehm and Ihlanfeldt (1986), Spivack (1991), Reschovsky (1992), and Bogdon (1996).

[33] Our specification obviously assumes a common treatment for all units whose values fall below construction costs. Of course, it need not be the case that everyone is equally marginal in this sense. Hence, we also estimated a model in which the interaction of the below-cost dummy with the gap between the value-to-cost ratio and one (i.e., Bel*(1-value/cost)) was included. In that case, the below-cost dummy retains its significance, but the interaction term is neither statistically nor economically significant. Because the data may not be of high enough quality for us to distinguish the impacts associated with small changes in the extent to which a unit is valued below cost, we also experimented with specifications that divided the sample of units with values into less fine groupings. When we did so, we always found bigger impacts for units with values the furthest below construction costs. [For example, if we divide the "below cost units" in half, we find that those in the group with value-to-cost ratios closest to one spent $161 less on renovation, while those in the other group spent $335 less on renovation. The cut-off point between these groups was a value-to-cost ratio of about 0.7. Both coefficients were statistically significant from zero, but we could not reject the null that they are equal. If we divide the "below cost units" into thirds, we find the same pattern of increasingly negative effects for units with the lowest value-to-cost ratios, but the coefficient for the group closest to one in value had a t-statistic of only –1.4.] Unfortunately, it is not clear whether this is due to true non-monotonicity in the impact or to the fact that attenuation bias from misclassification is greater for units with value-to-cost ratios close to one. This issue obviously will matter for certain policy purposes, including if one wished to estimate the precise amount of the additional renovation that would result if construction costs were (say) 10 percent lower. While we leave that policy simulation exercise to future research because its implementation requires much different data, we can identify the places with the largest fractions of homes whose "below cost status" would change because of a drop in construction costs. See the final section for those findings.

renovation expenditure of $1,950.[34] The other coefficients also have the expected signs: older, bigger, more valuable houses with richer inhabitants experience greater investments in renovation. Average home values and household income are $151,487 and $63,570 respectively, so the implicit elasticities for renovation at the mean are 0.3 with respect to home values[35] and 0.4 with respect to income.[36]

Our OLS estimate of the impact of construction costs on renovation spending may be biased upward because of endogeneity and biased downward because of measurement error. Endogeneity could be a problem because households that systematically invest less in home renovations are depreciating their housing stock faster, thereby increasing the probability that their home values will fall below construction costs.[37] Thus, the below-cost dummy is endogenous to renovation expenditures despite the fact that we are controlling for housing value in our reduced-form regression. Consequently, part of the negative association between the below-cost dummy and renovation might be accounted for by reverse causation.

As for measurement error, both the numerator and denominator of the below-cost dummy are highly likely to be noisy. This variable takes on a value of one if the ratio of house value to construction cost is less than one. Some units are likely to be

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[34] While these results are for the aggregate of spending on renovation, we have experimented with models for the different types of spending (i.e., on additions, alternations, regular maintenance, etc.). All regressions for separate renovation categories yield the same qualitative answer--units below replacement cost receive less investment. However, we could not discern any interesting patterns for these results, and the estimates using disaggregated spending data are noisier.

[35] If home loans are non-recourse, one could argue that is not value but home equity that matters for investment. In practice, the *AHS* data makes it very difficult to calculate this variable. We attempted to impute home equity values for housing units with fixed-payment mortgages, but the estimate is extremely noisy and is never significant in the regressions.

[36] The later is slightly smaller than Mendelshon's (1977) estimate of 0.6 and Boehm and Ihlanfeldt's (1986) estimate of 0.53. While both studies use different samples and time frames, we suspect that the inclusion of MSA fixed effects in our specification accounts for the bulk of the difference.

[37] Recent research by Knight and Sirmans (1996) and Gyourko and Tracy (2003) indicates that the impact of reduced investment in renovation is reflected in lower self-reported house values.

misclassified because relatively small errors in reporting square footage or home value can lead us to mistakenly categorize the unit as being above or below cost. For example, only a 10 percent underestimate of unit square footage increases value per square foot by about 11 percent. We suspect that errors of this magnitude are likely, especially with respect to unit size, so measurement problems in the below-cost dummy could be significant, thereby generating potentially severe attenuation bias.

To deal with both problems, we employ an instrumental variables (IV) approach that exploits a feature of the *AHS* that allows us to identify other units in the same census tract.[38] We calculate the average value per square foot for each unit in each year in the census tract in which the unit is located, and then create an instrument for the below-cost dummy for home i (denoted Bel_IV_{ikt} in equation (16)), excluding information on the unit's own value. That is, Bel_IV_{ikt} takes on a value of one if the average value of the other units in the same tract is below construction cost, and zero otherwise. More formally,

$$(16) \qquad Bel\_IV_{ikt} = 1 \quad if \quad \frac{\sum_{\forall j \neq i \in tract_i} \frac{Val_{jkt}}{ft_{jkt}}}{n_i - 1} < CC_{kt}\text{, with}$$

$$Bel\_IV_{ikt} = 0 \quad otherwise$$

This instrument should help us deal with both sources of bias. First, it lets us obtain consistent estimates in the presence of endogeneity, as a household's renovation expenditures should not affect the rest of the tract's average housing values.[39] Second, it

[38] We do not know the identity of the specific census tract, only that a cluster of units is located in a common tract.
[39] We do not believe that segregation with respect to tastes for renovation is an issue. Nevertheless, we will control for neighborhood-specific characteristics (such as possibly omitted neighborhood-specific tastes for renovation) in the unit fixed effects regressions reported below.

helps deal with the attenuation-bias problem. Averaging by tract should yield cleaner values of the below-cost dummy. If the tract's average house value is below construction cost and the below-cost variable is below one, then we can be much more confident that the unit is, in fact, valued below construction cost.

We then employ a two-stage least squares (2SLS) estimation using the Tobit model (Nelson and Olson (1978)). In the first stage, we regress the below-cost dummy variable on the instrument and the other explanatory variables. We then use the fitted variables in the second stage with the main Tobit model. Bootstap standard errors are reported based on 200 repetitions of the 2SLS procedure.

The results from this IV approach are reported in the second column of Table 3. The coefficient on the instrumented value-to-cost ratio becomes much larger (in absolute value) and remains highly statistically significant. Units with values below construction cost now are estimated to have renovation-related expenditures that are \$911 lower—or nearly 50 percent of the annual mean expenditure level. This suggests that the attenuation bias in the OLS specification is very important.

It is noteworthy that the results in Table 3 are not simply capturing the impact of lower housing values on renovation, since house values, not just unit traits, are being controlled for. And the findings are robust to including nonlinearities in house value.[40] In fact, additional analysis confirmed that the relationship between renovation and home values is strongly linear.[41] Note also that units with the same value can differ in the

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[40] For example, we experimented with up to third order polynomials of house value. These terms were not statistically significant, nor did they have a material impact on the estimated impact of being below cost. Notice that this strategy is akin to a regression discontinuity design, where we are also using the between-city variance in construction costs.

[41] After introducing 20 dummies for each corresponding value quantile into our regressions, we still could reject that they are significant at the 5 percent or 10 percent confidence levels. We have also plotted the

below-cost dummy because of differences in construction costs between city and over time.[42]

Robustness Checks of the Results

One concern with our estimation strategy is that the results might be being driven by omitted tastes for housing services that are negatively correlated with the below-cost dummy. Consequently, we estimated a specification for a home expenditure that is related to the consumption of house services, yet does not have an investment aspect. In the case of a pure consumption expense, we would not expect to find any significant relationship between being below replacement cost and expenditure on the item in the absence of the specification bias just discussed.

Our "placebo" of choice is the annual cost of electricity, which is reasonably well reported in the *AHS*. Consumption of electricity is directly connected with the time spent at home and with the consumption of various home-related services. The insignificant and positive coefficient (row 1, Table 4) certainly provides no evidence in support of the possibility that omitted tastes for housing-related consumption are likely to be accounting for our results here.

We also pursue a second approach to investigating this issue, this one exploiting the longitudinal aspect of the metropolitan files of the *AHS*. Specifically, we estimate a fixed-effects model, as in equation (17), which takes into account unobserved heterogeneity in the household's tastes for housing services

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relationship between average value and average renovation expenditure for 200 quantiles of value. A strong linearity remains.

[42] If we restrict ourselves to the common support (in terms of the value distribution) of the below-cost and above-cost groups, this point is more dramatic as there is always a unit in the alternate group with comparable housing values. The regression results in this case are –$170 (-$1,030) in the OLS (IV) specification, which are very similar to the findings reported in Table 3.

(17) $$R_{ikt} = A_i + Y_t + \beta \cdot Bel_{ikt} + \lambda \cdot Val_{ikt} + \Phi X_{ikt} + \varepsilon_{ikt},$$

where A_i is a household fixed effect and all other variables are as defined above. The fixed-effects estimator is identified on the within-unit variation in the explanatory variables.[43] Table 5 reports results from this specification, with the relationship between the below-cost dummy and renovation remaining negative and generally strong. Because the variables used in the fixed effects regressions are deviations from the group means, measurement error is likely to be exacerbated, and that is what we find. The IV estimates in particular are very similar to those reported in Table 3 but are less precisely estimated.

