The Price of Residential Land in Large U.S. Cities[†]

Morris A. Davis[a,*] and Michael G. Palumbo[b]

[a] *Department of Real Estate and Urban Land Economics, University of Wisconsin-Madison School of Business, 975 University Avenue, Madison, WI 53706, USA*

[b] *Flow of Funds Section, Federal Reserve Board, 20th and C Streets NW, Washington, DC 20551, USA*

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Abstract

Combining data from several sources, we build a database of home values, the cost of housing structures, and residential land values for 46 large U.S. metropolitan areas from 1984 to 2004. Our analysis of these new data reveal that since the mid-1980s residential land values have appreciated over a much wider range of cities than is commonly believed. And, since 1998, almost all large U.S. cities have seen significant increases in real residential land prices. Averaging across the cities in our sample, by year-end 2004, the value of residential land accounted for about 50 percent of the total market value of housing, up from 32 percent in 1984. An implication of our results is that housing is much more land intensive than it used to be, meaning that the future course of home prices — the average rate of appreciation and volatility — is likely to be determined even more by demand factors than was the case even ten or twenty years ago.

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[*]Corresponding author. Fax: +1 608 262 8775. *E-mail addresses:* mdavis@bus.wisc.edu (M. Davis) and michael.g.palumbo@frb.gov (M. Palumbo).

1 Introduction

The basis premise of this paper is that a house can be viewed as a bundle of physical structure and location, and that these components serve distinct functions and are priced quite differently. In this paper, we estimate and document changes to the price and value of residential locations for 46 large metropolitan areas in the U.S. from 1984 to 2004.

The physical structure of a house can be viewed as a capital input in production of goods and services at home. The "home-production" literature (see See Greenwood, Rogerson, and Wright [8] for a review) has typically treated residential structures as being in elastic supply, except perhaps for short-run adjustment costs, as noted by Fisher [4]. According to the analysis of Gyourko and Saiz [9], the assumption of elastic supply of structures is validated by the available data, implying the quantity of structures can easily respond to changes in demand for home-produced goods and services, but the price of structures is pinned down by construction costs.

By contrast, the location component of housing — or "land" in our terms — refers to the amenities associated with a particular parcel, including its topology, climate, distance from employment centers, quality of local schools, and the like. Thus, it may be the case that land is supplied relatively inelastically, so that, in equilibrium, demand factors play an important role in determining its price.

Therefore, when land and structures are bundled together as a *home*, the elasticity of the supply of housing and the response of house prices to changes in demand is closely related to the share of home value that is accounted for by the replacement cost of its physical structure and share that reflects the market value of its land and location. In areas where most of the value of housing is accounted for by the value of land, new housing arguably is relatively inelastically supplied, and house prices (but not quantities) will likely respond to changes to demand. In areas where most of the value of housing is accounted for by the replacement cost of structures, changes to demand will likely affect the quantity of structures, but not their price.

In this paper, we combine data from several sources to estimate changes in the value and price of residential land for 46 large U.S. metropolitan areas from 1984 to 2004. We show that over the past twenty years just about every large city in the U.S. has experienced a significant increase in the average share of home value attributed to the market value of residential land. It follows from the increase in average land values that we document that just about every large U.S. city has probably seen a significant decrease in the elasticity of supply of housing. We estimate that although residential land represented less than a quarter of average home value in quite a number of large U.S. metro areas twenty years ago, these days Oklahoma City is the only city in our sample where that is still true.

In a recent paper, Davis and Heathcote [2] stress the importance of distinguishing between construction costs and residential land values at the aggregate level. They demonstrate that the time-series properties and the macroeconomic relationships of construction costs and land prices bear no resemblance, and they show how macro analysis of home prices gives a very misleading picture of what is really going on with land valuations. One stark example from their paper that highlights this point concerns growth in house prices, construction costs, and land prices from 1950-1960. In real terms over this period, Davis and Heathcote estimate that aggregate house prices did not appreciate, but construction costs were falling by about 1 percent per year. They show the real price of land in the aggregate must have appreciated by over 5 percent per year throughout this decade to reconcile these facts.[1]

Two other recent studies — Glaeser and Gyourko [7] and Gyourko and Saiz [9] — have emphasized that the fraction of home value in a locality that is accounted for by the replacement cost of its physical structure is a critical determinant of the elasticity of supply of housing. Figure 1 presents a stylized housing supply curve to illustrate the point. In region I, land is abundant and, thus, inexpensive, so the replacement cost of residential structures accounts for just about all of home values in the locality.[2] The supply curve is quite elastic between points A and B, representing the ease with which new homes — that is, new structures on high-quality new land — can be built.[3] In region II, however, land is more scarce, implying more expensive homes, on average, and a smaller share of home value that is represented by the replacement cost of physical structures. Moving from point B to C to D, land becomes relatively more scarce and more expensive, increasing land's share of housing in the existing stock and driving down the elasticity of supply for new housing. In section 3, we present our new data suggesting that while quite a number of large U.S. cities seem to have been operating in region I as recently as the early 1990s, by the late 1990s and early 2000s, the evidence indicates that land had become significantly more scarce just about all around the country.

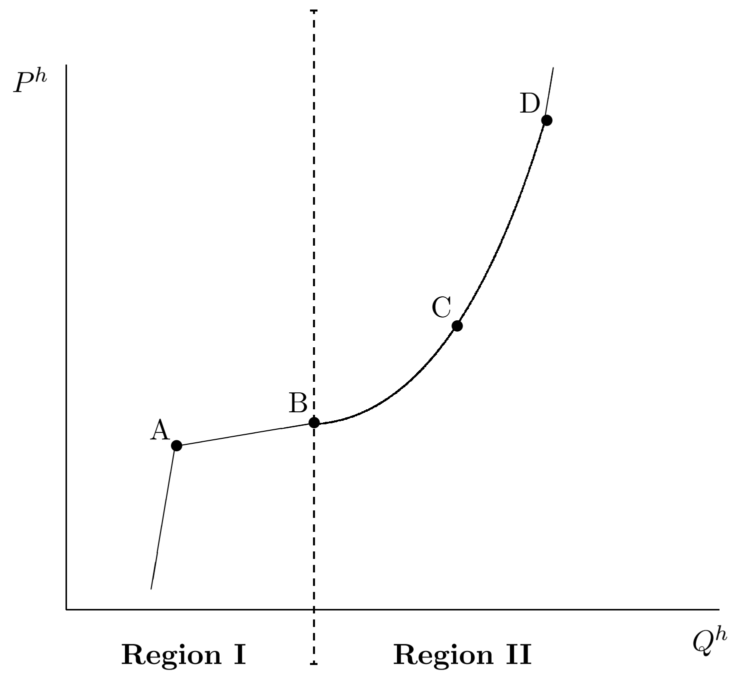
[1]See table 5 of Davis and Heathcote.

[2]Region I in our figure is a reproduction of Glaeser and Gyourko's Figure 1 ([7], p. 347).

[3]Glaeser and Gyourko argue that supply is inelastic to the left of point A to the extent that the durability of the current housing stock, taking point A as the initial equilibrium in this housing market, makes it expensive to reduce the quantity of housing supplied.

Figure 1

Stylized Supply Curve for Housing



In fact, one of the more striking results in this paper is just how widespread the strength of land prices has been in the recent housing boom. We show that in 43 of the 46 large metropolitan areas in our sample a rapid pace of land price appreciation has pushed up land's share of home value markedly in just the past six years.[4] To be sure, since 1998 land has appreciated at the fastest pace in cities along the East and West coasts, where residential land was arguably already in shortest supply. In these cities, home prices and land prices tell similar stories about the extent of the recent housing boom. In others, however — places like Houston, Kansas City, Milwaukee, Minneapolis, Pittsburgh, St. Louis, and Tampa, where in 1998 land was generally not very expensive — our new data on land prices show the significant imprint that was made in the recent housing boom — an imprint which is understated to an important extent in data on home prices.

As a concrete example of the insights that our new data offer for the analysis of housing markets, consider the following "case study" from the recent boom in U.S. home prices, which we take as having begun in 1999. Conventional wisdom generally accepts the boom as having

[4]This is consistent with evidence from Del Negro and Otrok [3] that house price gains in the recent boom across all US states share an important common factor.

been dichotomous in that home prices have skyrocketed in coastal cities while nothing particularly interesting has been going in the Midwest. Indeed, in reference to Los Angeles, San Francisco, and Boston, Case and Shiller ([1], pp. 315-6) say: "These three might be called glamour cities, in that they are the home of either international celebrities, or the entertainment industry, or world-class universities, or high-technology industries, and the prices of homes in these metropolitan areas are high as well as volatile." They discuss Milwaukee as the "other" city — the exception in the small group they consider that has not seen "pronounced cycles" in home prices. However, our data cut significantly against this dichotomous view of the recent boom by revealing just how widespread across cities the sharp increases in *land prices* have been. The fact that land prices have been rapidly increasing in our sample of MSAs argues that new land and thus new housing may be in increasingly inelastic supply in almost all major U.S. cities.

Our perspective can be understood through a simple numerical example. Consider the cases of just two cities — San Francisco and Milwaukee — that, by our estimates, experienced almost the same net increase in residential land prices from 1999 through 2004. Going into the recent boom — that is, at the end of 1998 — we estimate that land represented about 81 percent of the average single-family home's value in San Francisco, whereas in Milwaukee land accounted for a share of only 33 percent. This means that, abstracting from any changes in real construction costs, a cumulative 90 percent increase in the real price of residential land in both cities would have translated into a 73 percent increase in home prices in San Francisco ($0.73 = 0.81 * 0.90$), but only a 30 percent increase in home prices in Milwaukee ($0.30 = 0.33 * 0.90$).[5]

Of course, the fact that the price of land appreciated at the same rate in both San Francisco and Milwaukee does not imply that both areas experienced the same sized demand or supply shock. Rather, our point is that a simple comparison of gains in house prices might make San Francisco seem "glamorous" compared with Milwaukee, but the rapid pace of appreciation in the price of residential land in Milwaukee tells a different story about conditions in Milwaukee's housing market. And, it's not just Milwaukee: As we show below, for many other cities across the country, data on home prices significantly obscure the increases in residential land prices that have been registered over the past two decades and particularly in the recent housing boom.

We also emphasize that even though residential land has appreciated significantly, on net, over

[5]Once we factor in the real increases in construction costs from 1999 through 2004 (5 percent in San Francisco and 8 percent in Milwaukee), the actual increase in home prices in these cities can be completely accounted for — San Francisco: $0.74 = 0.81 * 0.90 + 0.19 * 0.05$; Milwaukee: $0.35 = 0.33 * 0.90 + 0.67 * 0.08$.

the past past twenty years, for most large metro areas the path has been more of a roller coaster ride than a steady upward march. Indeed, we show that 39 of the 46 cities in our sample have experienced a clear temporary peak in the real residential land price index, and in many of these cities it has taken 10 years or more for land prices to fully recover from their previous troughs.

