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Urban Decline and Housing Reinvestment: The Role of Construction Costs and the Supply Side

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Abstract

Negative housing demand shocks have afflicted many American cities in the 20th century and are the main explanation for city decline. But what is the role of housing supply? We argue that 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. Using instrumental variables techniques to account for the endogeneity of home values to renovation expenditures and for measurement error, we find that owner-occupied homes with market values below construction costs spend about 50 percent less on renovation than similar average homes. Simulations point to an important role of construction costs in the decline of marginal areas in ailing cities.

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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 later half of the 20th century. And the American story is not unique, as the shift of manufacturing employment away from urban areas also was foreboding for European cities such as Glasgow, Liverpool, Rotterdam, and Turin.

There is no doubt that 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 certainty about what will happen to the number of people or households 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. 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 over the long run, and reinvestment is required to avoid decay.

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. On purely financial grounds, rational entrepreneurs should not invest in new buildings or renovation of existing ones when home values are below replacement or construction costs. Owner-

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

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 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 it is all demand driven or whether the supply side of the housing market plays a meaningful role. Glaeser and Gyourko's (2002) finding that housing prices are 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 changes in renovation costs may be critical on the margin to determining whether fundamental decay sets in or whether reinvestment occurs.

This leads us to begin our analysis with a careful look at construction costs which need not be exogenous to the decay process. If they are flexible downward in response to negative demand shocks, then one would expect a much reduced negative impact on housing investment. However, our analysis finds that construction costs are not very sensitive to construction levels. There is substantial between-city variance 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 spending on regulation and code enforcement (which we use as a proxy for the overall

[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

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 of about 13 percent 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 services to be relatively price-inelastic, with our best estimate being –0.28 (i.e., a 10

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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 a new bathroom.

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.

We then simulate the impact of an exogenous 10 percent decline in construction costs. There is substantial heterogeneity in responses across different market areas. In places with high house values, there is virtually no impact on renovation spending beyond the own-price effect. Thus, in San Francisco, San Diego, Los Angeles, and New York, a 10 percent drop in construction costs does 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 7 percent or more 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 revitalization. These areas, which include many older and Rust Belt cities, 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, the reason in Phoenix is that 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. If there is a moral to this story, it is that declining cities truly cannot afford to be expensive cities in terms of replacement costs. For both urban scholars and policy makers, much greater attention needs to be paid to the cost side of declining cities in particular.

The remainder of paper is organized as follows. The next section discusses the various data sources we employ. This is followed in Section 3 with an analysis of the cross sectional variance in building costs. Section 4 then documents the relationship between construction costs and housing values. The differences in renovation expenditures by city are linked with construction costs in Section 5. Section 6 joins together all the previous aspects of the paper for the simulation analysis. A brief summary concludes the paper.

2. Data

The *American Housing Survey* (*AHS*) is our primary data source on housing prices and renovation expenditures. The national files of the *AHS* are used to describe the long-run evolution of housing prices. Micro-data are gathered from 1974 to 2001, with the series being annual from 1974-1981 and biannual after that. Individual prices of single unit or attached owner-occupied homes within metropolitan areas across the country are used in our analysis. The *AHS* national samples also are used to construct a panel of metropolitan area house values and incomes. This is done by averaging house prices and household incomes by metropolitan area and year. To reduce measurement error concerns, we limit the MSA panels to those areas with at least 50 valid observations in each year.

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.[4] Data on ten categories of expenditures are available.[5] We aggregate spending across all categories into a single sum that we term 'renovation' expenditures. 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 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 43 metropolitan areas across the country.[6] Our source for construction costs is the R.S. Means Company. These data have been used in Glaeser and Gyourko (2001,

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[4] 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.

[5] 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.

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

2002) and are well described there. Briefly, the Means Company monitors construction costs in numerous American and Canadian cities. 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.[7] 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 600ft^2 to 3,200ft^2), the number of stories in the unit, and a few other differentiators, such as the presence of a basement.[8]

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.[9] 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).

In order to obtain comparable values for homes 'as if new', a number of adjustments are made to the AHS data prior to constructing this ratio. While the data

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[7] 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.

[8] 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 to 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 towards zero the estimated relationship between construction costs and renovation spending. Given the absence of any reason to suspect the data would bias us towards finding a significant relationship, the issue of quality literally is an empirical one. And, it turns out the variable performs quite well empirically. See below for more on that.

[9] 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.

appendix goes into the details, it is noteworthy that prices are adjusted to account for depreciation, for general inflation, and to account for the fact that research shows owners overestimate the value of their homes.[10]

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 key variable is the extent of unionization in the construction sector, from the *Current Population Survey*. Because there typically 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 one 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;[11] in another 20, they exceed 30 percent.[12]

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

[11] 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.

[12] 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.

3. 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.[13] The interquartile range runs from $45.12/ft^2 to $52.93/ft^2. Costs of a very modest quality home were lowest in Columbus, Georgia, ($40.95/ft^2) and highest in Anchorage, Alaska ($69.34/ft^2).[14]

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 places. 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

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[13] 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.

[14] 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 $52.08/ft^2 to 60.32/ft^2, with Norfolk, VA, having the lowest cost (46.29$/ft^2) and San Francisco, CA, the highest (72.88/ft^2).

for demand.[15] 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.[16] 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 the log of population and the log of cooling degree days are used as instruments for the demand for housing.[17] These results are reported 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.[18]

If variation in the amount of building activity can not 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 0.18 in the IV results. Interestingly, the share of construction workers that

[15] Other obvious candidates are renovation and rehabilitation themselves. However, they are strongly correlated with the level 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.

[16] 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.

[17] 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 and Shapiro (2003) provide the details on how this amenity has become an important driver of the demand for metropolitan location.

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. 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.[19]

Yet, one should not necessarily confer a causal interpretation to unions for the entire effect in Table 1. The impact of unions on local economies is likely to be very 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.[20] The variable controlling for local expenditures per capita on inspection and

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

[19] Unions also have effects on productivity and the organization of labor within firms (Freeman and Medoff, 1983).

[20] 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.

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 regional correlation of unionization rates.[21] The Northeast (which is the omitted region) and West census regions are relatively expensive, as the same quality house can be built for at least 10 percent less in the South and Midwest.

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.

4. The Ratio of Home Values to Construction Costs

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

It is to the relation between house prices and construction costs that we now turn. While there are extensive literatures in urban and real estate economics focused on Ricardian rents (often based in models constructed within the monocentric Alonso-Muth-Mills paradigm), the capitalization of local amenities and public goods on home values, and the asset price of residential real estate (Poterba (1984)), relatively less has been written on the relationship between physical construction costs and house prices.

In hedonic models, home values are the sum of the values of the attributes of the location that are capitalized into land values, plus the price of the unit's physical attributes. If the local home construction industry is competitive, the price for the physical part of the house in a metropolitan area should trivially equal the long run minimum average cost of production. Empirically, Rosenthal (1999) has demonstrated that building prices and construction costs are cointegrated, with price deviations from construction costs being arbitraged away quickly. If this is the case across areas, then the variance in house prices across locations should be accounted for by the variance in land values.

However, we also need to know whether land values are relevant for explaining average price levels. To a significant degree, this depends upon whether the physical structure accounts for a large fraction of total property value. For example, if land was very expensive everywhere so that it, not the structure, represented the major part of overall house value, then relative changes in construction costs and asset values probably would not affect renovation decisions. Essentially, it generally would be worth it to renovate or reinvest, and we would not expect typical changes in rents or building costs to affect those decisions in a material way.