Note that the OLS and IV results in the first two columns of Table 5 use the variance from units that changed their below-cost status. If households take time to adjust their investment decisions after their units change from above to below cost (or *vice versa*), then those estimates may understate the long-run impact of being below cost. To investigate this possibility, we exploit information for the units that did not change their below-cost status. Each unit can appear with full information in either of at most three waves of the metropolitan files of the *AHS* (during the period for which we have data). Each wave typically is four years apart. Thus, we can create a variable that takes on the value of the number of the corresponding sample wave for each unit. We then interact this variable with the below-cost dummy and include it in the specification reported in column 3 of Table 5. This allows us to identify whether there is a trend effect, not just a level effect, of being below cost on maintenance. The results suggest that this does seem

[43] Notice that we cannot deal with the censoring of the renovation variable here, since the sign of the difference between a zero value and the group mean that contains other zeros is indeterminate. This is not a major problem in the empirical specification. OLS estimates of the parameters reported in column 1 of

to be the case, since the difference in renovation expenditures between units that are always below cost and units that are always above cost increases by about $100 each wave (or about $25 per year).

We close this section with an analysis of two additional issues pertaining to the reliability of these findings. One, in the fixed effects specification, derives from the possibility that changes in the "below-cost" dummy could be capturing long-term trends (not levels) in neighborhood quality that themselves could be correlated with (or even caused) by trends in the demand for renovation at the local level. The other arises from the possibility that owners of below cost units could be substituting "sweat equity" for cash spending on renovation. If so, the decline in monetary expenditures need not reflect an overall drop in reinvestment in one's home.

Table 6 sheds light on the first issue by reporting the transition matrix into and out of below-cost status. Units can appear in the sample once (T=1), twice (T=1,2) or three times (T=1,2,3). We show all possible transitions for our sample and match these to the average expenditures in renovation. It is striking that *all* transitions are consistent with a behavioral story of responses in renovation to changes in below-cost status. Even medium-lived (4-year) transitions in the below-cost status (transitions 1,0,1 and 0,1,0 in the table) are associated with changes in renovation expenditures in the right direction.

As for the possibility that total investment in renovation may not have fallen, we can provide two pieces of evidence. First, we draw on the implications of Bogdan's (1996) research into the decision to hire outsiders for renovation projects. She reports that a number of variables—unit square footage, house value, household income, and select

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Table 5 yield similar results and, if anything, underestimate the impact of the below-cost dummy on renovations.

household traits such as education, race, and household composition—are important predictors of the propensity to "do it yourself." We already explicitly control for the first three of her factors, and have estimated more extensive models (not reported here) that include the other variables, without changes in the coefficient of interest.[44]

While our models with unit fixed effects should control for any household-level propensity to use "sweat equity," we also estimated a linear probability model of the propensity to "do it yourself." The dependent variable was a dichotomous dummy for whether owners reported doing any renovations themselves. The independent variables included the below cost dummy and all the other variables from Table 3; year and MSA fixed effects also were controlled for. We found a small, but statistically significant *negative* correlation between being below cost and "doing it yourself." Not only is there no evidence of owners in below-cost units substituting "sweat equity" for cash reinvestment, but the data suggest that "do it yourself" efforts fall along with cash expenditures for such owners. Hence, it seems likely that our estimates are lower bounds on the overall drop in renovation effort among below-cost units.

6. The Distribution of Home Values: How Empirically Relevant Are "Fringe" Areas?

Because the impact of supply shocks on revitalization will be greater in areas in which home values tend to be close to replacement costs, we summarize the distribution of the value-to-cost ratio for the 43 metropolitan areas from the 1984-1995 AHS Metro

[44] Specifically, if we also control for race, the presence of a female head, the number of persons in the household, and the head's education, the coefficient on the below-cost dummy is not affected in a material way.

samples in Tables 7 and 8. Table 7 focuses on central cities, while Table 8 pertains to the outlying areas of each metropolitan area.

The markets are sorted in descending order by the fraction of their housing stocks that we calculate have values between 90-100 percent of construction costs in the area (see the numbers in the middle column of the tables), with a fuller description of the distribution in the other columns. We choose this particular cut-off point because we think it relevant for considering a number of changes that could influence construction costs in an area. Recall that a one-standard-deviation decline in construction sector unionization rates was associated with a 9 percent decline in construction costs (see Table 1). In addition, changing regional status from the Northeast to the South was associated with construction costs that were at least 10 percent lower. One can also readily imagine various targeted supply-side policies that could reduce construction costs by at least 10 percent, thereby taking the values of these homes from being below to above replacement costs.

Among the central cities, Milwaukee has the highest fraction of its owner-occupied units—at 14.4 percent--with values between 90-100 percent of construction costs (Table 7). Over one-quarter of Milwaukee's units are between 80-100 percent of construction costs. It also is clear from Table 8 that there are various suburban markets with relatively large fractions of units having values just below replacement costs. Buffalo is the leading example, with 11 percent of its units priced less than 10 percent below costs and another 10 percent no less than 80 percent of replacement costs.

That said, it also is apparent that modest changes in construction costs are unlikely to change the "below-cost status" of many units in a number of other markets.

And it is noteworthy that not all of these markets are growing areas with relatively high prices. For example, it should be no surprise to find that the Seattle, San Francisco, San Diego, Los Angeles, Anaheim, New York City, and Riverside markets have virtually no units priced anywhere below construction costs. However, the situation is only little different in Detroit. Only 2 percent of homes in the central city of Detroit have values between 90-100 percent of construction costs, with another 3 percent are priced between 80-90 percent of costs. Modest changes in construction costs clearly will not affect whether the vast majority of Detroit's homes are valued below or above replacement value because 84 percent have value-to-cost ratios below 0.7. For markets such as these, it is difficult to imagine any realistic supply-side policy that could change the "below-cost status" of enough units to materially affect renovation spending in the market area.

Figures 4-6 then plot kernel density estimates of the distribution of value-to-cost ratios for three types of cities. Los Angeles represents the first group and is the prototype of a market experiencing rapid growth and in which land prices are high. Figure 4 highlights that the bulk of the mass in that distribution is to the right of 1 (where value equals replacement cost). Figure 5 graphs the kernel density for Detroit, a city in obvious decline, but one in which the decline has been so severe that values are so far below costs on average that positive supply-side shocks are unlikely to lead to much of an increase in renovation effort. Figure 6 then reports on Philadelphia, which like Milwaukee is a declining area. In this case, much of the mass of the value distribution is close to replacement cost. It is in cases such as this that the evolution of the supply side can play an important role in determining whether many areas of the city will decline or be redeveloped. The data in Tables 7 and 8 indicate that there are many areas similar to Philadelphia for which the maintenance and renovation expenditure effect identified above is likely to be quite relevant. Most of these places are in decline, but with downturns not so severe as to render irrelevant improvements in cost conditions. In places such as Milwaukee and Philadelphia, modestly lower construction costs certainly will not change basic urban trends, but the level of construction costs is likely to be a key factor that determines whether many of their neighborhoods will experience any significant reinvestment in their housing stocks. An upper bound estimate of the impact of a supply side change that lowered construction costs by ten percent would be the sum of the 2.8 percent additional renovation spending from the own price elasticity (of –0.28 from Table 2) and the $911 for each home valued between 90-100 percent of replacement costs whose house value is pushed above costs. Among cities with at least five percent of the stock changing its 'below cost status' from a 10 percent decline in construction costs, the increase in renovation spending ranges from 5.2 percent (Tampa) to 9.5 percent (Milwaukee).[45]

All this strongly suggests that urban scholars and policymakers should begin to focus attention on the drivers of high construction costs.

7. Conclusions

Negative housing demand shocks that have afflicted many American cities in the 20th century have received much attention in the urban and real estate literatures. In this

[45] There are upper bound estimates because they presume that all affected units are marginal. In Philadelphia's case the calculation suggest that renovation expenditures in the city would be higher by 6.4 percent--2.8 percent from the own price effect and 3.6 percent from the impact of 7.6 percent of the city's owned units changing their 'below cost status'. Even if the true effect of the latter impact is only half of what we estimate, the influence is economically meaningful.

paper, we examined the role of housing supply in declining areas. Construction costs were shown to be very insensitive to building activity, suggesting that the supply of structures is very elastic. Unions and regional factors were shown to significantly influence construction costs across areas, with income and regulatory effort playing lesser roles.

We then estimated that building costs are a very important determinant of renovation effort across metropolitan areas. Such spending increases by 0.72 percent when building costs go up by 1 percent, implying a price elasticity of –0.28. In addition, households were found to reduce their investment in renovation when home values go below construction costs--by nearly 50 percent of average annual expenditures in our preferred specification. The result is robust to using instrumental variables that account for endogeneity and for the attenuation bias introduced by measurement error. The results do not hinge on omitted household characteristics and are robust to including household fixed effects.