Moreover, a point we emphasize is that, with residential land having appreciated so significantly around the country, the future course of land prices is expected to play an even more prominent role in governing home prices — in terms of average appreciation rates and volatility. This is because the average appreciation rates and volatility are likely increasing functions of land's share of home value. So, whether or not the run-up in home prices since 1998 was a "bubble" or a reasonable response to shifting demand for residential land and location, the fact that land accounts for a much larger share of home value than it used to could mean that there is significantly more "home value at risk" right now, should demand fall back.

The story we have weaved in above is that our new data suggest that residential land has become significantly more scarce in large cities all over the U.S., in the sense that new housing construction evidently has occurred in places that are poor substitutes for the existing stock of residential land, driving up the average price and value of the existing stock. The link between the increasing scarcity of residential land and its price is consistent with the insights of a standard urban model: As the population of an MSA increases, new housing units are built on the urban/rural fringe. Existing parcels will therefore offer better commutes to a CBD than the new parcels, and the price of existing parcels will be bid up accordingly. Therefore, with population growth we should expect the average value of land in an MSA to increase. Critical to this story is the idea that the supply of parcels with good commutes in an MSA is in relatively fixed supply. Glaeser, Gyourko, and Saks [6], Malpezzi [12], Quigley and Raphael [14], Van Nieuwerburgh and Weill [17], and others have focused on the role that land-use regulations may play in determining the supply of parcels and the path of house prices.

The next section of the paper briefly describes our source data and methods for estimating land's share of home value and generating a constant-quality price index for residential land across large U.S. metropolitan areas and a much more detailed explanation can be found in the paper's appendix. Section 3 reports evidence on the average pace of appreciation and variability of land prices across our sample of metropolitan areas since 1984, with a particular emphasis on the patterns seen in the recent housing boom. In the final section, we discuss the implications of our main empirical results for the future course of home prices around the country. The data we create are available for download at *http://morris.marginalq.com/davispalumbodata.htm.*

2 Brief Summary of Data and Estimation Methods

Our measurement and analytical framework centers on the idea that a home's value is the sum of the replacement cost of its physical structure and the market value of the land and location it occupies. Extending recent work by Davis and Heathcote, it follows from this perspective that the percentage change in home prices in city j during period t (denoted g_{jt}^{hp}) can be thought of as the weighted average of the percentage changes in construction costs (g_{jt}^{cc}) and residential land prices (g_{jt}^{lp}):[6]

$$g_{jt}^{hp} = \omega_{jt-1}^{s} g_{jt}^{cc} + \omega_{jt-1}^{l} g_{jt}^{lp}. \tag{1}$$

In equation (1), the weights ω_{jt-1}^{s} and ω_{jt-1}^{l} are the shares of home value in in period $t-1$ in city j that are accounted for by the replacement cost of residential structures and the market value of residential land, respectively, at the beginning of period t. Naturally, these shares sum to one, so $\omega_{jt-1}^{s} = 1 - \omega_{jt-1}^{l}$.

One can rearrange this equation to express growth in land prices as a weighted average of growth in construction costs and growth in home prices:

$$g_{jt}^{lp} = \frac{1}{\omega_{jt-1}^{l}} \left[g_{jt}^{hp} - \omega_{jt-1}^{s} g_{jt}^{cc} \right]. \tag{2}$$

To solve for the growth in land prices between periods $t-1$ and t, one only needs accurate measurement of all of the right-hand side variables: growth in home prices g_{jt}^{hp}, growth in construction costs g_{jt}^{cc}, and the structures share of home value as of the start of period $t-1$, ω_{jt-1}^{s}.

Table 1 provides a concise summary of the complete set of source data we use in equation (2). We take direct observations on the percentage change in home prices in major MSAs from Freddie Mac's Conventional Home Price Index (CMHPI). For construction costs at the city level, we use data published by R.S. Means Company [15] that are used by building contractors to prepare bids for residential construction projects. Table 1 illustrates exactly how we match data from the R.S. Means company, the CMHPI, and other data we use from the BEA to operationalize equation (2).

To back out changes in residential land prices using equation (2), we need time-series estimates of the weights w_{jt-1}^{s} and w_{jt-1}^{l}. Deriving these weights requires a good deal of work. As described in detail in the appendix, we compute the time series of these weights using a two-step procedure.

[6] If p_{jt}^{h} denotes an index for home prices in city j for period t, $g_{jt}^{hp} = \frac{p_{jt}^{h}}{p_{jt-1}^{h}} - 1$.

First, we estimate the structures share of home value at a benchmark date using micro-data on home values and housing characteristics from the Metropolitan American Housing Surveys that are available for 46 large U.S. metropolitan areas ("cities", for short).[7] Then, given the estimates of the structures share of home value at the benchmark date, and given changes in home prices and construction costs each year, we apply a dynamic equation that is compatible with (1) to derive a complete time-series for structures' share of home value back to 1984 and forward to 2004 in each metro area.

The dynamic equation for this second step, which is derived as equation (A-13) in the appendix, is:

$$\omega_{jt}^{s} = \omega_{jt-1}^{s} \left(\frac{g_{jt}^{cc}}{g_{jt}^{hp}} \right) \left(\frac{h_{jt-1}}{h_{jt}} \right) + \theta_{jt} \frac{\Delta h_{jt}}{h_{jt}}. \tag{3}$$

In the above equation, h_{jt} denotes the real stock of housing, inclusive of real land and structures, in city j in period t. The logic embedded in equation (3) is that the structures share of home value rises (that is, $\omega_{jt}^{s} > \omega_{jt-1}^{s}$) in years in which construction costs increase faster than overall home prices ($g_{jt}^{cc} > g_{jt}^{hp}$) and in years in which there is a lot of new construction ($\frac{\Delta h_{jt}}{h_{jt}}$ is large). The latter part follows from our assumption — consistent with available data — that newly constructed homes tend to be much more structure-intensive than the existing stock of homes – in our notation, $\theta_{jt} > \omega_{jt-1}^{s}$. Thus, we explicitly control in our accounting for the fact that land's share of new homes is likely less than land's share of the average existing home.[8]

As the appendix makes pretty clear, our point estimates for residential land values and their price indexes are derived using several formulas, different sources of data, and a few assumptions about unobserved quantities, none of which is likely to be exactly right. However, a few of our assumptions that have raised eyebrows are worth mentioning. First, we assume that land does not depreciate. We also assume that the depreciation rate of structures is a function of only the age of the structure, and apply a constant depreciation rate of 1.5% per year to all owned structures in all MSAs. This assumption is in line with that of the Bureau of Economic Analysis (BEA) in its construction of its current-cost estimate of the aggregate stock of residential structures (Fraumeni [5], p. 18). Of course, it could be the case that the rate of depreciation of structures depends on the age of the structure, that vintages of structures have differing depreciation schedules, or

[7]Table 2 lists the number of observations we use, by MSA, to benchmark the structures share of home value.

[8]Although θ_{jt} is always greater than ω_{jt-1}^{s}, we allow for a correlation of the two variables; specifically, in areas where existing homes are land intensive and ω_{jt-1}^{s} is relatively low, new homes are also assumed to be relatively land intensive and θ_{jt} is also relatively low. Thus, θ_{jt} is updated each period with ω_{jt-1}^{s} – see equation (A-14) of the appendix for details.

that depreciation schedules vary by MSA for a variety of possible reasons. To the extent that our assumed depreciation rate is incorrect, our time-series estimates of land's share of home value may be off the mark.[9] On this point, we would suggest that more research is needed.[10]

Second, we measure the value of land residually as home value less the replacement cost of the structure. If the land-use intensity of a given parcel is not optimal – say the structure is not the right size given (a) a production function for housing (as a function of land and structure) and (b) true but unobserved lot value – then what we report will be a lower bound to the value of land if the land were vacant. In this sense, our estimates can be recast as the value of land after conditioning on current use. That said, we believe our residual estimate of lot value is intrinsically linked to the value of the same lot if it were empty: Our residual estimate of lot value, and a different estimate of lot value assuming a vacant lot, both condition on the current use of surrounding lots. Neither estimate uncovers lot value if the surrounding lots were either vacant or were developed at optimal intensity.

With these caveats in mind, we believe our main results to be rather robust, as they largely are derived from interpreting the sizes of changes in Freddie Mac's CMHPI relative to changes in construction costs measured by data from R.S. Means — and these data are pretty solid.

Consider, for example, the cases of Minneapolis-St. Paul and San Francisco. Few would disagree that residential land is relatively inexpensive in the former city: By our estimates, in 1984 land represented 12 percent of home value in Minneapolis-St. Paul and 75 percent of home value in San Francisco. Now, suppose that, in both cities, construction costs had been completely flat in real terms so that equation (1) could be reduced in real terms to

$$g_{jt}^{hp} = \omega_{jt-1}^{l} g_{jt}^{lp} \tag{4}$$

for $j = \{SF, MSP\}$. Then, if land prices had increased at about the same rate in Minneapolis-St. Paul and San Francisco ($g_{j=SF,t}^{lp} = g_{j=MSP,t}^{lp}$), we would have expected real home prices to have risen more than 6 times faster in San Francisco than in Minneapolis-St. Paul after 1984: That is, taking the ratio of equation (4) for the two cities gives the following expression for their relative change in

[9] For example, if were to increase the depreciation rate to (say) 2 percent per year, our estimates of land's share of home value in all MSAs would increase, and our estimates of the growth rate of land prices would be reduced.

[10] We view one procedure to uncover depreciation – regressions of house value on age and vintage – as inadequate, as these regression results yield accurate estimates of the depreciation rate of structures when the (omitted) value of land is not correlated with age or vintage. That is, regressions may incorrectly infer the rate of depreciation on structures because homes built at different times may be built in different locations, and these locations may systematically differ in value.

home prices: $\omega^l_{j=SF,t-1}/\omega^l_{j=MSP,t-1} = 0.75/0.12 = 6.25$.[11] But according to the CMHPI, from 1984 through 2004, home prices in San Francisco rose only about 3 times as fast as in Minneapolis-St. Paul. Thus, we infer that land values must have risen faster in Minneapolis-St. Paul than in San Francisco. All told (factoring the actual changes in construction costs in these two cities and the updating of the structures share according to equation 3), we estimate that by 2004, land's share of home value jumped by 34 percentage points in Minneapolis-St. Paul — to 46 percent — whereas in San Francisco, the share increased by 13 percentage points to 88 percent.