Recent research by Glaeser and Gyourko (2002) brings some evidence to bear on this issue, and concludes that the typical home value is pinned down by construction costs throughout much of the United States. The important implication of their work for our purposes is that land values and capitalization play a relatively minor role in explaining average price levels. Nevertheless, we check on the robustness of their findings using 18 years worth of house price data from the 1974-2001 national *AHS* files in conjunction with physical construction costs from the R.S. Means Company.

Figures 1-4 plot the ratio of house value-to-construction costs for the 25th, 50th, and 75th percentiles of the house price distribution in the central city and suburban areas of each of the four main census regions. The numerator of this ratio reflects an adjusted price for a sample of owner-occupied, single unit or attached homes in metropolitan areas. More specifically, we calculate an 'as-if-new' value for each home, adjusting the *AHS* reported value by age and vintage effects and overvaluation in the self-reported prices. [See the Data Appendix for the details.] The denominator uses Means Company data on economy-quality homes and the reported unit footage from the *AHS*.

Note that the ratios are remarkably close to one for the 25th percentile home and around 1.2-1.5 for the median home value. The latter indicates that land constitutes no more than 20-50 percent of total property value for the median home, even when assuming construction costs are those for a very modest quality home. [22] They also are relatively stable over the period, with the West region being the obvious exception. In the East, Midwest and South regions of the country, construction costs clearly are the most important component of value for the vast majority of dwellings. Yet, it is also the

[22] Conservatively assuming costs associated with a modest quality home suggests that prices are even closer to construction costs on average than Figures 1-4 imply.

case that significant fractions of dwellings have prices below construction cost (i.e., those in the bottom quartile of the price distribution). We will be especially interested in identifying how households go about investing in these "financially unsound" homes with values below construction costs.

The regression results reported in the first two columns of Table 2 confirm the somewhat casual empiricism of Figures 1-4. They are from specifications in which the dependent variable is the average house value by metropolitan area and year based on observations from the national *AHS* files between 1974 to 2001. Restricting the sample to MSAs with more than 50 observations per year, we specify the following random-effects model

(1) $\ln V_{kt} = \pi \ln CC_{kt} + Z_{kt}\Theta + \Omega_t + \partial_k + \xi_{kt}$

where V_{kt} stands for average home value, CC_{kt} is the construction cost per square foot of an economy-quality home, Z_{kt} is a vector of other variables, Ω_t is a year fixed effect, ∂_k is a metropolitan area random effect, and ξ_{kt} is an i.i.d. perturbation.

Note that the elasticity of the average housing value with respect to construction costs (π from equation (1), see row 1 of columns 1-2) is very close to one even when we control for income (column 2).[23] The remaining three columns of Table 2 use the Metropolitan AHS panel to compare whether prices of housing units with relatively low prices are equally responsive to changes in building costs. If the elasticity of house values with respect to construction costs was one for all housing units, not just those near

[23] Essentially, this is the same finding as in Rosenthal (1999). He uses structure price as the dependent variable (obtained via a hedonic analysis) and found an elasticity of one with respect to construction costs. The regressions here extend the result to overall house values (building price and land values). And, the results are not driven by omitted variables that are correlated with construction costs, as a fixed-effects model yields similar results.

the mean, then the value-to-cost ratio would not change for any unit with changes in construction costs. In that case, one would only expect to find an own-price effect from higher construction costs, not a separate impact from a rise (fall) in costs leading the unit's value to be below (above) construction costs.

The findings in columns three and four of Table 2 confirm the strong link between average house values and construction costs that we just found in the National AHS samples. The elasticity of house value with respect to construction costs is higher if we use a MSA-fixed effects model (column four), but in neither case can we reject the null that the elasticity is one.

The final column of Table 2 implements a fixed effects model for what we term 'at risk' units.[24] These are units with a house price-to-construction cost value below one in the first wave of the relevant metro sample. They are then tracked through the different waves. While changes in construction costs clearly do materially influence average house values, this is not the case for 'at risk' units, as the construction cost coefficient is small and insignificantly different from zero. Thus, for units that are below cost, changes in construction costs primarily affect the denominator of the value-to-cost ratio.[25] This suggests that relatively high costs will be associated with more units being valued below cost. As such, it emphasizes the importance of trying to estimate the independent impact on renovation spending of a unit's value dropping below replacement cost, not just the

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[24] Note that using the between city variation is erroneous in this context. By construction, the values of 'at risk' units are higher in more expensive cities.

[25] It may be that 'at risk' units are not perfect substitutes for newly constructed homes. As will become clear from the simulation results reported below, the location of 'at risk' units differs from the location of newly built dwellings. The correlation of housing values with average tract values is very strong in the metro AHS samples, and 'at risk' units are more likely to be in the central city, whereas most new dwellings are built in the suburbs.

own-price effect of higher construction costs. It is to those empirical exercises that we now turn.

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 noted 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.[26] However, it is at least theoretically possible that the true cost of renovation is determined more by the prices of the materials charged by the Home Depot than it is by local building costs for new units.

We address this issue in Table 3 which reports results from random effects specifications that regress the logarithm of mean renovation expenditures on the log of construction costs. We use the MSA panel of average house prices from the Metro AHS 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 one 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.[27] 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 3 can be defined as

$$(2) \quad \frac{\partial \ln \left(p \cdot q(p)\right)}{\partial \ln p} = 1 + \frac{\partial q(p)}{\partial p} \cdot \frac{p}{q(p)} = 1 + \varepsilon_p ,$$

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.[28]

Table 4 then reports our findings on how sensitive renovation expenditures are to house values being below building costs. In order 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”

[26] 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 that is investigated below.

[27] 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 time observations per are in the panel).

[28] In that case, a one 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.

materials and labor.[29] The latter cost simply 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,

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

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

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 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 4 reports our baseline Tobit results. They include MSA fixed effects that account for time-invariant, city-specific variables such as tastes, municipal

[29] 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.

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.[30] 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. This is about 12 percent of the mean annual renovation expenditure of $1,950. 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 and 0.4 with respect to income.[31]

Unfortunately, our OLS estimate of the impact of construction costs on renovation spending may be biased upward due to endogeneity and biased downward due to 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 value will fall below construction costs.[32] 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.

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

[31] 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.

[32] 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.

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. Many units are likely to be 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.[33] This allows us to calculate the average value per square foot for each unit in each year in the census tract in which the unit is located--excluding the unit's own value. Our instrument for the below-cost dummy for home i (denoted 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,

$$(4)\quad Bel\_IV_{ikt} = 1 \quad if \quad \frac{\sum_{\forall j \neq i \in tract_i} \frac{Val_{jkt}}{ft_{jkt}}}{n_i - 1} < CC_{kt}\text{, with}$$

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

[33] We do not know which specific census tract it is, only that a cluster of units is located in a common tract.

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.[34] Second, it 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 4. 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 4 are not simply capturing the impact of lower housing values on renovation, as house values, not just unit traits, are being controlled for. And, the findings are robust to including nonlinearities in house value.[35]

[34] We do not believe that segregation with respect to tastes for renovation is an issue. Nevertheless, we will control for neighborhood-specific characteristics in the unit fixed effects regressions reported below.
[35] 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.