Finally, we present evidence on the distribution of house prices to construction costs implying that supply-side policies that generated a 10 percent reduction in construction costs could have a considerable impact on housing reinvestment in some areas. The impact will be greater, the flatter the distribution of the value-to-cost ratio in the area. A large number of older, manufacturing cities from Philadelphia to Minneapolis have relatively large fractions of their housing stock valued just below replacement costs. It is in these places that at least some neighborhoods are likely to become viable candidates for reinvestment if construction costs could be lowered even modestly.

References

Arnott, Richard, Davidson, Russell, and David Pines (1983). "Housing Quality, Maintenance and Rehabilitation," *Review of Economic Studies*, vol.50,no.3, pp.467-494.

Boehm, Thomas P., and Keith R.Ihlanfeldt (1986). "The Improvement Expenditures of Urban Homeowners: An Empirical Analysis," AREUA Journal, Vol,14, No.1.

Bogdon, Amy (1996). "Homeownership Renovation and Repair: The Decision to Hire Someone Else to Do the Project," *Journal of Housing Economics* 5, pp.323-350.

Burby, Raymond J., Peter J. May, Emil E. Malizia, and Joyce Levine (2000). "Code Enforcement Burdens and Central City Decline*," Journal of the American Planning Association*, 66, pp.1453-161.

Freeman, Richard B. (1984). "Longitudinal Analyses of the Effects of Trade Unions," *Journal of Labor Economics*, vol.2, no.1, pp.1-26.

Freeman, Richard B. and James L. Medoff (1981). "The Impact of the Percentage Organized on Union and Nonunion Wages," *The Review of Economics and Statistics*, 63 (4), pp.561-72.

Freeman, Richard B. and James L. Medoff (1983). "Trade Unions and Productivity: Some New Evidence on an Old Issue," NBER Working Paper #1249.

Glaeser, Edward L. and Joseph Gyourko (2001). "Urban Decline and Durable Housing," National Bureau of Economic Research: *Working Paper W8598*.

Glaeser, Edward L. and Joseph Gyourko (2002). "The Impact of Building Restrictions on Housing Affordability," *FRBNY Economic Policy Review*, forthcoming.

Glaeser, Edward L., Jed Kolko, and Albert Saiz (2001). "Consumer City," *Journal of Economic Geography*, vol.1, n.1, pp.27-50.

Glaeser, Edward L. and Jesse Shapiro (2003). "Urban Growth in the 1990s: Is City Living Back?" *Journal of Regional Science*, vol. 43, no.1, pp.139-165.

Goodman, John C. and John B. Ittner (1992). "The Accuracy of Home Owners' Estimates of House Value," *Journal of Housing Economics*, 2(4), pp.339-357.

Gyourko, Joseph and Joseph Tracy (2003). "Using Home Maintenance and Repairs to Smooth Variable Earnings," Wharton Real Estate Center Working Paper, March 2003.

Henderson, Jordan V. (1977). "Economic Theory and the Cities," New York: Academic Press.

Knight, John R., and C.F.Sirmans (1996). "Depreciation, Maintenance, and Housing Prices," *Journal of Housing Economics* 5, pp.369-389.

Margolis, Stephen E. (1981). "Depreciation and Maintenance of Houses," *Land Economics*, vol.57, no.1, pp.91-105.

Mendelsohn, Robert (1977). "Empirical Evidence on Home Improvements," *Journal of Urban Economics* 4, pp.459-468.

Nelson, Forest, and Lawrence Olson (1978). "Specification and Estimation of a Simultaneous-Equation Model with Limited Dependent Variables," International Economic Review 19, pp.695-709.

Reschovsky, James D. (1992). "An Empirical Investigation into Homeowners Demand for Home Upkeep and Improvement." *Journal of Real Estate Finance and Economics,* vol.5, n.1, pp.55-73.

Roback, Jennifer (1982). "Wages, Rents, and the Quality of Life," *Journal of Political Economy*, 90, pp.1257-78.

Rosen, Sherwin (1979). "Wage-Based Indexes of Urban Quality of Life," in P. Mieszkowski and M. Strazheim (eds.) Current Issues in Urban Economics (Baltimore, MD.: Johns Hopkins University Press), pp.74-104.

Rosenthal, Stuart S. (1999). "Residential Buildings and the Cost of Construction: New Evidence on the Efficiency of the Housing Market," *The Review of Economics and Statistics*, 81(2): 288-302.

Spivack, Richard N. (1991). "The Determinants of Housing Maintenance and Upkeep: A Case Study of Providence, Rhode Island," *Applied Economics*, 23, pp.639-646.

Somerville, Tsuriel (1999). "Residential Construction and the Supply of New Housing: Endogeneity and Bias in Construction Cost Indexes," *Journal of Real Estate Finance and Economics*, 18:1, pp.43-62.

TABLE 1

Accounting for Construction Costs

	Log Cost Sq.Ft. Economy 2000 ft. Home	
	OLS	IV
Log Total Housing permits at T-1	0.003	0.027
	(0.006)	(0.008)***
Log MSA per Capita Income	0.249	0.15
	(0.046)***	(0.051)***
Share Union Construction Workers	0.409	0.448
	(0.050)***	(0.050)***
Log Inspection Expenditures per Capita	0.022	0.017
	(0.009)**	(0.009)*
Midwest	-0.115	-0.14
	(0.017)***	(0.018)***
South	-0.094	-0.108
	(0.019)***	(0.018)***
West	0.027	-0.005
	(0.018)	(0.019)
Constant	1.129	1.922
	(0.449)**	(0.480)***
Observations	146	142
R-squared	0.79	0.79

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
The missing regional dumy correspond to the Northeast
Observations are weighted by number of responses to CPS union question.
IV: Log permits instrumented with log population and log cooling degree days

TABLE 2

Impact of Construction Costs on Renovation

	Log City Average Renovation Expenditures	
	(1)	**(2)**
Log City Construction Cost, 2000 Sq.ft. unit	**1.152**	**0.719**
	(0.188)***	(0.168)***
Log City Average Household Income		0.714
		(0.127)***
Constant	2.99	-3.203
	(0.740)***	(1.254)**
Year FE	*yes*	*yes*
MSA random effects	*yes*	*yes*
R-squared	0.52	0.67
Observations	108	108
Number of MSA	43	43
Implied price elasticity		**-0.28**

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 3

The Impact of Being Below Cost on Renovation

	Average Renovation ($)	
	(1)	**(2)**
	Tobit	IV Tobit
Unit is below economy cost, 1 = yes	**-238.803**	**-911.47**
	(60.134)***	(265.928)***
Property value	0.004	0.003
	(0.001)***	(0.0006)***
Estimated home age	26.429	28.661
	(1.426)***	(1.268)***
Number of rooms in unit	209.413	188.939
	(17.802)***	(16.274)***
Household Income	0.013	0.013
	(0.001)***	(.0006)***
Patio or porch, 1 = yes	279.019	215.97
	(61.365)***	(51.18424)***
Size of unit, sq. ft.	0.073	0.213
	(0.039)*	(.047)***
Constant	-2,708.26	-2,444.92
	(200.609)***	(227.171)***
MSA Fixed Effects	*yes*	*yes*
Year Fixed Effects	*yes*	*yes*
Observations	153647	141963

Robust (clustered by unit) standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

The average expenditure in renovation in the sample is $ 1,945 (2,387 conditional on a nonzero value).

TABLE 4

A Placebo: Expenditures on Electricity

	Annual Cost of Electricity IV
Unit is below economy cost, 1 = yes	**38.928** (39.800)
Property value(sample unit only)	0.00094 (0.00007)***
Estimated home age	-3.703 (0.158)***
Number of rooms in unit	63.760 (2.111)***
Household Income	0.002 (0.00007)***
Patio or porch, 1 = yes	31.266 (6.864)***
Size of unit, sq. ft.	0.059 (0.007)***
Constant	6.719 (22.906)
MSA Fixed Effects	*yes*
Year Fixed Effects	*yes*
Observations	147293
R-squared	0.31

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
The sample average annual expenditure in electricity is $1256.60.