To be sure, Minneapolis-St. Paul is an extreme case from our sample, but it may help to clarify that our main results stem from recognizing that in places where land is relatively inexpensive and when land prices are stable, one would expect home prices to move closely with construction costs. And, if home prices are seen to be outpacing construction costs in places where land has been relatively inexpensive, the price of land must be appreciating at a fairly rapid clip.

3 Results

We use the algorithm of the previous section to construct a database of quarterly observations on the components of home values from 1984 through 2004 for 46 large U.S. metropolitan areas. More specifically, we have estimated average values for the stock of single-family, owner-occupied homes and their structure and land components, and we have constructed price indexes for residential land as well. In the text, we include tables reporting data at the regional level; tables 3 through 6 at the end of the paper include data for all 46 cities in our sample, and they show how the cities are distributed among the 5 broad geographic regions. In this section, we describe the basic trends uncovered by these new data, focusing on 5 broad geographic regions — cities in the Midwest, Southeast, Southwest, and along the East and West coasts.[12] The data show some variation across cities within these regions, but the regional variation is predominant. We describe changes in the components of home value from 1984 through 1998, then focus on the housing boom that has affected most of the country since 1998. After documenting the trends in land values since 1984, we show that most cities across the country have experienced a significant land pricing-cycle since the mid-1980s, in which the real price of residential land reached a significant peak followed by a long

[11] In this example, we abstract from changes to $\omega^l_{j,t}$ that would occur as $g^{lp}_{j,t} > g^{cc}_{j,t}$ in both cities.

[12] In aggregating to the regional and full-sample level, we report simple averages across cities — not weighting by population or home value. The distribution of home values is sufficiently skewed that weighted averages would closely resemble the patterns shown for the cities located just along the East and West coasts.

period of recovery. In large cities in the southwest, the peak occurred around 1985 — essentially following a boom in energy production in that region; in other cities, the peaks were around 1990. Only for a handful of large Midwest cities have real residential land prices exhibited a fairly steady upward march over the past two decades.

3.1 Components of home value in 1984

Table A shows that in the mid-1980s homes were, on average, much less expensive in large U.S. cities in the Midwest and the Southeast than along the East and West coasts. The regions differed little in terms of their average replacement cost of residential structures, but there were large regional differences in the value of residential land. In 2004 dollars, the average residential lot in 1984 was worth just $14,000 in the Midwest, $135,000 along the West Coast, and $62,000 across our entire sample of large cities.[13] As of year-end 1984, on average, residential land accounted for just 11 percent of home value in cities in the Midwest, 55 percent of value in cities along the West Coast, and 32 percent of value across our full sample.

Table A
Components of Home Value in 1984 by Geographic Region

Region	Home value (*$1000s*)	Structure value (*$1000s*)	Land value (*$1000s*)	Memo: Land's share of value (*percent*)
a. Midwest	120	106	14	11
b. Southeast	129	94	36	27
c. Southwest	158	100	58	35
d. East Coast	172	105	67	38
e. West Coast	226	91	135	55
f. Full sample	162	100	62	32

2004 dollars. Unweighted averages across sample-cities in each region. Components may not sum to totals due to rounding.

3.2 Changes in home value, 1984 through 1998

The following table B documents the cumulative changes in the components of home value between 1984 and 1998 in the 5 geographic regions. In real terms — that is, relative to the core PCE price

[13] We convert to 2004 dollars using the BEA's chain-weighted price index for personal consumption expenditures excluding food and energy items.

index — homes became considerably more valuable in 4 of the 5 regions — the exception being in cities in the Southwest. In real terms, average home values in the Southwest and the share of home value accounted for by the market value of residential land was lower in 1998 than in 1984. By contrast, the two other regions of the country that had relatively low home values in 1984 — the Midwest and the Southeast — experienced significant increases, on net, over the next 15 years, and the lion's share of those increases can be traced to very fast appreciation of residential land. Indeed, as reported in the table, land's share of home values rose by 16 percentage points and 9 percentage points, respectively, in Midwest and Southeast cities from 1984 through 1998. Appreciating land values also pushed up home values, in real terms, in cities along the East and West coasts, but the average increases in land's share of home value — 3 and 6 percentage points, respectively, over this period — were not as large as in the Midwest and Southeast. Looking across all the large cities in our sample, the real value of average residential lots increased 50 percent from 1984 through 1998, and land's share of home value increased 8 percentage points, from 32 percent to 40 percent.

Table B
Change in Components of Home Value
by Geographic Region — 1984 through 1998

Region	Cumulative change in: Home value (*pct*)	Structure value (*pct*)	Land value (*pct*)	Change in land's share of value (*pctg pts*)
a. Midwest	26	2	208	16
b. Southeast	14	0	53	9
c. Southwest	-9	-4	-17	-4
d. East Coast	24	8	49	3
e. West Coast	39	20	51	6
f. Full sample	22	5	48	8

In real terms; unweighted averages across sample-cities in each region.

3.3 Changes in home value, 1999 through 2004

Table C indicates how widespread across the country the recent housing boom has been. All 5 regions have seen substantial real increases in average home values since 1998 — about 25 percent (cumulatively) in large cities in the Midwest, Southeast, and Southwest, and around 80 percent along the East and West coasts. In addition, although construction costs around the country have generally outpaced consumer price inflation — leading to increases in the real value of residential structures on the order of 10 to 18 percent since 1998 — the more important story has been a widespread rapid appreciation of residential land. We estimate inflation-adjusted increases in the market value of residential lots of around 50 percent in the Southeast and Southwest, 75 percent in the Midwest, and around 125 percent along the East and West coasts. Thus, land's share of home value has risen considerably in each of the 5 regions of the country, up 7 to 10 percentage points in the South and Midwest and 13 or 18 percentage points along the coasts.

Indeed, among the 46 large cities in our sample, only Charlotte and Salt Lake City show lower land shares of home value in 2004 than in 1998, and Memphis's share only edged up by 1 percentage point. Since 1998, the largest increases in land's share of home value were registered in Providence, RI (26 percentage points), New York City (23), Minneapolis/St. Paul (21), St. Louis (18), and Washington, DC (18). In St. Louis, land's 30 percent share of home value was still well below our sample-average (51 percent), but was appreciably greater than the 12 percent share recorded just six years earlier. Since 1998, home values in St. Louis rose 34 percent in real terms — well below the sample-average pace — but the relatively low value of residential lots in 1998 led this to translate into more than a 200 percent cumulative increase in the real value of residential land — right up there with the other fastest increases in our sample (Sacramento and San Bernardino, CA, and Providence, RI).

Table C
Change in Components of Home Value
by Geographic Region — 1999 through 2004

Region	Cumulative change in: Home value (*pct*)	Structure value (*pct*)	Land value (*pct*)	Change in land's share of value (*pctg pts*)
a. Midwest	28	9	75	10
b. Southeast	26	15	45	7
c. Southwest	24	10	52	8
d. East Coast	77	14	115	18
e. West Coast	81	18	145	13
f. Full sample	56	13	105	11

In real terms; unweighted averages across sample-cities in each region.

3.4 Components of home value in 2004

As can be seen in table D, by year-end 2004, single-family owner-occupied homes remained much more expensive in cities along the East and West coasts ($376,000 and $568,000, respectively) than in the other regions of the country, where the average was near $185,000. Our estimates of the value of residential structures for homes along the coasts were not much greater than those for the other 3 regions, so that nearly all of the difference in home values reflected differences in the value of their land components. The average lot was worth about $75,000 in cities in the Midwest, Southeast, and Southwest, but was valued at $245,000 on the East Coast, and $440,000 in West Coast cities. At year-end 2004, we estimate that land's share of home value had risen to 75 percent along the West Coast and 65 percent on the East Coast, compared with about 40 percent in the other 3 regions and 51 percent across the entire sample of 46 cities.

Still, despite the wider differences in home values across the country in 2004, we find that 4 of the 5 regions saw substantial increases in land values and land shares since 1984. Midwest cities saw their share rise to 36 percent from just 11 percent twenty years earlier — the largest percentage-point increase of the 5 regions — and these cities saw the largest cumulative increase in average land values as well, averaging more than a four-fold increase over the twenty-year period. On net, the slowest average rates of increase in home and land values were found for cities in the Southwest, and, by our estimates, there were several cities in that region for which average home values in 2004 remained below their 1984 levels (in real terms) — Dallas, Fort Worth, Houston, Oklahoma City, and San Antonio. Overall, though, we estimate that, on average, real land values rose 26 percent since 1984 in our Southwest cities, and land's share of home value edged up 4 percentage points, on net, to 38 percent at year-end 2004.[14]

Table D
Components of Home Value in 2004 by Geographic Region

Region	Home value (*$1000s*)	Structure value (*$1000s*)	Land value (*$1000s*)	Land's share of value (*percent*)	Memo: Land's share in 1984 (*percent*)
a. Midwest	192	119	73	36	11
b. Southeast	187	108	79	42	27
c. Southwest	179	106	73	38	35
d. East Coast	376	131	245	64	38
e. West Coast	568	128	440	74	55
f. Full sample	307	120	187	51	32

Unweighted averages across sample-cities in each region.

[14] These numbers were boosted by real increases in residential land values in New Orleans, Denver, and Salt Lake City, which we included in the Southwest grouping based on their similar time-series paths for land and home values (discussed below).

3.5 Changes in the distribution of land's share of home value, 1984 through 2004

The widespread net increase in land's share of home value across the U.S. since the mid-1980s is evident in figure 2, which shows the cumulative distribution function of land's share of home value across the 46 large cities in our sample as of year-end 1984, 1998, and 2004. As was consistent with the relatively fast appreciation of real land values in the Midwest and Southeast from 1984 through 1998, figure 2 shows a relatively large rightward shift in the distribution of land share for cities in the lower two-thirds of the distribution.[15] By contrast, for cities with the largest land shares, the line segment in 1998 lies just about on top of the 1984-segment, indicating that cities shuffled their order at the top of the distribution in that period; but, overall, there was not a material net increase in land's share in the most expensive cities. Between 1998 and 2004, the entire distribution function for land's share of home value shifted noticeably to the right, with somewhat larger increases generally occurring among cities in the top half of the distribution. At year-end 2004, the average share of home value we attribute to residential land ranged from a low of about 25 percent in Oklahoma City to nearly 90 percent in San Francisco. The range from lowest to highest is about the same as in 1984, as land's share of home value in 1984 was less than 5 percent in a handful of cities in the middle of the country — running from Buffalo down to Pittsburgh and over to St. Louis, for example — and reached about 75 percent in San Francisco and Anaheim.