In fact, additional analysis confirmed that the relationship between renovation and home values is strongly linear.[36] Note also that units with the same value can differ in the below-cost dummy because of differences in construction costs between city and over time.[37]

As a robustness check on the possibility that the results might be being driven by omitted tastes for housing services that are negatively correlated with the below-cost dummy, we estimated a similar 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 construction 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 5) 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 or for the main findings on renovation in Table 4.

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

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Notice that this strategy is akin to a regression discontinuity design, where we are also using the between-city variance in construction costs.

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

[37] If we restrict to 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 always is a unit in the alternate group with

fixed-effects model, as in equation (5), which takes into account unobserved heterogeneity in the household's tastes for housing services

$$(5)\quad R_{ikt} = A_i + Y_t + \beta \cdot Bel_{ikt} + \lambda \cdot Val_{ikt} + \Phi X_{ikt} + \varepsilon_{ikt}\,,$$

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.[38] Table 6 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 4, but are less precisely estimated.

Note that the OLS and IV results in Table 6 use the variance from units that changed their below-cost status. If households take time to adjust their investment decisions after the unit changes 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-

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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 4.

[38] Notice that we cannot deal with the censoring of the renovation variable here, as 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

cost dummy and include it in the specification reported in column 3 of Table 6. 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 to be the case, as the difference in renovation expenditures between units that are always below-cost and units that are always above cost increase 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 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 7 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 can draw on the implications of Bogdan's

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Table 4 yield similar results and, if anything, underestimate the impact of the below-cost dummy on renovations.

(1996) research on the decision to hire outsiders for renovation projects. She reports that a number of variables—unit square footage, house value, household income, and select 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 conclude there is no problem with our estimates arising from the propensity to 'do it yourself' being correlated with the below cost dummy.[39]

While our models with unit fixed effects should control for any household-level propensity to use 'sweat equity', we also estimated our own 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 4; 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. Simulation Exercise: Lowering Construction Costs by Ten Percent

In this section we simulate the impact of an exogenous 10 percent reduction in construction costs on the amount of renovation in metropolitan areas. Recall that this is

[39] 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

close to the change in costs associated with a one standard deviation change in the extent of construction sector unionization or with changing cost conditions from (say) the East region to those prevalent in the South region.

To simulate the impact of a reduction in building costs on renovation in a metropolitan area, we begin by considering $q_i = q\left(p, Bel_i\right)$, the consumption of renovations for household *i* in a given city. We will assume that q_i is separable in construction costs (p), and also is a linear function of whether the unit is below construction cost (Bel_i). This allows us to write it as $q_i = q^*(p) + \beta^q \cdot Bel_i$. If we denote the square footage of the unit as ft_i and the unit's market value as val_i, then

$$(5)\quad Bel_i(p) = \begin{cases} 1 & if \quad p \cdot ft_i < val_i \\ 0 & otherwise \end{cases}.$$

If we further define $f\left(val\right)$ to be the density of values in the city, then the average consumption of renovations in the city (using separability and linearity in Bel_i) can be written as

$$(6)\quad \overline{q} = \int_0^\infty q\left(p, Bel_i\right) df\left(val\right) = q\left(p, \int Bel_i\left(p\right) \cdot df\left(val\right)\right).$$

It is helpful to next denote the share of units below construction cost as $SBel\left(p\right) = \int Bel_i\left(p\right) \cdot df\left(val\right)$. Assuming that this share is differentiable with respect to p, we obtain

$$(7)\quad \frac{d\overline{q}}{dp}\frac{p}{\overline{\overline{q}}} = \frac{\partial q}{\partial p}\frac{p}{\overline{\overline{q}}} + \beta^q \cdot \frac{dSBel\left(p\right)}{dp}\frac{p}{\overline{\overline{q}}} = \frac{\partial \overline{q}}{\partial p}\frac{p}{\overline{\overline{q}}} + \frac{\beta}{p\overline{\overline{q}}} \cdot \frac{dSBel\left(p\right)}{dp}\frac{1}{p}.$$

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way.

The first term is the elasticity of renovations with respect to changes in building costs, $\frac{\partial \bar{q}}{\partial p}\cdot\frac{p}{\bar{q}} = \varepsilon_p$. The first component of the second term, $\beta = \beta^q \cdot p$, represents the impact of being below cost on renovation spending; this is multiplied by $\frac{dSBel(p)}{dp/p} \equiv \frac{n_{shift}}{n}$, which is the change in the share of units below cost for a percentage change in building cost. We define n^{shift} as the number of units that change their below-cost status because of a change in costs, and n as the total number of units in the city. Using the fact that $\overline{pq} = \frac{\sum_{\forall i} p\cdot q_i}{n} = p\cdot\bar{q}$ and substituting in yields the following simplified expression

(8) $\frac{d\bar{q}}{dp}\cdot\frac{p}{\bar{q}} = \varepsilon_p + \frac{n_{shift}}{n}\cdot\frac{\beta}{\overline{p\cdot q}}$.

Thus, the total percentage change in the real consumption of maintenance and alterations is the sum of the price elasticity of demand plus the product of the share of units that change status times of the impact of being below construction over average renovation expenditures.

In the simulations reported below, we assume that ε_p=-0.28, our estimate of the price elasticity of renovation expenditures from Table 3. For β, we use our -$911 estimate of the impact of being below cost on renovation spending from the IV specification reported in column 2 of Table 4. Average maintenance/renovation expenditures are assumed equal to our overall sample average--$1,945. Each of these variables is common across all metropolitan areas. This is not the case for the share of units sent above cost when construction costs decrease in our simulation. The ratio of

$\frac{n_{shift}}{n}$ is calculated by examining the full distribution of owner-occupied house values within each metropolitan area.

Tables 8 and 9 report our results for the 43 metropolitan areas from the AHS Metro samples. Table 8 focuses on central cities, with Table 9 pertaining to the outlying areas of each metropolitan area. The first column in each table lists the fraction of homes sent 'above cost' by the 10 percent reduction in construction costs. There is a fairly wide range across cities, including those with large fractions of below cost housing. For example, we estimate that over 90 percent of the owner-occupied units in the central city of Detroit had values at least 10 percent below construction costs. The same was the case for over 80 percent of Buffalo's central city homes. However, a 10 percent reduction in construction costs results in only 2 percent of Detroit's units being 'sent above cost', while 9 percent of Buffalo's units now have values in excess of replacement costs. This simple comparison highlights the fact that the ultimate impact of any policy intervention targeted towards reducing building costs will depend upon the nature of the house price distribution in the area. The greater the mass just below a value-to-cost ratio of one, the greater the impact of the policy intervention.

The remaining columns of Tables 8 and 9 report the percentage increases in renovation spending due to the price effect and due to the combination of the homes becoming 'financially viable' times the impact of viability. The price effect is assumed the same across all areas, as a 10 percent fall in construction costs results in 2.8 percent more renovation expenditures based on our –0.28 price elasticity estimate from Table 3. Focusing now on the central city results in Table 8, the effect from home values rising above construction costs is larger than the pure price effect in nearly half the cities (20 our of 43). The effect is particularly large in places with the following two traits: (a) fairly large fractions of units with house prices below construction costs; and (b) fairly flat distributions of value-to-cost.[40] On average, the impacts are smaller for the outlying areas (Table 9), but there clearly are suburban neighborhoods in various metropolitan areas with house values such that modest decreases in construction costs affect whether they are above- or below cost.