TABLE 5

Within-Units Changes

	Expenditures in Renovation		
	(1)	**(2)**	**(3)**
	All		"Stable" Units
	FE	FE IV	FE
Unit is below economy cost, 1 = yes	**-138.577**	**-969.993**	
	(44.195)***	(609.21)	
Property value(sample unit only)	0.004	0.003	0.005
	(0.000)***	(0.001)**	(0.000)***
Estimated home age	1.362	2.111	0.408
	(9.160)	(9.794)	(10.792)
Number of rooms in unit	163.616	160.369	155.203
	(12.831)***	(13.547)***	(14.565)***
Household Income	0.007	0.006	0.007
	(0.000)***	(0.000)***	(0.000)***
Patio or porch, 1 = yes	153.085	134.657	184.865
	(41.975)***	(44.294)***	(48.704)***
Size of unit, sq. ft.	1.574	1.63	2.045
	(0.090)***	(0.134)***	(0.114)***
Below Cost Dummy x Sample Wave			**-105.852**
			(44.882)**
Constant	-3,518.62	-3,142.99	-4,547.97
	(296.216)***	(355.681)***	(348.231)***
Unit FE	*yes*	*yes*	*yes*
Year FE	*yes*	*yes*	*yes*
Observations	153633	141949	132442
Number of Units	82485	76677	73728
R-squared	0.02	0	0.02

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
"Stable" Units are units that do not experience a change in the below cost dummy (always above or under).
Sample Wave can take values 1,2 or 3, and refers to the number of times a unit has been sampled

TABLE 6

Transition Matrix: Total Expenditure in Renovation -- Units Sampled More than Once

	Below-Economy Dummy			Average Maintenance+Repairs		
Number of Units	**T=1**	**T=2**	**T=3**	**T=1**	**T=2**	**T=3**
25259	0	-	-	1430	-	-
4994	1	-	-	1900	-	-
25546	0	0	-	2132	2071	-
3574	1	1	-	1597	1382	-
2300	1	0	-	1620	1996	-
1745	0	1	-	1903	1425	-
1231	1	0	0	1639	2074	1935
688	1	1	0	1510	1763	1871
498	0	1	1	1626	1311	1194
758	0	0	1	1800	1730	1320
299	1	0	1	1342	1609	1466
638	0	1	0	1876	1439	1966
13361	0	0	0	2047	2247	2062
1598	1	1	1	1581	1511	1359
82489						

Note: Units can be sampled up to 3 times (3 waves)

TABLE 7
The Distribution of Value/Cost Ratios

CENTRAL CITIES

	<0.7	0.7-0.8	0.8-0.9	0.9-1	1-1.1	1.1-1.2	1.2-1.3	>1.3
Milwaukee	21.70%	10.09%	12.38%	**14.40%**	11.41%	7.58%	6.24%	16.20%
Minneapolis	6.17%	2.91%	6.32%	**11.24%**	10.66%	13.35%	9.31%	40.04%
Portland (OR)	10.37%	7.28%	9.72%	**11.06%**	11.10%	9.01%	7.69%	33.77%
Rochester (NY)	10.26%	6.57%	7.71%	**9.78%**	11.65%	6.64%	10.83%	36.56%
Birmingham	17.78%	7.06%	7.99%	**9.66%**	9.11%	8.49%	7.39%	32.53%
Buffalo	51.55%	10.30%	7.91%	**8.93%**	2.80%	3.11%	3.02%	12.37%
Cincinnati	15.68%	6.29%	7.63%	**8.92%**	10.19%	7.47%	5.98%	37.85%
St. Louis	23.48%	11.68%	8.66%	**8.63%**	11.25%	5.99%	6.05%	24.27%
Cleveland	48.29%	12.29%	10.17%	**8.10%**	6.30%	5.03%	3.27%	6.54%
Kansas City	17.89%	6.33%	7.85%	**7.65%**	8.11%	6.94%	7.98%	37.25%
Pittsburgh	30.01%	14.09%	6.85%	**7.58%**	5.50%	8.47%	5.41%	22.10%
Columbus (OH)	14.09%	6.73%	6.95%	**7.53%**	7.38%	7.26%	6.86%	43.20%
San Antonio	8.26%	4.05%	6.26%	**7.44%**	7.56%	9.25%	7.89%	49.30%
Philadelphia	27.15%	6.43%	6.67%	**7.29%**	8.82%	7.34%	5.84%	30.46%
Indianapolis	15.09%	5.95%	6.38%	**6.87%**	6.99%	6.66%	7.60%	44.45%
Baltimore	13.06%	5.28%	4.17%	**6.75%**	10.71%	9.21%	6.96%	43.84%
Chicago	15.10%	8.73%	6.34%	**6.75%**	6.47%	5.80%	4.59%	46.21%
Salt Lake City	1.57%	3.35%	4.58%	**6.69%**	7.79%	7.10%	9.30%	59.62%
Houston	10.54%	4.44%	5.51%	**6.09%**	6.79%	7.27%	7.74%	51.62%
Memphis	8.71%	4.27%	5.09%	**6.08%**	7.93%	7.83%	8.09%	52.01%
Tampa	4.10%	2.44%	4.04%	**4.86%**	5.65%	9.55%	6.24%	63.13%
Providence	9.57%	5.10%	7.42%	**4.73%**	6.15%	5.28%	6.00%	55.76%
Miami	6.08%	0.56%	0.56%	**4.58%**	2.62%	0.62%	4.86%	80.13%
Oklahoma City	8.37%	3.58%	4.25%	**4.37%**	5.39%	6.47%	9.11%	58.46%
Fort Worth	9.59%	4.30%	4.76%	**3.89%**	5.58%	6.05%	7.42%	58.41%
Dallas	3.94%	2.57%	3.85%	**3.63%**	4.55%	4.96%	6.75%	69.77%
Atlanta	9.99%	5.02%	1.78%	**3.20%**	3.57%	3.34%	4.12%	69.00%
New Orleans	2.55%	1.42%	2.47%	**3.18%**	2.71%	4.36%	6.50%	76.80%
Boston	5.57%	1.94%	3.29%	**2.89%**	3.52%	5.77%	1.84%	75.18%
Hartford	3.18%	1.47%	0.00%	**2.49%**	2.03%	2.31%	4.88%	83.65%
Phoenix	2.98%	1.27%	2.38%	**2.37%**	3.82%	4.52%	6.51%	76.14%
Detroit	83.65%	6.96%	3.14%	**2.18%**	1.17%	1.22%	0.34%	1.34%
Norfolk	3.15%	0.54%	1.09%	**2.13%**	1.88%	3.46%	4.42%	83.34%
Denver	0.95%	1.75%	1.95%	**1.92%**	3.89%	4.77%	8.70%	76.06%
Seattle	0.66%	0.76%	1.46%	**1.54%**	1.40%	3.76%	6.93%	83.48%
Washington	3.29%	0.12%	2.70%	**1.52%**	2.38%	2.12%	3.52%	84.35%
San Francisco	1.64%	0.18%	0.36%	**0.70%**	0.71%	2.02%	1.10%	93.30%
San Diego	0.32%	0.00%	0.08%	**0.21%**	0.16%	0.30%	0.56%	98.38%
Los Angeles	1.99%	0.17%	0.43%	**0.09%**	0.22%	0.70%	1.09%	95.29%
Anaheim	1.01%	0.23%	0.23%	**0.00%**	0.00%	0.28%	0.00%	98.26%
New York City	2.37%	1.06%	1.96%	**0.00%**	2.76%	1.91%	3.00%	86.95%
Riverside	0.00%	0.00%	0.76%	**0.00%**	0.77%	0.42%	1.31%	96.74%

TABLE 8
The Distribution of Value/Cost Ratios

SUBURBS

	<0.7	0.7-0.8	0.8-0.9	0.9-1	1-1.1	1.1-1.2	1.2-1.3	>1.3
Buffalo	14.68%	9.80%	9.95%	**11.08%**	10.79%	9.84%	6.46%	27.41%
St. Louis	11.26%	6.56%	9.04%	**9.86%**	9.45%	8.14%	7.49%	38.21%
Salt Lake City	2.96%	3.66%	6.77%	**9.44%**	10.47%	10.58%	9.84%	46.28%
Cleveland	6.49%	6.03%	6.47%	**9.27%**	9.43%	9.71%	8.24%	44.35%
Kansas City	10.14%	5.99%	6.36%	**8.75%**	9.11%	10.69%	9.73%	39.23%
Cincinnati	8.69%	4.09%	7.28%	**8.54%**	7.28%	8.51%	7.58%	48.02%
Detroit	10.59%	6.66%	8.18%	**8.31%**	8.86%	8.65%	6.76%	41.99%
Pittsburgh	21.50%	9.60%	9.71%	**8.16%**	8.36%	7.06%	5.88%	29.73%
Houston	6.47%	4.20%	6.83%	**8.05%**	9.29%	8.67%	8.47%	48.03%
Minneapolis	2.99%	2.44%	5.11%	**7.72%**	10.15%	11.07%	9.87%	50.63%
Milwaukee	1.47%	2.25%	3.58%	**6.22%**	10.69%	10.89%	10.59%	54.31%
Birmingham	10.09%	4.23%	4.73%	**5.90%**	6.81%	8.19%	7.75%	52.31%
Indianapolis	6.88%	2.91%	3.98%	**5.69%**	5.98%	7.47%	7.19%	59.90%
Providence	3.65%	3.11%	3.78%	**5.45%**	4.63%	5.41%	4.95%	69.02%
Rochester (NY)	5.21%	3.93%	4.99%	**5.41%**	6.62%	7.88%	7.77%	58.19%
Oklahoma City	5.82%	2.71%	3.78%	**5.41%**	5.38%	7.31%	8.14%	61.46%
Portland (OR)	2.80%	1.41%	3.69%	**4.99%**	7.83%	9.61%	10.86%	58.80%
Columbus (OH)	6.68%	4.29%	4.29%	**4.63%**	7.12%	7.45%	7.79%	57.75%
Philadelphia	5.71%	2.20%	3.47%	**4.19%**	5.39%	5.15%	6.12%	67.77%
Tampa	2.03%	1.20%	2.64%	**3.47%**	5.36%	7.53%	6.45%	71.31%
New Orleans	2.46%	1.31%	2.83%	**3.40%**	5.08%	6.44%	7.18%	71.30%
San Antonio	3.00%	1.40%	3.27%	**3.15%**	4.09%	6.31%	4.29%	74.49%
Chicago	2.77%	1.81%	2.05%	**3.13%**	3.71%	3.51%	4.10%	78.92%
Fort Worth	2.40%	1.22%	1.47%	**2.85%**	4.18%	5.73%	7.88%	74.27%
Denver	1.00%	1.01%	1.51%	**2.78%**	4.46%	7.81%	9.13%	72.30%
Atlanta	2.78%	1.16%	1.43%	**2.38%**	3.64%	4.27%	6.14%	78.19%
Boston	1.93%	0.92%	1.51%	**2.36%**	2.76%	3.42%	3.46%	83.64%
Memphis	3.83%	1.30%	1.56%	**2.34%**	4.41%	5.85%	6.82%	73.90%
Baltimore	2.80%	0.91%	1.37%	**2.32%**	2.62%	3.65%	4.08%	82.25%
Seattle	0.81%	0.55%	0.78%	**2.01%**	3.62%	4.13%	5.42%	82.68%
Dallas	1.89%	0.67%	1.24%	**1.91%**	2.85%	4.00%	6.22%	81.23%
Riverside	1.04%	0.39%	0.81%	**1.48%**	2.33%	2.91%	3.83%	87.20%
Miami	2.28%	0.74%	1.67%	**1.34%**	2.22%	3.90%	4.22%	83.65%
New York City	2.26%	1.30%	1.78%	**1.18%**	1.76%	1.59%	2.35%	87.78%
Norfolk	1.66%	0.74%	0.54%	**0.98%**	1.33%	1.83%	2.34%	90.59%
Phoenix	0.97%	0.43%	0.51%	**0.97%**	1.53%	3.37%	4.01%	88.21%
Washington	1.27%	0.45%	0.52%	**0.78%**	1.25%	1.61%	2.08%	92.05%
Newark	2.71%	0.44%	0.32%	**0.55%**	0.63%	0.77%	0.99%	93.60%
Hartford	0.87%	0.18%	0.42%	**0.55%**	0.72%	1.91%	1.93%	93.42%
San Francisco	0.92%	0.14%	0.36%	**0.30%**	0.42%	0.47%	0.80%	96.59%
Los Angeles	0.98%	0.13%	0.10%	**0.18%**	0.40%	0.51%	0.97%	96.73%
Anaheim	0.97%	0.13%	0.05%	**0.10%**	0.21%	0.18%	0.10%	98.25%
San Diego	0.50%	0.06%	0.16%	**0.05%**	0.28%	0.19%	0.31%	98.45%