3.6 Changes in the distribution of residential land values, 1984 through 2004

Figure 3 shows how far the distribution of average real land values shifted between 1984 and 1998, and then again over the past six years. Consistent with the patterns evident in figure 2, real land values in cities in the lower half of the distribution can be seen to have shifted by proportionately more from 1984 to 1998 (note the log scale for the x-axis). Although the entire distribution shifted further to the right between 1998 and 2004, in recent years the disproportionate increases in real land values occurred in cities in the top half of the distribution.

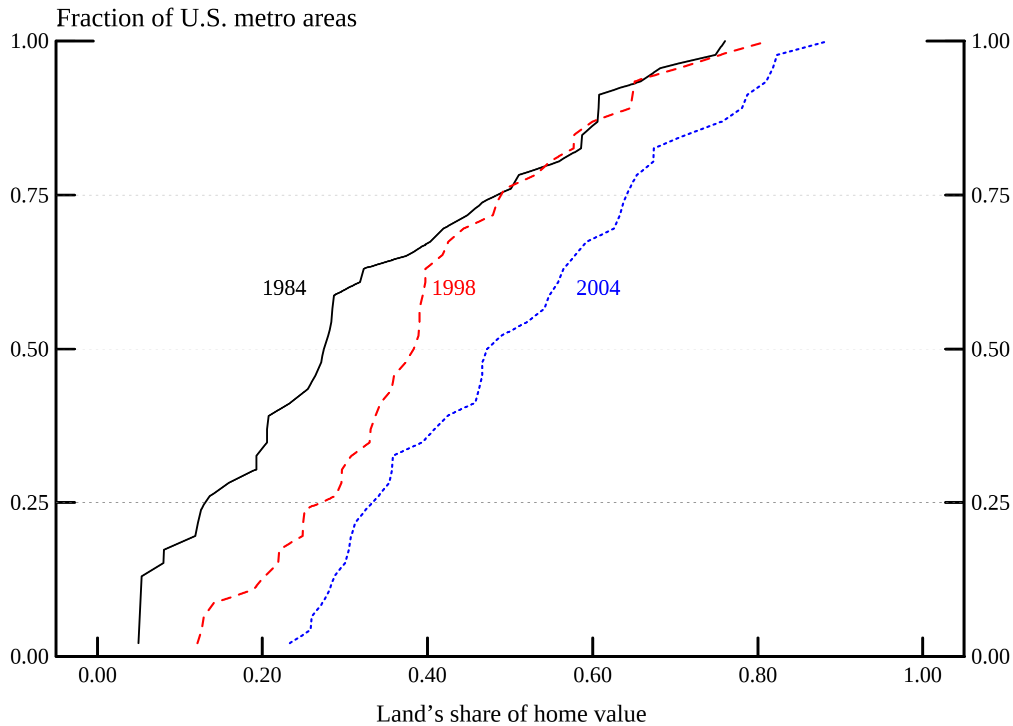
3.7 Volatility of real land prices since 1984

The previous subsections have emphasized net changes in the components of home value, in real terms, over a rather long period of time — 1984 through 1998 — and in the current housing boom

[15] Note that between years cities can shift around in the distribution.

Figure 2

Cumulative Distribution of Land's Share of Home Value
across Metropolitan Areas in Selected Years



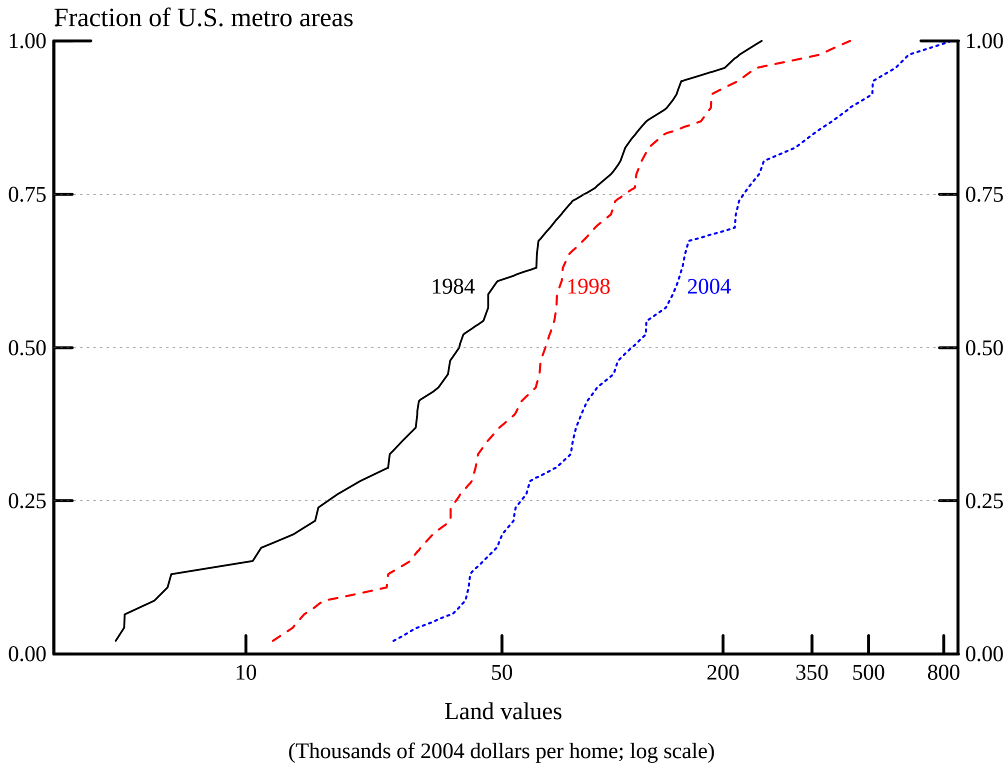
Note. This figure plots cumulative distribution functions of land's share of home value across our sample of 46 large metropolitan areas in 1984, 1998, and 2004.

— 1999 through 2004. In the course of that discussion, we mentioned that real land and home values in large cities in the Southwest have taken quite a roller coaster ride, and it was not until the early 2000s that many of those cities saw their average real home values return to levels last registered in the mid-1980s! This subsection emphasizes that the majority of large cities in other regions of the country has also experienced significant and prolonged decline in real land prices — generally in the latter 1980s or early 1990s, when national indexes of existing home prices fell in real terms.

Real land prices in the Southwest after 1985. Figure 4 plots indexes of real land prices across 9 cities in the southwestern U.S. that experienced a peak near early-1985. The indexes are normalized so that their value in 1985:Q1 is 100, and separate indexes are shown for the median city in each quarter after 1985:Q1 (the solid line) and for the cities representing the 20th and 80th percentiles

Figure 3

Cumulative Distribution of Residential Land Values
across Metropolitan Areas in Selected Years



Note. This figure plots the cumulative distribution functions of average real residential land values across our sample of 46 large metropolitan areas in 1984, 1998, and 2004.

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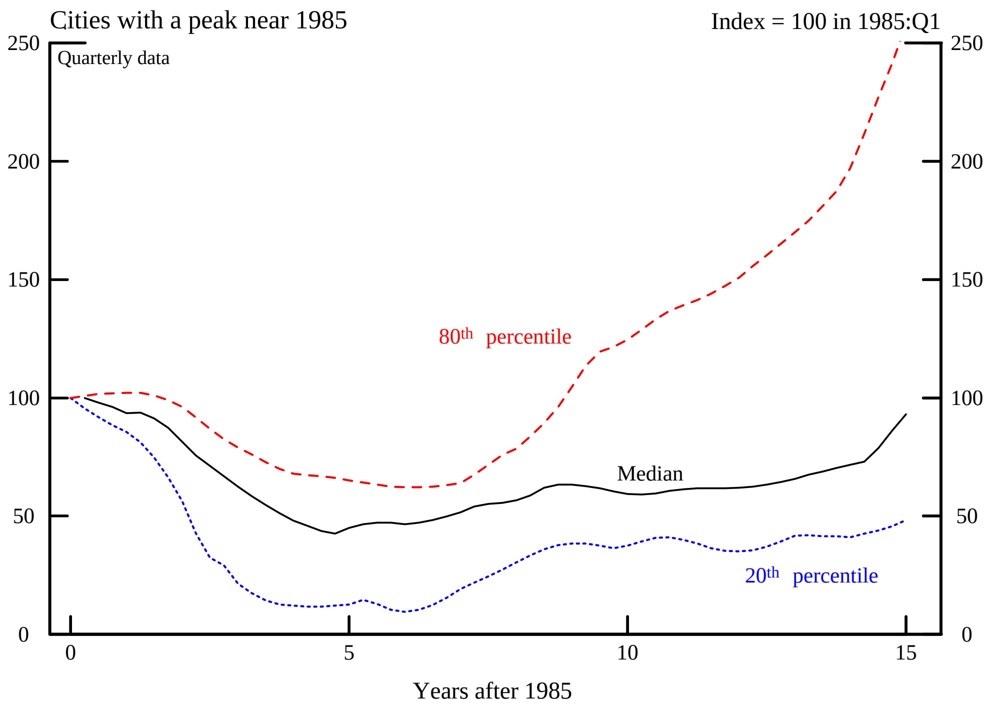
of the distribution (the dotted and dashed lines, respectively).[16] According to figure 4, the median city in this group — Houston — saw its land price index fall 50 percent, cumulatively, in real terms, over the five years ended in 1989. Although real land prices in Houston began rising gradually in 1990, our estimates imply that the index did not fully return to its early-1985 level until 1999 — 15 years later! Denver's experience is reflected in the dashed line: There, real land prices fell, cumulatively, by 60 percent from 1985 through 1991; however, the recovery in that city was much sharper, and by the mid-1990s Denver's index of real land prices had returned to its 1985-level.

[16]The 9 cities are: Dallas, Denver, Fort Worth, Houston, New Orleans, Oklahoma City, Phoenix, Salt Lake City, and San Antonio. For Phoenix, the index is set to 100 in 1986:Q1 because 1985 saw a decent-sized increase in real land prices there. Note that the 20th and 80th percentiles are computed for each quarter, and there is a little shuffling among cities in the distribution over the time period shown.