These simulation results indicate that the maintenance and renovation expenditure effect identified above is very relevant for most, but not all, declining cities. While modestly lower construction costs certainly will not change basic urban trends, the level of construction costs is a key factor that can determine whether many neighborhoods in declining areas will experience any significant reinvestment in their housing stocks. Hence, urban scholars and policy makers 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 paper, we ask what role housing supply plays in affecting how these shocks play out in declining areas. When housing values are below replacement costs, we should not expect a rational entrepreneur to provide new housing units or to renovate existing ones at replacement cost. Similarly, existing home owners with investment motives should

[40] We assume a common treatment for all units sent above costs—namely, that expenditures change by $911. Of course, it need not be the case that all units are marginal in this sense. To gain further insight, we estimated regressions akin to the ones in Table 4 in which we add the interaction of the below-cost dummy with the gap between the value/cost ratio and one (i.e., Bel*(1-value/cost)). The below-cost dummy retains its significance, but we can reject the null that the marginal effect of being below-cost changes at different

reduce their spending on renovation. Thus, we can expect areas with home prices below construction costs to disappear in the long run, and to experience significantly less reinvestment in the short run.

The results in the paper point out that building costs are a very important determinant of renovation effort across metropolitan areas. Such spending increases by 0.72 percent when building cost go up by 1 percent, implying a price elasticity of –0.28. Moreover, building costs are not very sensitive to changes in construction activity, as the supply of physical structures seems to be very elastic. Incomes, intensity of regulatory enforcement, unionization in the construction sector and regional effects are important supply shifters that account for nearly 80 percent of the between-city variance in building costs.

As expected, households reduce their investment in renovation when home values go below construction costs. 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 simulated the impact of a 10 percent reduction in construction costs and found it had a considerable impact on housing reinvestment, especially in declining cities with fairly flat distributions of house prices to construction costs. The results suggest that many areas of declining cities would become viable again for reinvestment if construction costs could be lowered.

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points in the value/cost ratio distribution. That said, one still should view the effects in Tables 8 and 9 as likely representing upper bound estimates.

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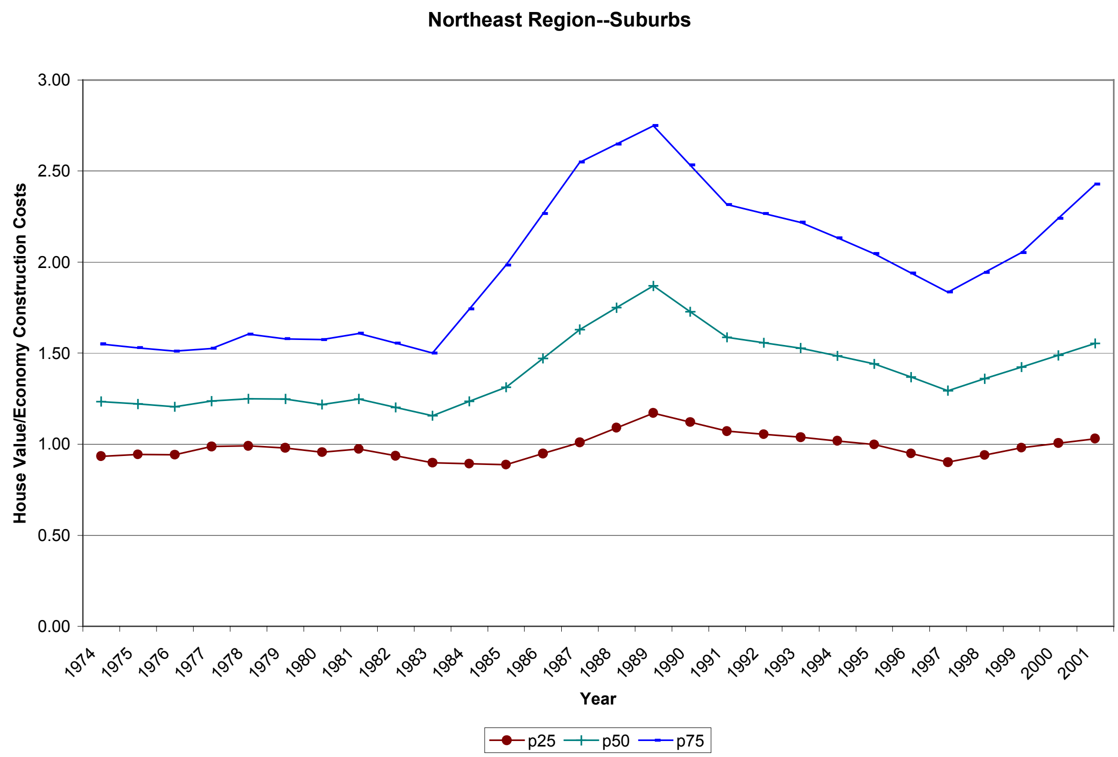
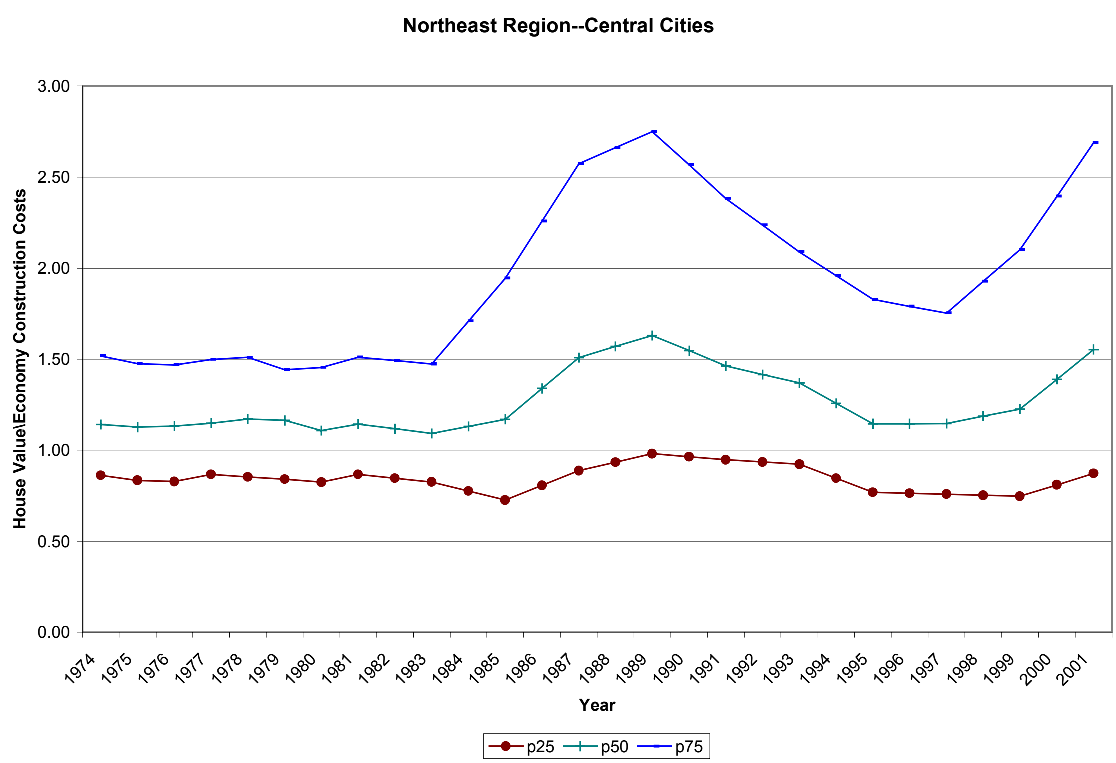
Graph 1