Appendix TABLE 1

Construction Cost and Share of Units Below 90% of Costs by Metro Area

	MSA	Central City		Suburbs				MSA	
		Average (Value/Cost) Ratio	Share Units Below 90% of cost	Average (Value/Cost) Ratio	Share Units Below 90% of cost	year			Construction cost (sq.ft.)
1	Detroit	0.53	0.94	1.12	0.35	85	**1**	San Francisco	72.88
2	Buffalo	0.67	0.82	0.97	0.50	84	**2**	New York City	67.46
3	Cleveland	0.77	0.73	1.26	0.21	84	**3**	Anaheim	66.76
4	Providence	0.98	0.54	1.21	0.27	84	**4**	Riverside	66.36
5	Philadelphia	1.00	0.50	1.37	0.18	85	**5**	San Diego	65.09
6	Pittsburgh	1.05	0.49	1.06	0.42	86	**6**	Los Angeles	64.92
7	St. Louis	1.03	0.45	1.24	0.27	87	**7**	Boston	63.68
8	Newark	1.16	0.43	3.07	0.03	87	**8**	Portland (OR)	61.87
9	Milwaukee	1.01	0.37	1.37	0.07	84	**9**	Hartford	61.35
10	Birmingham	1.17	0.36	1.42	0.20	84	**10**	Seattle	60.42
11	Columbus (OH)	1.22	0.35	1.40	0.17	87	**11**	Minneapolis	60.32
12	Chicago	1.36	0.34	1.85	0.07	87	**12**	Newark	58.32
13	Kansas City	1.19	0.33	1.21	0.23	86	**13**	Cleveland	57.38
14	Indianapolis	1.17	0.33	1.36	0.18	84	**14**	Chicago	56.94
15	Cincinnati	1.23	0.31	1.29	0.24	86	**15**	Rochester (NY)	56.91
16	Portland (OR)	1.18	0.26	1.38	0.10	86	**16**	Pittsburgh	56.84
17	Rochester (NY)	1.17	0.25	1.37	0.18	86	**17**	Philadelphia	56.41
18	Baltimore	1.38	0.25	1.85	0.07	87	**18**	Denver	56.23
19	Memphis	1.34	0.21	1.46	0.09	84	**19**	St. louis	56.22
20	Houston	1.53	0.18	1.45	0.16	87	**20**	Detroit	56.00
21	Atlanta	1.99	0.17	1.77	0.06	87	**21**	Buffalo	55.62
22	Boston	1.74	0.17	1.89	0.06	85	**22**	Providence	55.26
23	San Antonio	1.48	0.16	1.89	0.03	86	**23**	Kansas City	54.39
24	Fort Worth	1.62	0.13	1.78	0.04	85	**24**	New Orleans	54.25
25	Minneapolis	1.32	0.13	1.36	0.11	85	**25**	Cincinnati	54.12
26	Tampa	1.59	0.10	1.65	0.07	85	**26**	Washington	54.08
27	Oklahoma City	1.68	0.10	1.72	0.07	84	**27**	Phoenix	53.59
28	Dallas	2.08	0.09	1.89	0.04	85	**28**	Columbus (OH)	53.59
29	Miami	2.12	0.08	1.91	0.05	86	**29**	Houston	53.45
30	Phoenix	1.82	0.07	1.81	0.02	85	**30**	Dallas	53.25
31	Hartford	2.03	0.07	2.35	0.02	87	**31**	Miami	53.10
32	Norfolk	1.78	0.07	1.85	0.06	84	**32**	Tampa	53.05
33	New York City	2.70	0.06	2.55	0.06	87	**33**	Milwaukee	52.08
34	Salt Lake City	1.68	0.06	1.48	0.08	84	**34**	Indianapolis	51.80
35	Washington	2.49	0.05	1.95	0.03	85	**35**	Baltimore	51.68
36	Seattle	1.74	0.05	1.65	0.03	87	**36**	Fort Worth	51.54
37	New Orleans	1.99	0.04	1.70	0.05	86	**37**	Salt Lake City	50.95
38	Denver	1.88	0.03	1.71	0.03	86	**38**	San Antonio	50.85
39	San Francisco	2.55	0.03	2.50	0.02	85	**39**	Memphis	49.89
40	Los Angeles	2.83	0.02	2.56	0.01	85	**40**	Oklahoma City	49.61
41	Anaheim	2.39	0.01	2.74	0.01	86	**41**	Atlanta	48.39
42	San Diego	2.60	0.01	2.46	0.01	87	**42**	Birmingham	47.99
43	Riverside	1.87	0.00	1.79	0.03	86	**43**	Norfolk	46.29

Notes: Data from Metropolitan AHS samples (first year after 1984 in which the MSA is sampled). All values in real 2001 dollars. Construction costs for economy home (lowest cost available).

Appendix TABLE 2

Unionization in Major Cities (construction sector)

MSA	Percentage Construction Workers in Union (CPS 1983-2000)	MSA	Percentage Construction Workers in Union (CPS 1983-2000)
1 Chicago	55.72%	24 San Diego	22.88%
2 Buffalo	50.63%	25 New Orleans	19.18%
3 Minneapolis	48.39%	26 Columbus (OH)	17.13%
4 Detroit	48.17%	27 Riverside	16.19%
5 Paterson	47.93%	28 Baltimore	15.10%
6 Milwaukee	45.58%	29 Denver	14.48%
7 New York City	43.94%	30 Washington	14.24%
8 St. Louis	43.13%	31 Anaheim	11.53%
9 Cleveland	38.43%	32 Norfolk	10.71%
10 San Francisco	37.74%	33 Miami	10.31%
11 Indianapolis	34.33%	34 Memphis	9.52%
12 Seattle	33.85%	35 Houston	9.32%
13 Philadelphia	33.54%	36 Phoenix	8.29%
14 Newark	31.55%	37 Salt Lake City	7.67%
15 Boston	30.89%	38 Atlanta	7.50%
16 Portland (OR)	30.86%	39 Tampa	4.84%
17 Hartford	30.65%	40 Orlando	4.41%
18 Pittsburgh	30.56%	41 Dallas	4.30%
19 Sacramento	30.48%	42 Nashville-Davidson	3.54%
20 Rochester (NY)	30.05%	43 Fort Worth	3.27%
21 Cincinnati	28.62%	44 Charlotte (NC)	2.85%
22 Los Angeles	27.42%	45 Fort Lauderdale	1.61%
23 Kansas City	27.31%	46 Greensboro	1.33%
		47 San Antonio	0.00%

Notes: Cities with more than 1 million population in 1992. The sample correlation between the union share in construction and population growth between 1980 and 1990 is **-0.51**. The sample correlation between the union share and the share of units below 90% of construction costs is **0.36**.