Figure 4

Real Residential Land Prices
in Southwest Metropolitan Areas after 1985



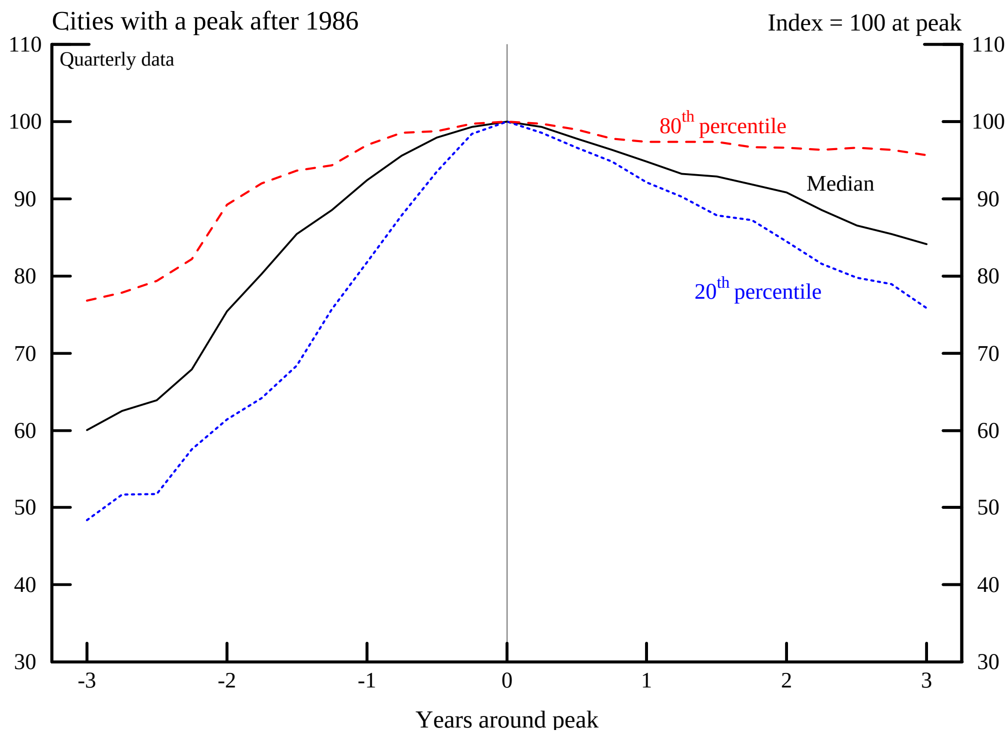
Note. This figure plots the 20th, 50th, and 80th percentiles of the distribution of real land prices in 7 Southwest cities over the fifteen years following the peak experienced around early 1985. For 6 of the 7 cities in this group, the index of real residential land prices is normalized to 100 in 1985:Q1; for Phoenix, the index is set to 100 in 1986:Q2.

By 1999 (the last period shown in figure 4), the index of real land prices was two-and-a-half times as high as it had been 15 years earlier. By contrast, San Antonio — whose experience is reflected in the dotted line — saw a remarkably large drop in real land prices, and by 1999 the level of the index in that city had recovered only about halfway. Indeed, we estimate that after a fairly rapid period of appreciation from 1999 through 2004, the index of real land prices in San Antonio finally returned to its 1985-level.

Peaks in real land prices in cities elsewhere across the U.S. Moving beyond the 9 Southwest cities in which real land prices peaked around 1985, 30 of the remaining 37 cities in our sample experienced a peak sometime after 1986 — figure 5 uses a "butterfly chart" to summarize those episodes. To generate figure 5, we identified for each of these 30 cities the quarter in which their real land price index reached a "local" peak, normalized the level of the price index in the peak-quarter

Figure 5

Real Residential Land Prices around Previous Peaks



Note. This figure plots the 20th, 50th, and 80th percentiles of the distribution of real land prices for 30 cities that experienced a peak in between 1987 and 1992. The figure shows the paths for real land prices from three years before a peak to three years after the peak. For each of the 30 cities in this group, an index of real land prices is normalized to 100 in the peak-quarter.

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to 100, and then computed the relative level of the index in all quarters around the peak. The solid line is the median normalized index among the 30 cities, and the dotted and dashed lines, respectively, denote the 20th and 80th percentiles across the distribution of cities at each quarter surrounding their respective peaks. The left-hand portion of the graph represents the behavior of real residential land prices three years before the peak-quarter, and the right-hand portion shows prices in the three years following the peak.

Thus, considering the path of the "median" line, figure 5 reveals that 15 of the 30 large U.S. cities in this broad group have experienced, at some point since 1986, a cumulative, net *three-year decline* in real land prices of 16 percent or more. This broad set of cities includes Boston (a 24 percent three-year decline through 1991:Q4), Kansas City (30 percent, 1990:Q3), Los Angeles (19 percent, 1992:Q4), New York (28 percent, 1991:Q2), Sacramento (24 percent, 1993:Q4), San Diego

(15 percent, 1993:Q1), San Francisco (18 percent, 1992:Q4), St. Louis (26 percent, 1990:Q3) and Washington DC (12 percent, 1992:Q4). Figure 5 does not show the full recovery period for this group of cities, but for the median city (Tampa) it took a full ten years for the real land price index to return to the level at its previous peak. In a number of large cities — including Los Angeles, Philadelphia, Providence, RI, and Sacramento — real land prices did not reach their 1990 peaks until 2001 or 2002, well into the current housing boom.

Considering the portion above the median in figure 5, 15 cities in our sample experienced a relatively mild cycle for land prices around 1990 — their cumulative real decline was generally less than 10 percent and the level of their real land price index had returned to its peak level by the mid-1990s. Indeed, by the time the current housing boom was getting underway toward the end of 1998, their real land price index was considerably above the level at the time of the previous peak. This group includes Charlotte, Detroit, Memphis, Miami, and Minneapolis-St. Paul. With the exception of Charlotte and Memphis — where land prices have languished in real terms since 1998 — this group of cities continued to see a rapid expansion of residential land values through 2004.

We note that for most of these cities that experienced a peak in real residential land prices around 1990, the subsequent real depreciation involved a stagnation of land prices in nominal terms that was eroded over time by an increase in core consumer prices. That is, the price index for personal consumption expenditures excluding food and energy items in the National Income and Product Accounts (NIPA) — which is the index we use to convert nominal values and price indexes into real terms — rose about 15 percent over three-year periods from 1989 through 1994. This is about the same order of magnitude as our estimate of real peak-to-trough declines in residential land prices for most of these cities, so our data do not suggest widespread, outright nominal declines in land prices. Still, the minority of cities in this group that are estimated to have experienced real land-price declines around 20 percent are also estimated to have seen their nominal land-price indexes fall in the peak-to-trough period.

Midwest cities that have not experienced a previous peak in land prices. According to our estimates, 7 large cities in the Midwest have seen a more smooth upward march in real land prices and average land values since 1984, rather than the roller coaster experience of the majority. This group, which includes Chicago, Cincinnati, Indianapolis, and Milwaukee, registered increases in home prices that outpaced construction costs and general price inflation year after year since 1984. In general, for cities in this group, land accounted for a small portion of home value in 1984 —

about 10 percent. By 1998, however, land's share of home value had risen to 30 percent, and, by 2004, the share in these cities had nearly reached 40 percent, not too far below the average across all cities in our sample.

4 Discussion

This paper has introduced methods we developed to build a new database for measuring the evolution of residential land values across large U.S. metropolitan areas since the mid-1980s. We have shown that, over the past twenty years, residential land has become relatively more expensive in just about every large metro area in the U.S. — not only in places along the east and west coasts of the country, as some have suspected — though the pace of appreciation has, of course, varied considerably from region to region. Moreover, we have demonstrated that the current housing boom, which began around the end of 1998, has left its imprint in the form of a rapid appreciation of residential land values just about everywhere. In addition, we have shown that, at some point since 1984, the majority of large U.S. cities have experienced one pronounced price-cycle in which residential land lost value for an extended period of time, usually following several years of particularly rapid appreciation. In real terms, land prices have generally taken several years to go from peak to trough, and the subsequent recovery from these price-declines has generally occurred at a more gradual pace.

To us, the most important implication of our findings is that, looking forward, cycles in land prices will shape the contour of home values to a greater extent than they have in the past — because in just about every large U.S. metro area land's share of home value is now much higher than it used to be. More specifically, land's greater share of home value could mean faster home-price appreciation, on average, and possibly larger swings in home prices, a story consistent with housing becoming increasingly inelastically supplied everywhere. The fact that the mean and variance of changes to house prices may have changed as a direct result of an increase in land's share has important implications for the optimal share of housing in a household's portfolio, and for studies that link returns to housing to returns to stocks and bonds.[17]

To gauge the possible magnitudes of the change to the growth rate and variance of house prices, we consider how current land values would translate into future home-price appreciation in cities along the East and West coasts should land prices and construction costs repeat their average

[17] For recent papers in this literature, see Lustig and Van Nieuwerburgh [11] and Piazzesi, Schneider, and Tuzel [13].

performance (in real terms) in recent history. From 1984 through 1998 (ignoring the current boom), these two regions experienced average annual real increases in land prices of 4.2 percent and 4.7 percent, respectively; over the same period, their real construction costs fell by an average of 0.3 percent and 0.8 percent, respectively. In 1984 and 2004, land accounted for 38 percent and 64 percent of home value, on average, in large cities along the East Coast; in cities along the West Coast, land's share was 55 percent in 1984 and 74 percent in 2004. In table E, we plug these values into equation (1) to compute, for each region, the percentage increase in home prices resulting from a repeat-experience of land prices and construction costs from 1984 through 1998. Our calculations imply that simply by taking into account the more expensive land values currently in place we would expect real home prices to accelerate by more than 1 percentage point per year in cities along both coasts. So, even if land prices were to increase from now on at the average pace seen before the current boom, home prices might rise more quickly, on average, than they did before.

Table E
Effect of Higher Land Share on Prospective Home-Price Appreciation

Using Land's Share in 1984:	
East Coast:	$1.4\% = 0.38 * (4.2\%) + (1 - 0.38) * (-.3\%)$
West Coast:	$2.2\% = 0.55 * (4.7\%) + (1 - 0.55) * (-.8\%)$
Using Land's Share in 2004:	
East Coast:	$2.6\% = 0.64 * (4.2\%) + (1 - 0.64) * (-.3\%)$
West Coast:	$3.3\% = 0.74 * (4.7\%) + (1 - 0.74) * (-.8\%)$
Acceleration in Home Prices from Higher Land Shares:	
East Coast:	1.2 ppt $= 2.6\% - 1.4\%$
West Coast:	1.1 ppt $= 3.3\% - 2.2\%$

The consequences for future home-price volatility could be just as significant because we would expect cycles in home prices to continue to be driven by cycles in real land prices. Again, in our framework, variance of home prices depends on the variances of land prices and construction costs, and the greater current share of home value accounted for by residential land has significantly pushed up the weight on land-price volatility.[18] Of course, it is possible that some of the factors driving up residential land prices so significantly over the past twenty years could also work to decrease their volatility, which would offset the simple "accounting effect" of land's greater share of home value. We see this to be an important avenue for future research.

[18] There is a positive covariance over time between real land prices and construction costs that also affects the variance of home prices.