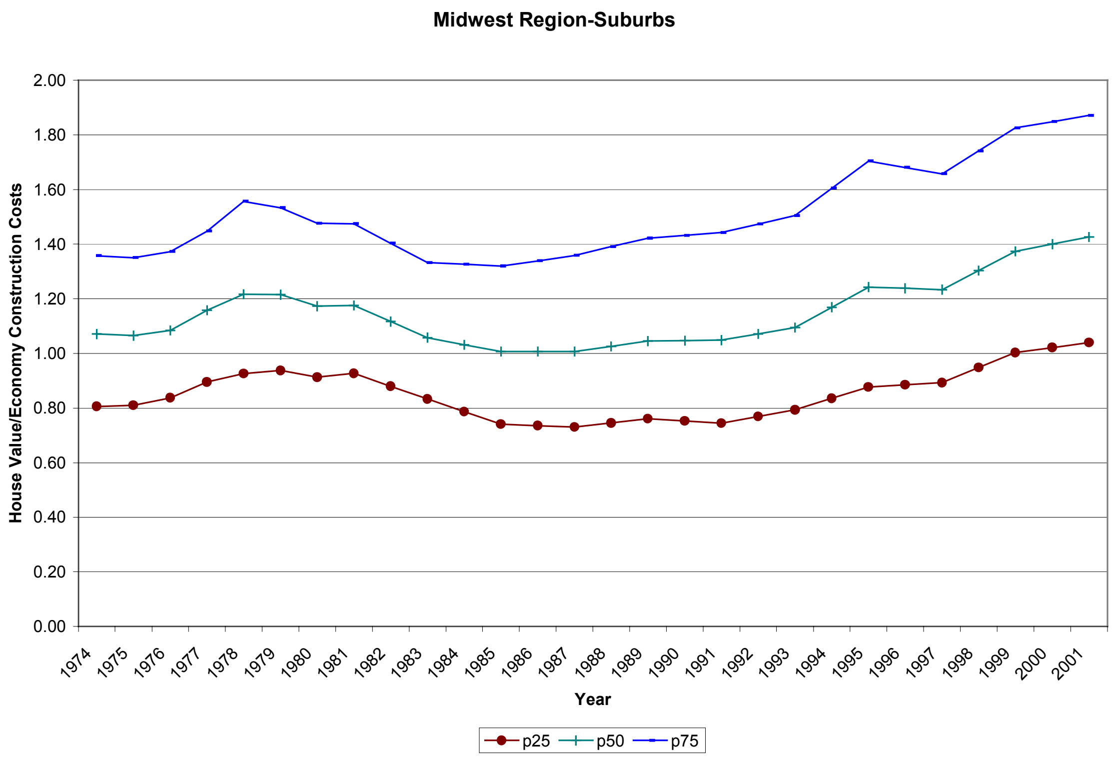
Home value to cost ratio: the Northeast

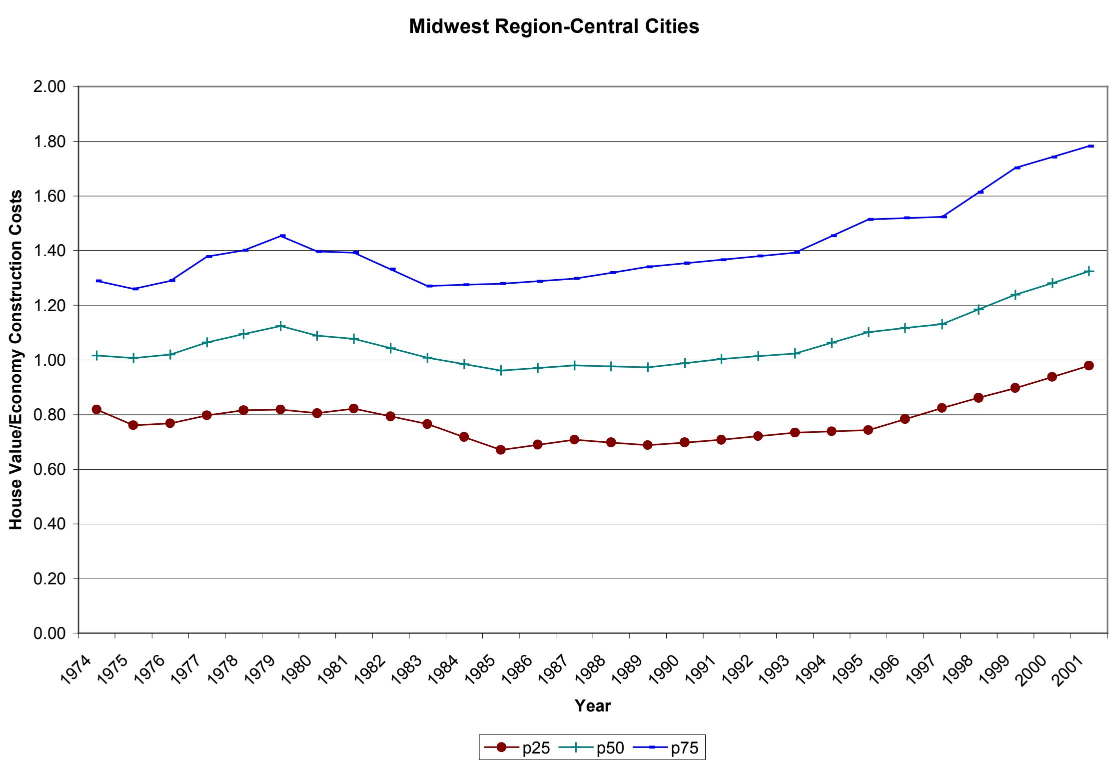




Graph 2

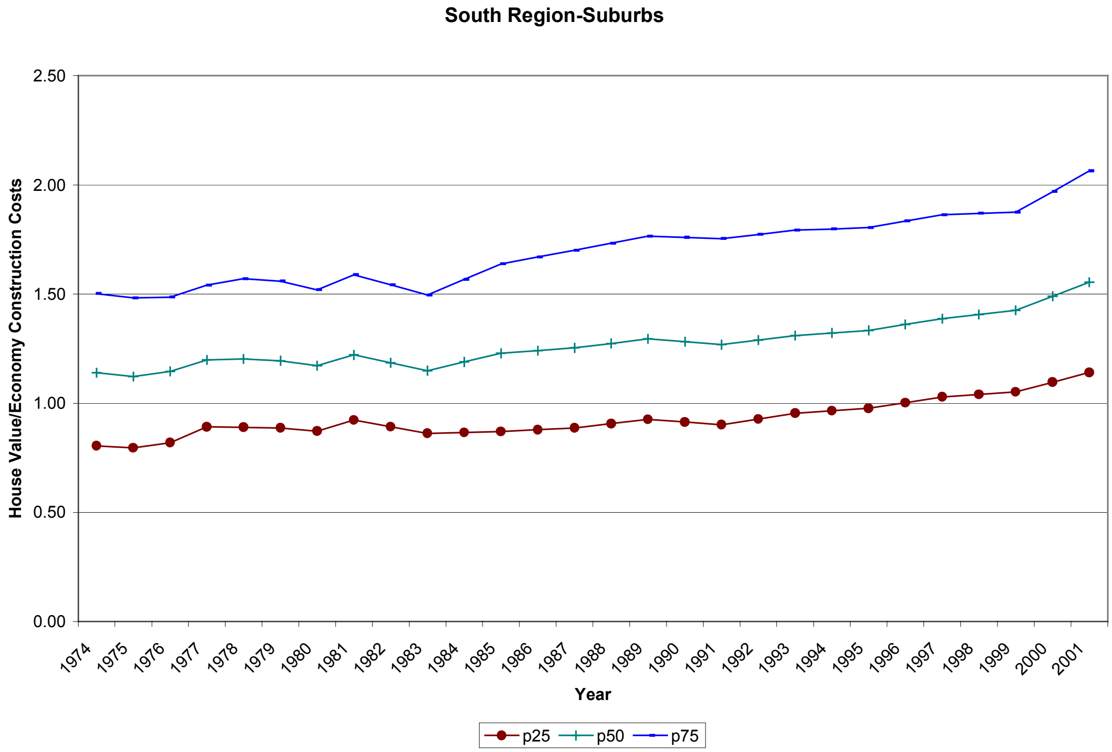
Home value to cost ratio: the Midwest

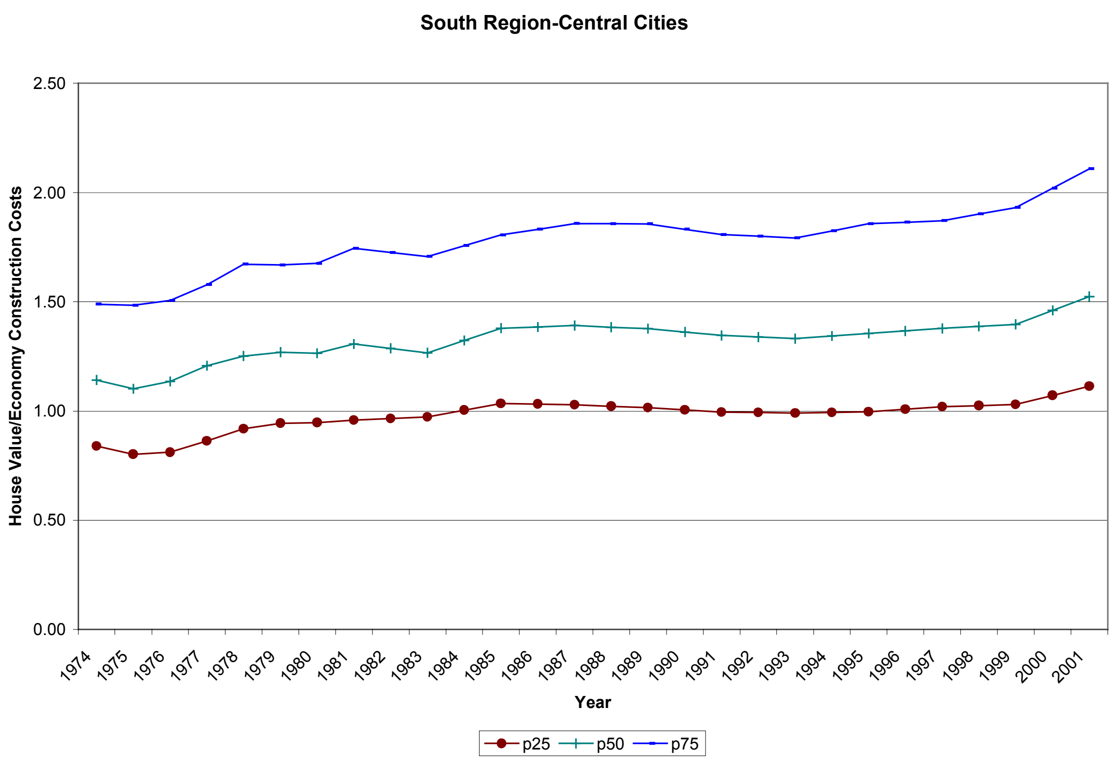




Graph 3

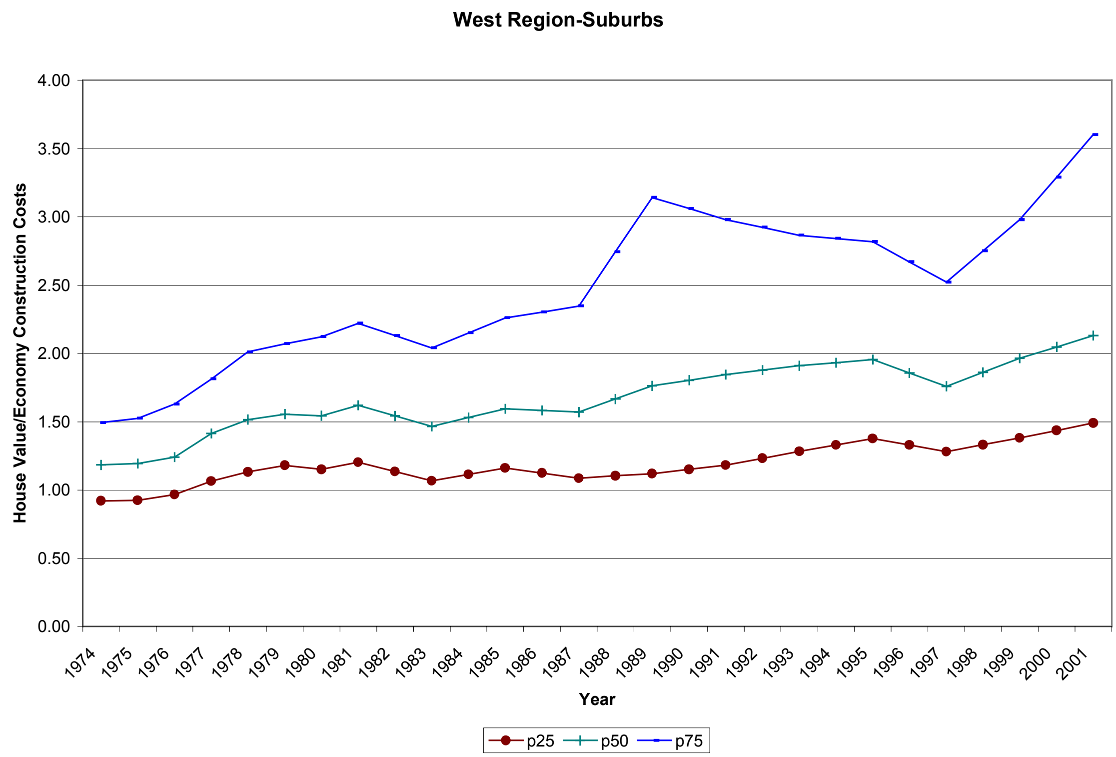
Home value to cost ratio: the South





Graph 4

Home value to cost ratio: the West



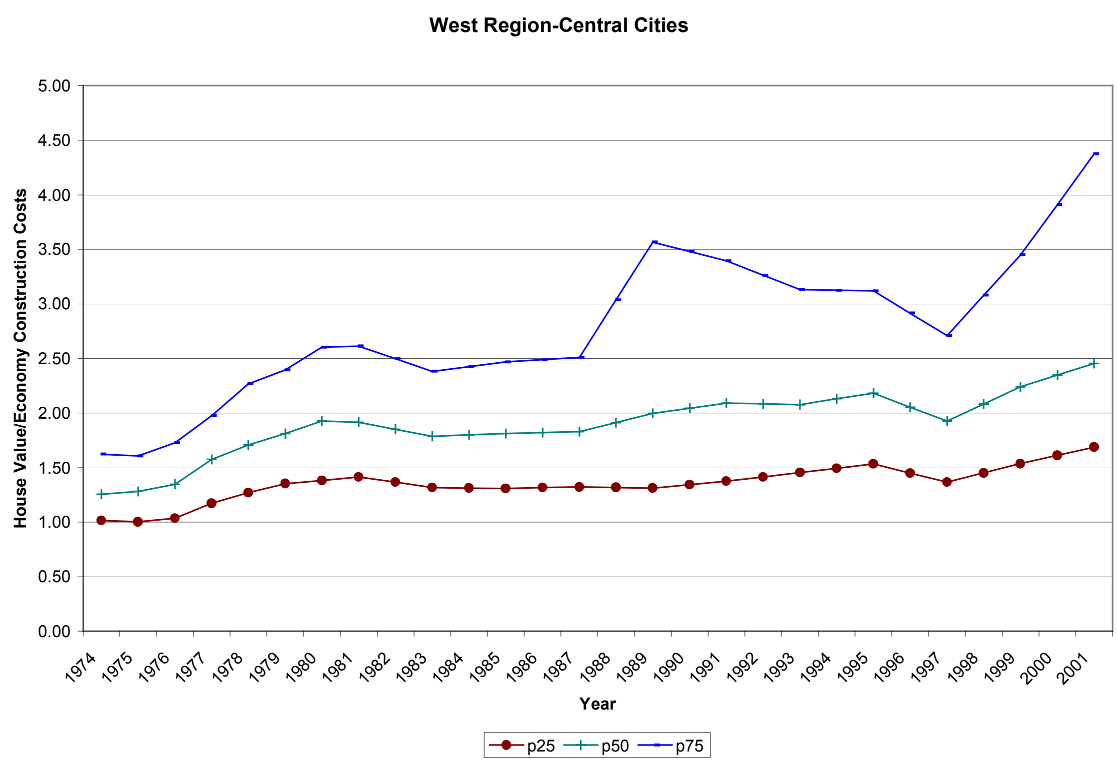


TABLE 1

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

Home values and construction costs

	(1)	(2)	(3)	(4)	(5)
	Log City Average House Value				Log Value: Units Below Cost at T=1
Log City Construction Cost, 2000 Sq.ft. unit	1.069 (0.101)***	0.961 (0.080)***	1.281 (0.255)**	1.478 (0.693)**	0.198 (1.316)
Log City Average Household Income		0.823 (0.033)***	1.61 (0.187)**	1.783 (0.426)**	1.619 (0.425)**
Constant	7.678 (0.399)***	-1.013 (0.450)**	-10.97 (1.852)**	-13.645 (4.440)**	-6.469 (6.873)
Year Fixed Effects	*yes*	*yes*	*yes*	*yes*	*yes*
MSA Random Effects	*yes*	*yes*	*yes*	*no*	*no*
MSA Fixed Effects	*no*	*no*	*no*	*yes*	*yes*
R-squared	0.47	0.74	0.81	0.53	0.68
Observations	1225	1225	108	108	108
Number of MSAs	102	102	43	43	43
AHS Source	National	National	Metro	Metro	Metro

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Only MSAs witho more than 50 observations each year in the AHS National Sample regressions