FIGURE 1: Equilibrium in the Residential Market

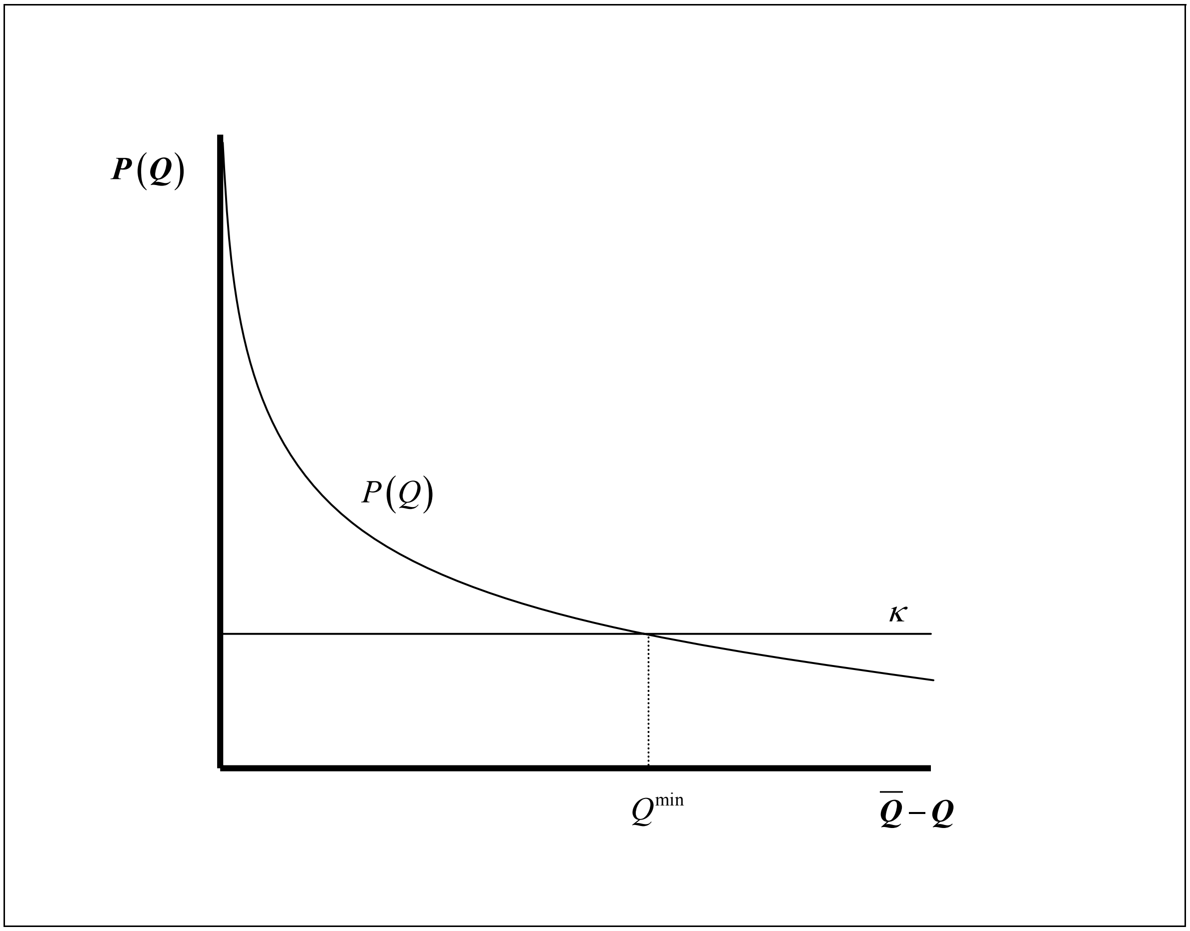


FIGURE 2: A Negative Demand Shock

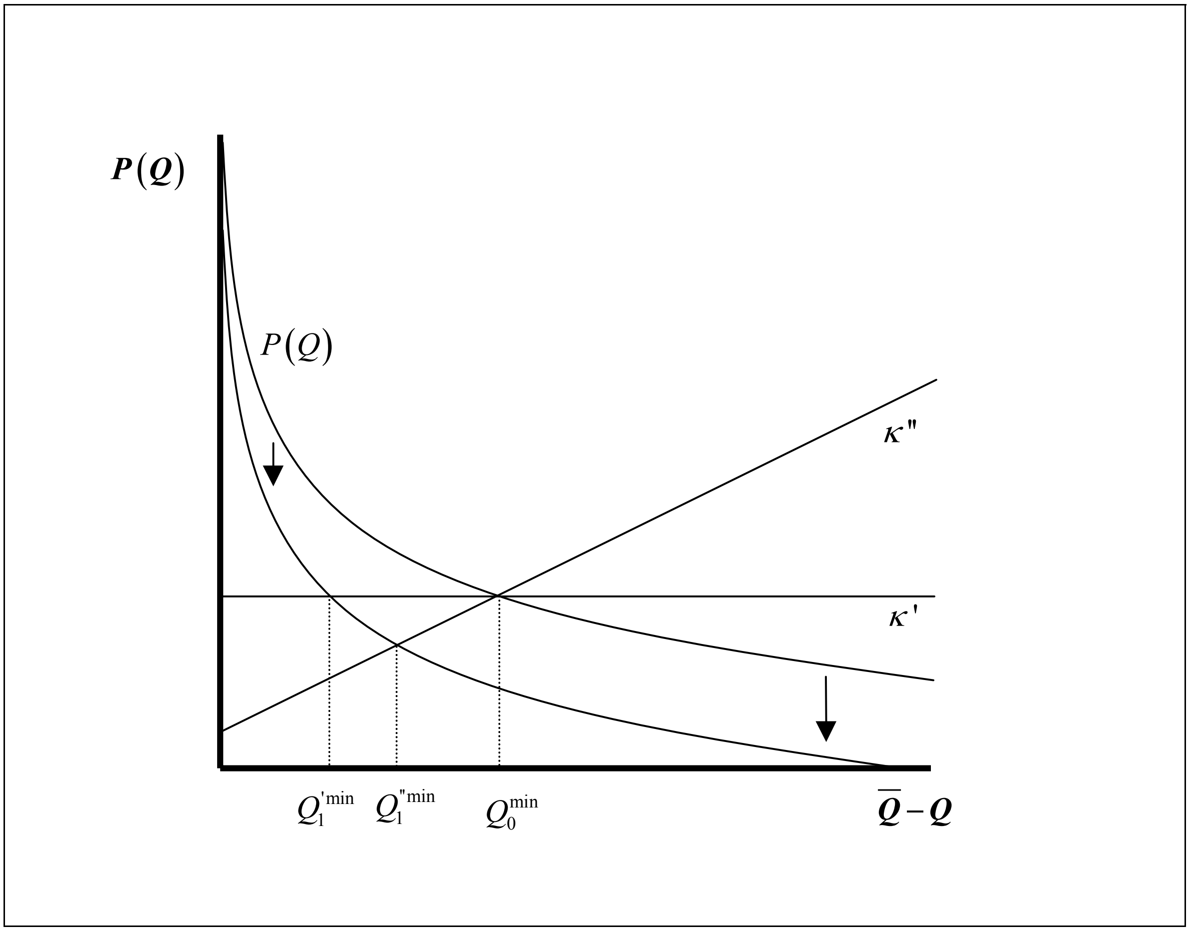


FIGURE 3: Negative Supply Shock

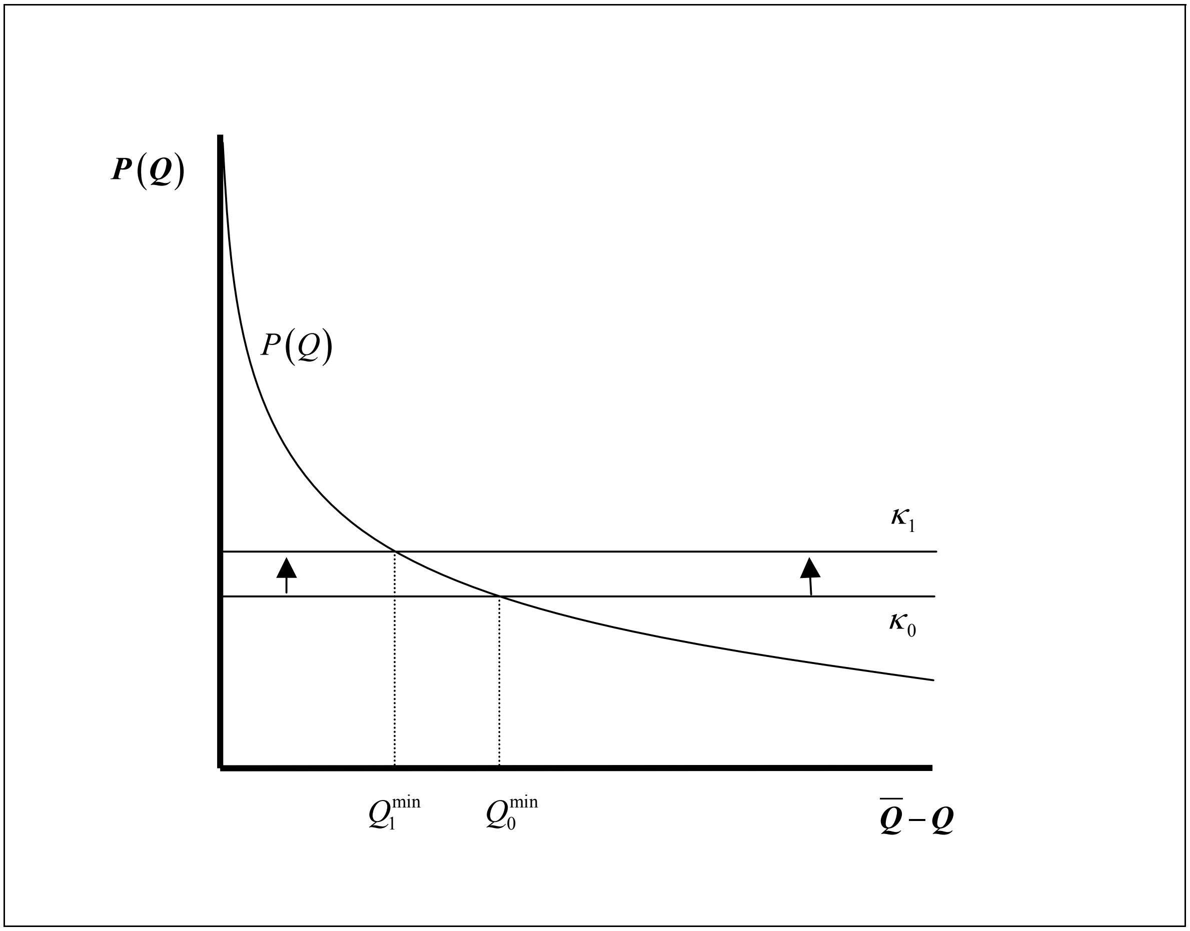