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Appendix

In this appendix, we describe how we merge different sources of data to compute, for 46 large MSAs in the United States, quarterly time-series estimates of the average value of land as a fraction of average home value, and the constant-quality growth rates of residential land prices. For each MSA, the estimation process occurs in two steps that are discussed below. The complete set of data we create and use, except for the R.S. Means data which belong to that company, are available at the web site *http://morris.marginalq.com/davispalumbodata.htm.*

A Benchmark Estimates, Replacement Cost of Structures

In the first step, we combine micro data for key variables from the Metropolitan American Housing Survey, denoted throughout as AHS-M, with data on construction costs from R.S. Means [15] to estimate, for each MSA in our sample, a benchmark estimate of the replacement cost of single-family, owner-occupied residential structures and the share of home values that is represented by the value of structures.

The specific MSAs surveyed and dates of the survey that are included in our study are listed in the rightmost columns of table 1. For each MSA we use data from the most recent AHS-M, with the exception of New York, Los Angeles, Chicago, Philadelphia, and Detroit. In these cases, we use data from the 1989, 1991, or 1993 AHS-M. For these MSAs, a specific AHS-M is not collected after 1993, rather the MSAs are oversampled in the national AHS. We do not use the national AHS because the top-code value for home values has been fixed at $350,000 for some time, and it is therefore quite difficult to reliably calculate average home values. For example, in the 2003 national AHS more than 40 percent of the observations of owner-occupied single-family detached units in the Los Angeles MSA are top-coded.[19]

We use the following set of variables from each AHS-M:[20]

- *tenure* and *nunit2*. *tenure* characterizes the owned/rented/vacant status of the unit. *nunit2* specifies whether the structure is single-family detached or attached or in a multiple-unit building. Our sample includes only owner-occupied single-family detached dwellings.

- *built*, *cellar*, *garage*, *floors*, and *unitsf*. *built* records the year the structure was built, *cellar* whether the unit has a partial or full basement, *garage* indicates whether the unit has an attached or detached garage, *floors* the number of floors of the structure, and *unitsf* is the finished square footage of the structure.

- *value*. *value* denotes the self-reported market value of the housing unit.

- *weight*. *weight* specifies the sampling weight of the unit reported in the AHS-M.

We discard from our sample any housing unit that is missing data for any of these 9 variables. In some cases, *built* brackets the year in which the house was built, in which case the midpoint of the bracket is chosen. In the case of the variable *cellar*, we specify that a housing unit has a basement if it has a basement under all or part of the building, but not a concrete slab, crawl space, or "something else" under the building. Finally, *unitsf* and *value* are top-coded at or around the 97th percentile for each city in each AHS-M. We do not adjust the square-footage of the unit for top-coding but we multiply the top-code of *value* by 1.5, an adjustment we believe is approximately correct based on the findings of Davis and Heathcote [2] on the relationship of the top-code of the 1990 and 2000 Decennial Census of Housing (DCH) and the average value of owned homes conditional on being worth more than the top-coded value in the DCH, estimated using proprietary data from the 1989 and 2001 Survey of Consumer Finances.[21]

The raw unweighted number of observations that meet all of our criteria are listed in table 2. The median number of observations for each AHS-M sample is slightly less than 1,800, with a

[19] In the 2003 national AHS, the fraction of top-coded values for this set of homes in the New York, Chicago, Philadelphia, and Detroit MSAs are 38, 16, 14, and 6 percent, respectively.

[20] A full description of each of these variables can be found in the AHS codebook. The current codebook can be downloaded from http://www.huduser.org/Datasets/ahs/AHS_Codebook.pdf.

[21] See the appendix of Davis and Heathcote for more details.

minimum sample of about 800 (single-family owner-occupied) for the New York metro area and a maximum of more than 2,500 for Salt Lake City.

For each housing unit we observe in the AHS-Ms, we first impute the cost of rebuilding the structure if it were brand new as of the AHS-M date. To do this, we estimate a parsimonious cost function for single-family detached residences using construction cost data published by R.S. Means [15], then we apply it to each housing unit in our sample based on the characteristics of the structure reported in the AHS-M.

In Square Foot Costs, R.S. Means publishes how much it would cost per square foot of living space to build a new single-family home in an average U.S. city – denoted by R.S. Means as the "National 30-city average" – as a function of several characteristics of the structure. The published characteristics include total square footage of living space, number of stories in the structure, the veneer/siding of the structure, and whether it has a finished basement. Our analysis is based on estimates of square foot-building costs of what R.S. Means calls an "average" quality single-family home. We use square foot-building costs for 11 sizes of homes (running from about 1,000 square feet of living space up to about 4,000 square feet), 3 types of veneer/siding (wood, brick, man-made siding), 3 types of basements (unfinished, half-finished, or fully finished), and two height-dimensions (less than two stories and two or more stories). This gives us 198 types of single-family homes that we treat as observations to use in estimating a building cost function (198 = 11 x 3 x 3 x 2).

After conducting a thorough search for a parsimonious cost function that captured the important variations in square foot-building costs across types of structures, we settled on the following specification:

$$\begin{aligned}&\textit{New cost per square foot, average U.S. city, year-end 2003} = \\ &\$77.8625 + \$11.675 * cellar - \$4.50 * I\,(floors \geq 2) \\ &+\$0.027 * d * (1900 - unitsf) - \$0.008 * (1 - d) * (unitsf - 1900)\,.\end{aligned} \tag{A-1}$$

In equation (A-1), $I(.)$ is an indicator function that takes the a value of 1 if the expression in parentheses is true, and a value of 0 otherwise. The dummy variable d is set to equal 1 if the reported square footage of the housing unit is less than 1,900, and to equal 0 otherwise. The cost function in (A-1) applies, roughly speaking, to a structure with three-quarters brick and one-quarter wood veneer, and a half-finished basement.[22]

The estimated cost function (A-1) captures the evident nonlinear relationship in the R.S. Means data between building costs per square foot and the total size (square footage of living space) of

[22]The AHS-M does not include data on the building veneer or type of siding.

a housing unit: We found that the R.S. Means square foot-costs data are well-approximated by a piecewise linear spline with a kink at 1,900 total square footage of living space; the data show that building costs per square foot are lower for larger homes, but that the gradient with respect to total size is larger for smaller homes (less than 1,900 square feet) than for larger homes (greater than 1,900). In addition, the estimated cost function (A-1) captures the fact that a half-finished basement increases the building cost per livable square footage by about 15 percent (11.675/77.8825) and that multiple-story structures cost less per square foot to build than single-story structures (-$4.50), holding total size constant.

To convert cost per square foot for each housing unit in our sample to total construction costs, we simply multiply the imputed square-foot cost from evaluating (A-1) times the reported total square footage of the unit, then add $10,000 if the unit reports having a garage.[23]

Next, to change this measure of total building costs, which is appropriate for the national 30-city average at year-end 2003 (2003:4), to the total cost that is relevant to the AHS-M MSA and date, we take advantage of another set of data in the R.S. Means book – annual year-end time-series price indexes for residential construction costs for most major MSAs in every state, with continuous observations beginning in 1982.[24] Specifically, we multiply the total cost for the national 30-city average in 2003:4 by

$$\frac{\text{R.S. Means index for the AHS-M MSA, date of AHS-M survey}}{\text{R.S. Means index for the national 30-city average, 2003:4}}. \qquad \text{(A-2)}$$

An example might help clarify how these calculations work. Suppose we wish to calculate the cost of a new single-family home to be built new in the Washington DC MSA in 1998:2, and suppose the home is 2,500 square-feet, with two stories, a garage, and a basement. According to (A-1), the cost-per-square foot at the national 30-city average in 2003:4 would be

$$\$77.8625 + \$11.675 - \$4.50 - \$0.008 * 600 = \$80.24. \qquad \text{(A-3)}$$

And, the total construction cost, inclusive of the garage, would be

$$\$80.24 * 2,500 + \$10,000 = \$210,594. \qquad \text{(A-4)}$$

Converting this cost to the cost for the Washington DC MSA in 1998:2 requires applying the DC

[23]Our estimate for the average cost of building a garage also comes from the R.S. Means data.

[24]The R.S. Means data are published for January of year y, which we treat as appropriate for December of year $y-1$. Also, shown in table 1, R.S. Means does not publish construction cost indexes for Oakland and San Jose. For these two MSAs, we use the construction cost index for San Francisco.

area's 1998:2 factor,

$$\$210,594 * \frac{110.07}{133.0} = \$174,286, \tag{A-5}$$

where 110.07 is our middle-of-year estimate of the R.S. Means index value for Washington, DC in 1998[25] and 133.0 is the R.S. Means Index value for the national 30-city average at year-end 2003.

Once we have calculated the cost of building the structure brand new (for the appropriate date and MSA of the AHS-M), we depreciate the structure based on its age to better estimate its true replacement cost — that is, the market value of the structure if the land indeed had no value. The way to think about depreciation in this context is that it measures the expense required to bring an existing aged structure up to "like-new" standards. This includes expenditures on physical repairs, such as fixing a roof, as well as expenditures on functional improvements, such as improving the insulation. In our calculations, we specify that the depreciation on a structure is only a function of its age. Let $n_{i,t}$ refer to the new building cost of the structure associated with household i in period t and $s_{i,t}$ refer to the replacement cost of the structure after accounting for depreciation. We calculate

$$s_{i,t} = n_{i,t} * \left(\frac{1}{1+\delta}\right)^{age_{i,t}}, \tag{A-6}$$

where $age_{i,t}$ is the age of the structure of housing unit i, in years, at date t and δ is the annual rate of depreciation. We set $\delta = 0.015$, a value consistent the depreciation schedule used by the BEA in its calculations of the replacement cost of residential structures for the aggregate economy.

Finally, we calculate a benchmark MSA-wide average structures share for the period corresponding to the AHS-M survey date, denoted ω_t^s, as in period t, as

$$\omega_t^s = \frac{\sum_i weight_{i,t} * s_{i,t}}{\sum_i weight_{i,t} * value_{i,t}}. \tag{A-7}$$

Where $weight_{i,t}$ and $value_{i,t}$ refer to the AHS-M variables associated with housing unit i in period t and the summation in the numerator and denominator is over all households in our included sample for that particular MSA. A nice property of this estimate of ω_t^s is that it does not require that $s_{i,t}$ and $value_{i,t}$ are exactly accurate for every i.[26] Rather, our estimates of ω_t^s and $\omega_t^l = 1.0 - \omega_t^s$ at the city-level should be consistent even in the presence of classical additive measurement error in our estimates of the replacement costs of residential structures and self-reported market values for individual homes in each city.

[25] We generate within-year quarterly indexes by interpolation, assuming constant growth rates between years.

[26] This is unlike Gyourko and Saiz [9], who graph something like the distribution of $value_{i,t}/s_{i,t}$ within an MSA.