TABLE 3

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 4

The Impact of Being Below Cost on Renovation

	Average Renovation ($)	
	(1)	**(2)**
	Tobit	IV Tobit
Units 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)***
Income of all HH members including non-relatives	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 5

A Placebo: expenditures in electricity

	Annual Cost of Electricity IV
Units 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)***
Income of all HH members including non-relatives	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 6

Within-Units Changes

	Expenditures in Renovation		
	(1)	**(2)**	**(3)**
	All		"Stable" Units
	FE	FE IV	FE
Units 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)***
Income of all HH members including non-relatives	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 7

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 8
Simulating the Impact of Reducing Construction Costs by10%

$\overline{pq} = 1945.36$ $\varepsilon_p = -0.28$ $\beta_{IV} = -911.47$

CENTRAL CITIES

	Percentage Homes Sent Above Cost $\frac{n_{shift}}{n}$	Rank (1)	Percentage Increase in Real Renovation: Price effect ε_p	Percentage Increase in Real Renovation: Effect through share of homes sent above construction cost $\frac{n_{shift}}{n} \cdot \frac{\beta_{IV}}{\overline{pq}}$
	(1)	(2)	(3)	(4)
Milwaukee	14.21%	1	2.80%	6.66%
Minneapolis	11.59%	2	2.80%	5.43%
Portland (OR)	10.98%	3	2.80%	5.14%
Birmingham	9.59%	4	2.80%	4.49%
Rochester (NY)	9.16%	5	2.80%	4.29%
Buffalo	9.07%	6	2.80%	4.25%
Cincinnati	9.05%	7	2.80%	4.24%
St. Louis	8.90%	8	2.80%	4.17%
Cleveland	8.23%	9	2.80%	3.86%
Kansas City	7.76%	10	2.80%	3.64%
San Antonio	7.61%	11	2.80%	3.56%
Philadelphia	7.60%	12	2.80%	3.56%
Columbus (OH)	7.47%	13	2.80%	3.50%
Pittsburgh	7.15%	14	2.80%	3.35%
Indianapolis	6.92%	15	2.80%	3.24%
Chicago	6.74%	16	2.80%	3.16%
Baltimore	6.74%	17	2.80%	3.16%
Salt Lake City	6.72%	18	2.80%	3.15%
Houston	6.32%	19	2.80%	2.96%
Memphis	6.06%	20	2.80%	2.84%
Tampa	5.03%	21	2.80%	2.36%
Providence	4.74%	22	2.80%	2.22%
Miami	4.34%	23	2.80%	2.03%
Oklahoma City	4.29%	24	2.80%	2.01%
Fort Worth	4.00%	25	2.80%	1.88%
Dallas	3.69%	26	2.80%	1.73%
Atlanta	3.14%	27	2.80%	1.47%
Boston	3.09%	28	2.80%	1.45%
New Orleans	2.89%	29	2.80%	1.35%
Hartford	2.74%	30	2.80%	1.28%
Phoenix	2.37%	31	2.80%	1.11%
Norfolk	2.29%	32	2.80%	1.07%
Detroit	2.19%	33	2.80%	1.02%
Denver	1.80%	34	2.80%	0.84%
Washington	1.65%	35	2.80%	0.78%
Seattle	1.41%	36	2.80%	0.66%
San Francisco	0.72%	37	2.80%	0.34%
San Diego	0.22%	38	2.80%	0.10%
Los Angeles	0.09%	39	2.80%	0.04%
Anaheim	0.00%	40	2.80%	0.00%
New York City	0.00%	41	2.80%	0.00%
Newark	0.00%	42	2.80%	0.00%
Riverside	0.00%	43	2.80%	0.00%