Figure 4: Kernel Density Estimate. Value/Cost Ratio in L.A

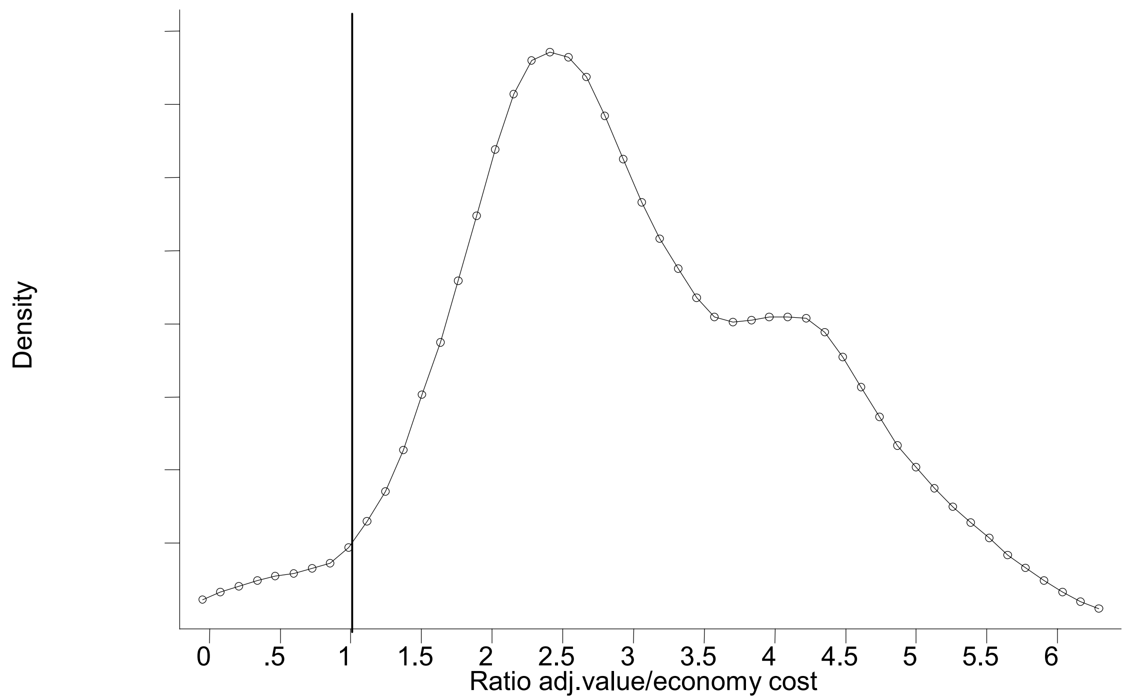


Figure 5: Kernel Density Estimate. Value/Cost Ratio in Central City Detroit

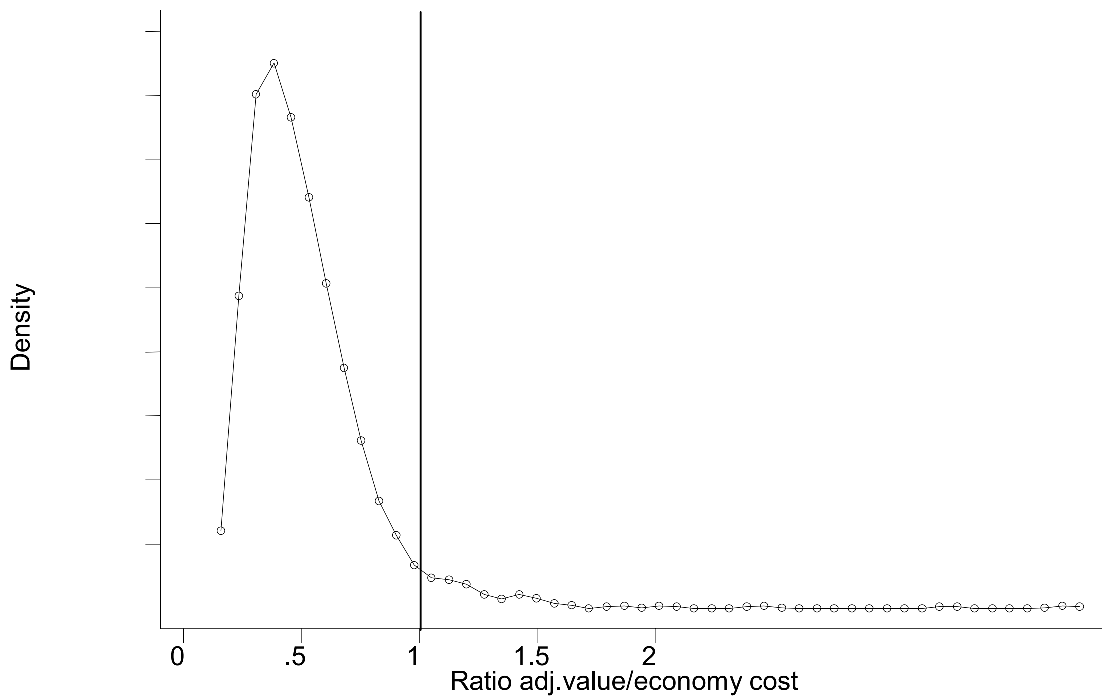
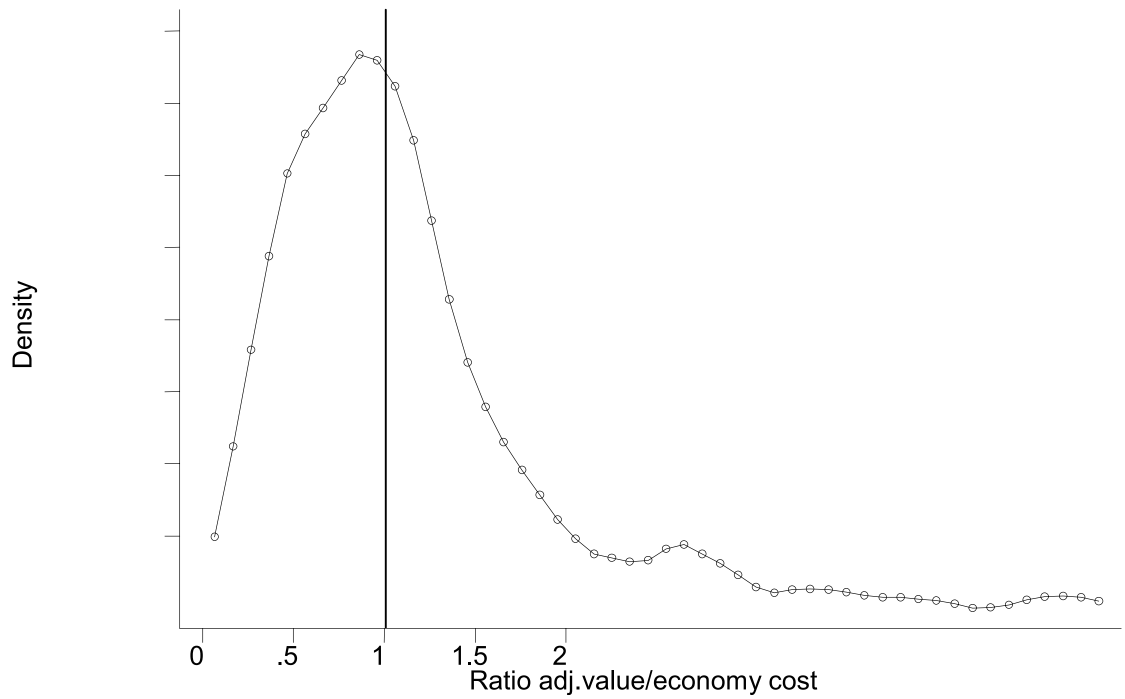