B Extrapolating the Benchmark Estimates

To uncover a continuous quarterly time-series of structures shares, we extrapolate backwards and forward the benchmark structures share derived in the last section.

Recall that we consider the total value of housing in any MSA in any period t, denoted as $p_t^h h_t$, as the sum of the replacement cost of structures in that MSA, $p_t^s s_t$, and the market value of the land in that MSA, $p_t^l l_t$, that is,

$$p_t^h h_t = p_t^s s_t + p_t^l l_t. \tag{A-8}$$

Note that the total nominal value of structures in an MSA at period $t+1$, $p_{t+1}^s s_{t+1}$, is equal to the total nominal value in period t, $p_t^s s_t$, revalued for changes to construction costs, plus nominal net new structures — that is, new structures less depreciation. We write this identity as

$$p_{t+1}^s s_{t+1} = p_t^s s_t \left(\frac{p_{t+1}^s}{p_t^s}\right) + p_{t+1}^s \Delta s_{t+1} \tag{A-9}$$

where (p_{t+1}^s / p_t^s) accounts for revaluation due to changes in construction costs and $p_{t+1}^s \Delta s_{t+1}$ denotes nominal value of net new structures.

To continue, we assume that the nominal value of net new structures in an MSA is equal to some proportion, call it θ_t, of the nominal value of net new housing value in that MSA, denoted $p_{t+1}^h \Delta h_{t+1}$,

$$p_{t+1}^s \Delta s_{t+1} = \theta_t p_{t+1}^h \Delta h_{t+1}. \tag{A-10}$$

This is the same assumption used by Davis and Heathcote and is consistent with the results of Thorsnes [16] who finds a unitary elasticity of substitution between structures and land in the production of new homes.[27] Inserting (A-10) into (A-9) produces

$$p_{t+1}^s s_{t+1} = p_t^s s_t \left(\frac{p_{t+1}^s}{p_t^s}\right) + \theta_t p_{t+1}^h \Delta h_{t+1}. \tag{A-11}$$

Now divide both sides of (A-11) by the nominal value of housing at $t+1$, $p_{t+1}^h h_{t+1}$:

$$\frac{p_{t+1}^s s_{t+1}}{p_{t+1}^h h_{t+1}} = \frac{p_t^s s_t}{p_t^h h_t} \frac{\left(\frac{p_{t+1}^s}{p_t^s}\right)}{\left(\frac{p_{t+1}^h}{p_t^h}\right)} \left(\frac{h_t}{h_{t+1}}\right) + \theta_t \frac{\Delta h_{t+1}}{h_{t+1}}. \tag{A-12}$$

Note that we used the identity $p_{t+1}^h h_{t+1} = p_t^h h_t \left(\frac{p_{t+1}^h}{p_t^h}\right) \left(\frac{h_{t+1}}{h_t}\right)$ when dividing $p_t^s s_t \left(\frac{p_{t+1}^s}{p_t^s}\right)$ by $p_{t+1}^h h_{t+1}$. Define the total structures share of aggregate house value in an MSA in period t as $\omega_t^s = \frac{p_t^s s_t}{p_t^h h_t}$.

[27] Davis and Heathcote assume that, on average, the nominal value of structures accounts for roughly 87.5 percent of the nominal value of new housing. This estimate, which was obtained during conversations with staff at the Census Bureau, is based on an unpublished Census study from 1999.

Substituting the structures share of home value, ω_t^s, into (A-12) yields

$$\omega_{t+1}^s = \omega_t^s \frac{\left(\frac{p_{t+1}^s}{p_t^s}\right)}{\left(\frac{p_{t+1}^h}{p_t^h}\right)} \left(\frac{h_t}{h_{t+1}}\right) + \theta_t \frac{\Delta h_{t+1}}{h_{t+1}}. \tag{A-13}$$

Equation (A-13) gives us a formula we can use to update our structures share in an MSA from its benchmark value; that is, given a structures share in period t, ω_t^s, the growth rate of construction costs (p_{t+1}^s/p_t^s), the growth rate of home prices $\left(p_{t+1}^h/p_t^h\right)$, a value for θ_t (the structures intensity of nominal net new housing), and a proxy for the growth rate of the real housing stock, inclusive of both structures and land, (h_{t+1}/h_t), we can calculate a new structures share, ω_{t+1}^s.

Notice the implications of equation (A-13). First, in the absence of growth in the housing stock, i.e. $h_{t+1} = h_t$, the structures share in $t+1$ simply equals the structures share in t, adjusted for growth in construction costs relative to house prices. In growing cities, that is, $h_{t+1} > h_t$, the growth of construction costs relative to existing home prices matters less in determining the structures share next period. Instead, the share of new homes accounted for by structures plays a role, since new homes account for a nonzero fraction of the total stock next period.

To implement this dynamic equation for each MSA, we start by benchmarking the structures share at the appropriate date to our estimate of the structures share derived from AHS-M data that was detailed earlier. Then,

- For growth in construction costs by MSA, p_{t+1}^s/p_t^s, we use MSA-specific time-series of construction cost indexes from R.S. Means, data mentioned in the previous section.[28]

- For growth in constant-quality house prices, p_{t+1}^h/p_t^h, we use MSA-level data from Freddie Mac's quarterly Conforming Mortgage House Price Index (CMHPI), a quarterly repeat-sales price index for existing owned homes.[29]

[28]Mentioned earlier, the R.S. Means indexes are year-end annual indexes; we generate quarterly indexes by assuming constant growth between years. Also note that it is unclear that changes to the R.S. Means construction cost indexes fully incorporate changes in builders' margins. If not, fluctuations in builders margins will be attributed to the value of land. We are confident that the results reported in the paper are not importantly affected by this consideration.

[29]Early drafts of the Davis and Heathcote paper show that measurement error is an important feature of the national CMHPI prior to 1980. The key piece of evidence they show is that the growth rate of the CMHPI is highly volatile and negatively autocorrelated in that period. To correct for measurement error of MSA-level CMHPI data, we follow the procedure documented in early drafts of the Davis and Heathcote paper and apply the state-space representation of the Hodrick-Prescott filter as described by King and Rebelo [10]. We use maximum likelihood to determine the optimal amount of smoothing to apply to each MSA, allowing for a one-time break in the variance of

- For growth in the real housing stock of an MSA, we assume that (h_{t+1}/h_t) is proportional to growth in the number of households of that MSA.[30] We compute the number of households in an MSA in each period as the population of that MSA divided by the average household size for the aggregate U.S.[31] The data for MSA-population is taken from the regional economic accounts of the Bureau of Economic Analysis, available at http://bea.gov/regional/reis/. Data for the average household size in the U.S. is taken from Table HH-4, "Households by Size: 1960 to Present," of the Current Population Survey (CPS) Reports, available at http://www.census.gov/population/www/socdemo/hh-fam.html. The population and household size data are reported at an annual frequency, and we convert to quarterly using linear interpolation.

- Finally, we assume that the fraction of *new* home value accounted for by new structures is

$$\theta_t = \frac{\exp\left(3.243 * \omega_t^s\right)}{1 + \exp\left(3.243 * \omega_t^s\right)}. \tag{A-14}$$

  This specification of θ_t allows developers to vary the land-intensity of new homes with the average land-intensity in the MSA. Since ω_t^s is, by definition, never less than 0 or more than 1, θ_t is bounded from below by 0.50 and from above by 0.96, and the function is concave between those values. We chose the scale parameter 3.243 such that when the average structures share in an MSA is 0.60, the structures share of new housing is 0.875, values that are consistent with the assumptions in Davis and Heathcote and roughly consistent with the Census Bureau's data on construction value put in place.[32]

For a few Midwestern cities early in the sample period, our algorithm implies near-zero point estimates for land's average share of home value; we set land's share to 0.05 in these few cases.

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measurement error in each MSA to account for the possibility that the variance of the measurement error may have changed. In many MSAs, measurement error is an important feature of the CMHPI prior to 1982, but after 1982 we find measurement error to be inconsequential for most MSAs. Therefore, given our analysis begins in 1984, the smoothing of the CMHPI does not affect any of our results.

[30] This assumption is approximately consistent with the Davis and Heathcote data on the real stock of housing and data from the Census Bureau on the aggregate number of households in the U.S.

[31] We cannot find continuous data on average household size by MSA. Of course, the assumption that household size is the same across MSAs is most likely incorrect. However, for our calculations on changes in land prices to be accurate, we require simply that our estimate of the percent change to the number of households is correct, not the actual number of households.

[32] Our results would be qualitatively similar if we simply set $\theta_t = 0.875$ for all MSAs.

C Deriving the Land Price Index

If home values are considered to be the sum of structure and land values, as we assume, it follows that the percentage change in home prices can be thought of as a weighted average of the percentage changes in land prices and construction costs. Here is the algebra for this result, taken almost directly from Davis and Heathcote. Begin with equation (A-8),

$$p_t^h h_t = p_t^s s_t + p_t^l l_t. \tag{A-15}$$

Adding in the logic that if the replacement cost of structures and the nominal value of residential land are revalued between periods t and *t+1* then home values are appropriately revalued gives the following expression:

$$\left(\frac{p_{t+1}^h}{p_t^h}\right) p_t^h h_t = \left(\frac{p_{t+1}^s}{p_t^s}\right) p_t^s s_t + \left(\frac{p_{t+1}^l}{p_t^l}\right) p_t^l l_t. \tag{A-16}$$

Dividing both sides of (A-16) by home value ($p_t^h h_t$) yields

$$\left(\frac{p_{t+1}^h}{p_t^h}\right) = \left(\frac{p_{t+1}^s}{p_t^s}\right)\left(\frac{p_t^s s_t}{p_t^h h_t}\right) + \left(\frac{p_{t+1}^l}{p_t^l}\right)\left(\frac{p_t^l l_t}{p_t^h h_t}\right). \tag{A-17}$$

Substituting into equation (A-17) the expressions for land's share of home value ($\omega_t^l = \frac{p_t^l l_t}{p_t^h h_t}$) and the structures share of home value ($\omega_t^s = \frac{p_t^s s_t}{p_t^h h_t}$), then subtracting 1 from both sides shows that the percentage change in home prices (g_{t+1}^{hp}) is a weighted average of the percentage change in land prices (g_{t+1}^{lp}) and construction costs (g_{t+1}^{cc}):

$$g_{jt+1}^{hp} = \omega_{jt}^l g_{jt+1}^{lp} + \omega_{jt}^s g_{jt+1}^{cc}. \tag{A-18}$$

Rearranging the terms in equation (A-18) provides a formula for directly estimating percentage changes for a (constant-quality) index of residential land prices,

$$g_{jt+1}^{lp} = \frac{1}{\omega_{jt}^l}\,[g_{jt+1}^{hp} - \omega_{jt}^s\ g_{jt+1}^{cc}]. \tag{A-19}$$

g_{jt}^{lp} is the value-weighted average growth rate of residential land containing the existing stock of homes in MSA j between periods $t-1$ and t. As long as the growth rate of construction costs g_{jt}^{cc} and home prices g_{jt}^{hp} are derived from constant-quality price indexes, then g_{jt}^{lp} is, by construction, a constant-quality growth rate. Note that g_{jt}^{lp} is not a "dollars-per-acre" concept, nor is it necessarily related to growth in the price of farmland on the outskirts of an MSA. g_{jt}^{lp} simply tracks the growth rate of the price of the combined set of attributes of existing homes that make these homes more expensive than the replacement cost of their structures, including premiums for location and other local amenities.