TABLE 9
Simulating the Impact of Reducing Construction Costs by10%

$\overline{pq} = 1945.36$ $\varepsilon_p = -0.28$ $\beta_{IV} = -911.47$

SUBURBS

	Percentage Homes Sent Afloat $\frac{n_{shift}}{n}$	Rank (1)	Percentage Increase in Real Renovation: Price effect ε_p	Percentage Increase in Real renovation: Effect through share of homes sent above construction cost $\frac{n_{shift}}{n} \cdot \frac{\beta_{IV}}{\overline{pq}}$
	(1)	**(2)**	**(3)**	**(4)**
Buffalo	11.15%	1	2.80%	5.22%
St. Louis	9.75%	2	2.80%	4.57%
Salt Lake City	9.52%	3	2.80%	4.46%
Cleveland	9.27%	4	2.80%	4.34%
Kansas City	8.79%	5	2.80%	4.12%
Cincinnati	8.49%	6	2.80%	3.98%
Detroit	8.30%	7	2.80%	3.89%
Houston	7.98%	8	2.80%	3.74%
Pittsburgh	7.97%	9	2.80%	3.74%
Minneapolis	7.78%	10	2.80%	3.64%
Milwaukee	6.27%	11	2.80%	2.94%
Birmingham	5.91%	12	2.80%	2.77%
Indianapolis	5.71%	13	2.80%	2.67%
Providence	5.47%	14	2.80%	2.56%
Oklahoma City	5.41%	15	2.80%	2.53%
Rochester (NY)	5.39%	16	2.80%	2.52%
Portland (OR)	5.07%	17	2.80%	2.38%
Columbus (OH)	4.60%	18	2.80%	2.15%
Philadelphia	4.28%	19	2.80%	2.01%
Tampa	3.45%	20	2.80%	1.62%
New Orleans	3.43%	21	2.80%	1.61%
San Antonio	3.16%	22	2.80%	1.48%
Chicago	3.02%	23	2.80%	1.41%
Fort Worth	2.87%	24	2.80%	1.34%
Denver	2.79%	25	2.80%	1.31%
Boston	2.38%	26	2.80%	1.12%
Baltimore	2.36%	27	2.80%	1.11%
Atlanta	2.34%	28	2.80%	1.10%
Memphis	2.26%	29	2.80%	1.06%
Seattle	1.94%	30	2.80%	0.91%
Dallas	1.91%	31	2.80%	0.90%
Riverside	1.45%	32	2.80%	0.68%
New York City	1.25%	33	2.80%	0.59%
Miami	1.08%	34	2.80%	0.50%
Phoenix	1.01%	35	2.80%	0.47%
Norfolk	1.00%	36	2.80%	0.47%
Washington	0.78%	37	2.80%	0.36%
Hartford	0.57%	38	2.80%	0.27%
Newark	0.51%	39	2.80%	0.24%
San Francisco	0.30%	40	2.80%	0.14%
Los Angeles	0.18%	41	2.80%	0.09%
Anaheim	0.10%	42	2.80%	0.05%
San Diego	0.05%	43	2.80%	0.02%

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**.

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 in 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, T.3,A.T.1
Log city average house value	MSA average of AHS reported housing value for single unit (attached and detached), owner-occupied homes. Only for MSA with 50 or more valid observations per year.	National Sample American Housing Survey (1974-2001)	T.2
Log City Average Household Income	MSA average of AHS reported total household income. Only for MSA with 50 or more valid observations	National Sample American Housing Survey 1974-2001	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.3
Log city average house value	MSA average of AHS reported housing value for single unit (attached and detached), owner-occupied homes.	Metropolitan Sample American Housing Survey (1984-1994)	T.3
Log city average household income	MSA average of AHS reported household income for single unit (attached and detached), owner-occupied homes.	Metropolitan Sample American Housing Survey (1984-1994)	T.3
Log city average value for units below cost in the initial wave	Tracks the average value (at the MSA level) for units with values below construction cost in the first wave of the Metro AHS (1984-1994) in which the metropolitan area was sampled. 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
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.4, T.6, T.7
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 Sample American Housing Survey (1984-1994) +	T.4, T.5, T.6

	Metropolitan AHS sample.	Residential Cost Data (2000) Square Foot Costs (2001) (R.S. Means Company)	
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.4, T.5, T.6
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.4, T.5, T.6
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.4, T.5, T.6
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.4, T.5, T.6
Units has Patio or Porch		Metropolitan Sample American Housing Survey (1984-1994)	T.4, T.5, T.6
Size of Unit Sq. Ft.	Self reported square footage	Metropolitan Sample American Housing Survey (1984-1994)	T.4, T.5, T.6
Annual Cost of Electricity	12 times the self-reported average monthly cost of electricity	Metropolitan Sample American Housing Survey (1984-1994)	T.5.

Notes:

* Expenditures in Inspection

Correspond to local expenditures in regulation and inspection of private establishments for the protection of the public or to prevent hazardous conditions not classified under another major function. Examples of these are 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 further add expenditures for all counties in a MSA using the 1999 county-based definitions from the Census.

† Value-to-cost ratio: National AHS Data

a. Imputing missing square footage and basement variables

Prior to 1985, the AHS did not report square footage. This is a necessary variable to calculate the replacement cost of the unit (cost per feet times footage). We impute square footage in three steps. First, for units with some reported and some missing square footage data, we calculate the average square footage reported for each housing unit across years (units are resampled every year) and substitute this average for the missing observations. This step deals with most of the post-1984 missing values. In the second step, regress square footage on a host of available housing and personal traits from the AHS. The explanatory variables include the number of rooms, a dummy for whether the unit is attached or not, the presence of a garage, the presence of a basement, the presence of complete kitchen facilities, the presence of central air conditioning, the number of bathrooms, vintage dummies, the number of persons in the household, household income, the age of household head (and its square), a dummy for whether the head is female, a dummy for whether the head is Hispanic, and MSA or region fixed effects. The R-squared of the regression is 0.37. We then use the estimated parameters to predict square footage in 1974-1983 for units with all these variables available. In the final step, we recalculate the average square footage reported by a housing unit across years and substitute in for missing observations. This provides estimated values for some of the pre-1985 observations that did not have complete information on the independent variables in the regressions across all years.

Information on the presence of basement is only available for the pre-1978 and post-1983 period, based on the variable termed 'cellar' in the AHS. Because construction costs differ for units with and without a basement, we impute the presence of a basement for the 1978-1983 period. More specifically, we generate a variable that takes value one if the housing unit reports a basement in any of the previous interview years. In that case, we simply assume the unit has a basement in future years with missing data on the variable. For units that only appear after 1977, the presence of a basement cannot be imputed this way. For the rest of units with missing data on this trait (including the units with missing information on basement in the 1984-2001 period), we randomize using the probability of having a basement in the corresponding MSA. If the MSA is not identified we calculate that probability for the corresponding Census region.

b. 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 1997-2001. 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 1997-2001. 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.

c. 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 a 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 Mean specifications.

‡ Value-to-cost ratio: Metro AHS Data

We have little to say here, as the adjustments made are quite similar to those noted in †, except for the fact that we do not need to impute square footage (because these data begin after 1983). We do impute the presence of basement if we have another observation of the same unit with complete values. However, we discard observations without information on square footage.

± 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.