Figure 6: Kernel Density Estimate. Value/Cost Ratio in Central City Philadelphia



Data Appendix

Variable	Data Notes	Source	Tables
Log Total Housing Permits at T-1	New housing permits at the metropolitan area level in 1991	Census Housing Units Authorized by Building Permits C40 series	T.1
Log MSA per Capita Income	Total income per capita in 1992	Bureau of Economic Analysis	T.1
Share Union Construction Workers	Average share of respondents in construction sector reporting union enrollment by metropolitan area: 1983-2001	Current Population Survey (1983-2001)	T.1, A.T.2
Log Inspection Expenditures per Capita	Expenditures on regulation and inspection of private establishments for the protection of the public or to prevent hazardous conditions, at the MSA level. See * for more details.	Census of Governments 1992	T.1
Regional Dummies	We match each with the corresponding Census Region.	U.S. Census Bureau	T.1
Log Cost Per Square Foot, Economy-Quality, 2000 ft^2 Home	Log of the construction cost per square feet corresponding to an economy home of 2,000 ft	Residential Cost Data (2000) Square Foot Costs (2001) *(R.S. Means Company)*	T.1 (1992) T.2, A.T.1
Log City Average Household Income	MSA average of AHS reported total household income. Only for MSA with 50 or more valid observations	Metropolitan Sample American Housing Survey (1984-1994)	T.2
Log City Average Renovation Expenditures	MSA average of sum of yearly expenditures in renovation by housing unit. Single unit (attached and detached), owner-occupied homes. See ± on how renovation expenditures are defined.	Metropolitan Sample American Housing Survey (1984-1994)	T.2
Average Expenditures on Renovation	Owner-occupied, single units (attached or detached). See ± on how renovation expenditures are defined.	Metropolitan Sample American Housing Survey (1984-1994)	T.3, T.4, T.5
Dummy on Unit Below Cost	Takes value 1 if the value/cost ratio is below 1. See ‡ on how we construct the value to cost ratio for units in the Metropolitan AHS sample.	Metropolitan Sample American Housing Survey (1984-1994) + Residential Cost Data (2000) Square Foot Costs (2001) (R.S. Means Company)	T.3, T.4, T.5
Property Value	Self-reported home value. The variable is topcoded. Topcodes change each year. Typically, 3 percent of the observations fall in the topcode. Note that the value-to-cost ratio for these observations is always above one. The results are robust to omitting the observations with topcoded values.	Metropolitan Sample American Housing Survey (1984-1994)	T.3, T.4, T.5
Estimated Home Age	We estimate building age as the sample year minus the estimated year of construction. The estimated year in which the unit was built is the midpoint of the range given by the AHS. We assume that the year of construction is 1908 if the code is 1919 or earlier."	Metropolitan Sample American Housing Survey (1984-1994)	T.3, T.4, T.5

Number of rooms in unit	Number of rooms (top-coded at 21; only 1 unit in our sub-sample reaches the top).	Metropolitan Sample American Housing Survey (1984-1994)	T.3, T.4, T.5
Income of all Household Members Including Non-relatives	As reported in the AHS. Top-coded at $999,996; no unit in our sub-sample reached the topcode).	Metropolitan Sample American Housing Survey (1984-1994)	T.3, T.4, T.5
Units has Patio or Porch		Metropolitan Sample American Housing Survey (1984-1994)	T.3, T.4, T.5
Size of Unit Sq. Ft.	Self reported square footage	Metropolitan Sample American Housing Survey (1984-1994)	T.3, T.4, T.5
Annual Cost of Electricity	12 times the self-reported average monthly cost of electricity	Metropolitan Sample American Housing Survey (1984-1994)	T.4.

Notes:

* Expenditures on Inspection

Correspond to local expenditures on regulation and inspection of private establishments for the protection of the public or to prevent hazardous conditions, not classified elsewhere under another major function. Examples include the inspection of plans, permits, construction, or installations related to buildings, housing, plumbing, electrical systems, gas, air conditioning, boilers, elevators, electric power plant sites, nuclear facilities, weights and measures, etc.; regulation of financial institutions, taxicabs, public service corporations, insurance companies, private utilities (telephone, electric, etc.), and other corporations; licensing, examination, and regulation of professional occupations, including health-related ones like doctors, nurses, barbers, beauticians, etc.; inspection and regulation or working conditions and occupational hazards; motor vehicle inspection and weighing unless handled by a police agency; regulation and enforcement of liquor laws and sale of alcoholic beverages unless handled by a police department.

The following expenditures are excluded: distinctive license revenue collection activities; regulatory or inspection activities related to food establishments or to environmental health; motor vehicle inspection, liquor law enforcement, and other regulatory type activities of police agencies; regulatory and inspection activities related to other major functions, such as fire inspections, health permits, water permits, and the like.

The variable is reported at the metropolitan area level. The expenditures are reported for all local governments in a county by the *Census of Governments* (1992). All local governments within the county area are added together, and the duplicative inter-local amounts are removed. We then sum expenditures for all counties in a MSA using the 1999 county-based definitions from the Census.

‡ Value-to-cost ratio: Metro AHS Data

a. Creating adjusted house values

Two important adjustments to the house values reported in the AHS involved controlling for depreciation on older structures and the fact that owners typically over-estimate their house value. Recall that we need to know if the value of a unit is above construction costs were it to be rebuilt under current specifications (such as current building codes). Thus, we need an adjusted value that corresponds to the price of a newly built unit. It is only adjusted value that is properly comparable with current construction costs for the purposes of obtaining implicit land values.

Goodman and Ittner (1992) report that the typical household reports home values that are 6 percent higher than actual market prices. Thus, we divide reported values by 1.06 to correct for this bias. Restricting ourselves to housing units with reported square footage, we then regress the logarithm of the value per square foot on age and vintage dummies (age effects are identified, as we have repeated time observations of units in the same vintage). The omitted vintage is 1991-1994. We use the coefficients from this regression to inflate the value that would pertain had their been no depreciation (i.e., as if it had been built between 1991-1994. After all the adjustments, the mean adjusted value is 32 percent *bigger* than the unadjusted mean, due to the importance of age and vintage effects.

b. Matching with construction cost data

The Means data reflect average costs for several home sizes and qualities, with and without a basement. The data are reported for 177 cities. We match these cities to their corresponding metropolitan areas. In 95 percent of the cases, there is a one-to-one correspondence of city and metropolitan area. For the rest of MSAs, we use the cost in the main city. The variation in costs across cities within the same metropolitan area (e.g., Long Beach and Los Angeles) is very small. For units that are in unidentified MSAs or not in an MSA, we assign construction costs at the regional level. Construction costs at the regional level are obtained as a weighted average of construction costs for all MSAs in a region, where the weights are population by MSA and year. We have data on construction costs for 1940, 1950, 1960, 1970, 1979, 1980, 1985, 1987, 1989, 1990, 1991, 1993, 1995, 1997, 1999, and 2000. We use interpolation to estimate the values in the missing years from 1970 to 2000. From 1980 to 2000, the evolution of construction costs is almost linear, so we use linear interpolation for that period. Unfortunately, we only have data for 1970 and 1979 when considering the seventies. Linear interpolation may be too rough, as inflation accelerated only after 1974. Consequently, the approach we take is to calculate the share of the CPI gap between 1970 and 1979 that was covered each year. We then apply that share to the gap between the 1970 and 1979 housing cost indexes.

Finally, we match homes with the corresponding construction costs for its MSA, year, and type of building (i.e., by size and whether there is a basement present). As noted in the text, all cost data are for an economy-quality home based on Means Co.'s specifications.

± Expenditures in Renovation

We define expenditures on renovation as the sum of the following expenditure categories in the AHS:

- Roofing job
- Additions
- Kitchen remodeling/addition
- Bathroom remodeling/addition
- Siding replaced
- Other repairs/fixes over $500
- Major equipment replaced added
- Storm windows/doors added/replaced
- Insulation added/replaced
- Costs of routine maintenance

We restrict ourselves to the 1984-1994 time period. Prior to 1984, the AHS does not provide information on such expenditures. Beginning in 1995, the definition of such expenditures changed and we cannot match to previous data and obtain a consistent series.

Finally, we assign a zero expenditure in cases in which the household reports not having done any addition/alteration. When the household reports to have done the repair but does not report the value, we impute the average value for that kind of repair in that MSA and year.

Additional General Notes

- All dollar values are deflated to 2001 prices using the urban CPI "All items less shelter" index.
- MSA definitions follow the ones provided by the AHS, except in Table 1, where we use 1999 MSA/NECMA definitions.
- We use only single unit structures from the AHS. However, these units may be attached or detached.