Table 1
List of Data Sources and Data Labels

CMHPI	R.S. Means	BEA Population	AHS-M	AHS-M date
ORANGE COUNTY CA PMSA	Anaheim	Santa Ana-Anaheim-Irvine, CA Metropolitan Division	Anaheim-Santa Ana, CA PMSA**	2002
ATLANTA GA MSA	Atlanta	Atlanta-Sandy Springs-Marietta, GA (MSA)	Atlanta, GA MSA	1996
BALTIMORE MD PMSA	Baltimore	Baltimore-Towson, MD (MSA)	Baltimore, MD MSA	1998
BIRMINGHAM AL MSA	Birmingham	Birmingham-Hoover, AL (MSA)	Birmingham, AL MSA	1998
BOSTON MA-NH PMSA	Boston	Boston-Cambridge-Quincy, MA-NH (MSA)	Boston, MA-NH CMSA	1998
BUFFALO-NIAGARA FALLS NY MSA	Buffalo	Buffalo-Niagara Falls, NY (MSA)	Buffalo, NY CMSA**	2002
CHARLOTTE-GASTONIA-ROCK HILL NC-SC	Charlotte	Charlotte-Gastonia-Concord, NC-SC (MSA)	Charlotte, NC-SC MSA	2002
CHICAGO IL PMSA	Chicago	Chicago-Naperville-Joliet, IL-IN-WI (MSA)	Chicago, IL PMSA	1991***
CINCINNATI OH-KY-IN PMSA	Cincinnati	Cincinnati-Middletown, OH-KY-IN (MSA)	Cincinnati, OH-KY-IN PMSA**	1998
CLEVELAND-LORAIN-ELYRIA OH PMSA	Cleveland	Cleveland-Elyria-Mentor, OH (MSA)	Cleveland, OH-KY-IN PMSA**	1996
COLUMBUS OH MSA	Columbus	Columbus, OH (MSA)	Columbus, OH MSA	2002
DALLAS TX PMSA	Dallas	Dallas-Plano-Irving, TX Metropolitan Division	Dallas, TX PMSA	2002
DENVER CO PMSA	Denver	Denver-Aurora, CO (MSA)	Denver, CO MSA	1995
DETROIT MI PMSA	Detroit	Detroit-Warren-Livonia, MI (MSA)	Detroit, MI PMSA	1993***
FORT WORTH-ARLINGTON TX PMSA	Fort Worth	Fort Worth-Arlington, TX Metropolitan Division	Ft. Worth-Arlington, TX PMSA	2002
HARTFORD CT PMSA	Hartford	Hartford-West Hartford-East Hartford, CT (MSA)	Hartford, CT MSA	1996
HOUSTON TX PMSA	Houston	Houston-Sugar Land-Baytown,TX (MSA)	Houston, TX PMSA	1998
INDIANAPOLIS IN MSA	Indianapolis	Indianapolis, IN (MSA)	Indianapolis, IN MSA**	1996
KANSAS CITY MO-KS MSA	Kansas City	Kansas City, MO-KS (MSA)	Kansas City, MO-KS MSA	2002
LOS ANGELES-LONG BEACH CA PMSA	Los Angeles	Los Angeles-Long Beach-Glendale, CA Metropolitan Division	Los Angeles-Long Beach, CA PMSA**	1989***
MEMPHIS TN-AR-MS MSA	Memphis	Memphis, TN-MS-AR (MSA)	Memphis, TN-AR-MS MSA	1996
MIAMI FL PMSA	Miami	Miami-Fort Lauderdale-Miami Beach, FL (MSA)	Miami-Ft. Lauderdale, FL CMSA	2002
MILWAUKEE-WAUKESHA WI PMSA	Milwaukee	Milwaukee-Waukesha-West Allis, WI (MSA)	Milwaukee, WI PMSA	2002
MINNEAPOLIS-ST. PAUL MN-WI MSA	Minneapolis	Minneapolis-St. Paul-Bloomington, MN-WI (MSA)	Minneapolis-St. Paul, MN-WI MSA	1998
NEW ORLEANS LA MSA	New Orleans	New Orleans-Metairie-Kenner, LA (MSA)	New Orleans, LA MSA	1995
NEW YORK NY PMSA	New York	New York-Nassau-Suffolk-Orangeˆ	New York-Nassau-Suffolk-Orange, NY PMSA	1991***
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS	Norfolk	Virginia Beach-Norfolk-Newport News, VA-NC (MSA)	Norfolk-Virginia Beach-Newport News, VA MSA	1998
OAKLAND CA PMSA	San Francisco	Oakland-Fremont-Hayward, CA Metropolitan Division	Oakland, CAˆ	1998
OKLAHOMA CITY OK MSA	Oklahoma City	Oklahoma City, OK (MSA)	Oklahoma City, OK MSA	1996
PHILADELPHIA PA-NJ PMSA	Philadelphia	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (MSA)	Philadelphia, PA-NJ PMSA**	1989***
PHOENIX-MESA AZ MSA	Phoenix	Phoenix-Mesa-Scottsdale, AZ (MSA)	Phoenix, AZ MSA**	2002
PITTSBURGH PA PMSA	Pittsburgh	Pittsburgh, PA (MSA)	Pittsburgh, PA MSA	1995
PORTLAND-VANCOUVER OR-WA PMSA	Portland	Portland-Vancouver-Beaverton, OR-WA (MSA)	Portland, OR-WA PMSA	2002
PROVIDENCE-FALLS RIVER-WARWICK RI-MA	Providence	Providence-New Bedford-Fall River, RI-MA (MSA)	Providence-Pawtucket-Warwick, RI-MA PMSA	1998
ROCHESTER NY MSA	Rochester	Rochester, NY (MSA)	Rochester, NY MSA	1998
SACRAMENTO CA PMSA	Sacramento	Sacramento-Arden-Arcade-Roseville, CA (MSA)	Sacramento, CA PMSA	1996
SALT LAKE CITY-OGDEN UT MSA	Salt Lake City	Salt Lake City, UT (MSA)	Salt Lake City, UT MSA	1998
SAN ANTONIO TX MSA	San Antonio	San Antonio, TX (MSA)	San Antonio, TX MSA	1995
RIVERSIDE-SAN BERNARDINO CA PMSA	Riverside	Riverside-San Bernardino-Ontario, CA (MSA)	Riverside-San Bernardino-Ontario, CA PMSA**	2002
SAN DIEGO CA MSA	San Diego	San Diego-Carlsbad-San Marcos, CA (MSA)	San Diego, CA MSA**	2002
SAN FRANCISCO CA PMSA	San Francisco	San Francisco-San Mateo-Redwood City, CA Metropolitan Division	San Francisco, CA	1998
SAN JOSE CA PMSA	San Francisco	San Jose-Sunnyvale-Santa Clara, CA (MSA)	San Jose, CA PMSA	1998
SEATTLE-BELLEVUE-EVERETT WA PMSA	Seattle	Seattle-Tacoma-Bellevue, WA (MSA)	Seattle-Everett, WA PMSA	1996
ST. LOUIS MO-IL MSA	St. Louis	St. Louis, MO-IL (MSA)	St. Louis, MO-IL MSA	1996
TAMPA-ST. PETERSBURG-CLEARWATER FL	Tampa	Tampa-St. Petersburg-Clearwater, FL (MSA)	Tampa-St. Petersburg, FL MSA	1998
WASHINGTON DC-MD-VA-WV PMSA	Washington	Washington-Arlington-Alexandria, DC-VA-MD-WV (MSA)	Washington, DC-MD-VA MSA	1998

** From AHS documentation: "Same area since beginning. All other areas change boundaries over time."
*** Most recent AHS-M is not used due to top-coding issues. See text for details.
Ŝum of New York-White Plains-Wayne, NY-NJ Metropolitan Division and Nassau-Suffolk, NY Metropolitan Division.

Table 2
Observations Used to Benchmark Structures Share

MSA	AHS-M year	Number of Observations
Anaheim	2002	1,582
Atlanta	1996	1,990
Baltimore	1998	1,316
Birmingham	1998	2,264
Boston	1998	1,071
Buffalo	2002	1,391
Charlotte	2002	2,289
Chicago	1991	1,313
Cincinnati	1998	1,470
Cleveland	1996	1,474
Columbus	2002	2,029
Dallas	2002	2,082
Denver	1995	2,181
Detroit	1993	1,986
Fort Worth	2002	1,924
Hartford	1996	2,065
Houston	1998	1,650
Indianapolis	1996	2,242
Kansas City	2002	2,233
Los Angeles	1989	1,190
Memphis	1996	1,924
Miami	2002	1,378
Milwaukee	2002	1,637
Minneapolis/St. Paul	1998	2,237
New Orleans	1995	1,424
New York	1991	791
Norfolk	1998	1,629
Oakland	1998	1,715
Oklahoma City	1996	2,032
Philadelphia	1989	1,049
Phoenix	2002	1,975
Pittsburgh	1995	1,894
Portland	2002	2,321
Providence	1998	1,232
Rochester	1998	1,897
Sacramento	1996	1,760
Salt Lake City	1998	2,513
San Antonio	1995	1,797
San Bernardino	2002	2,262
San Diego	2002	1,573
San Francisco	1998	1,132
San Jose	1998	1,684
Seattle	1996	2,077
St. Louis	1996	1,868
Tampa	1998	1,768
Washington, DC	1998	1,336

Table 3
Components of Home Value by Region of the U.S.:
Cumulative Changes from 1984 through 2004

	Home value	Land value	Structure value
	—— percent (cumulative) ——		
Full sample	89.8%	203.8%	18.9%
By region:			
Midwest	60.2%	437.3%	11.9%
Southeast	44.8%	121.2%	15.6%
Southwest	13.0%	26.2%	5.3%
East Coast	119.3%	266.3%	22.1%
West Coast	151.2%	225.0%	41.2%
Cities within regions:			
Midwest			
Buffalo	50.7%	765.5%	13.1%
Chicago	106.1%	422.9%	24.3%
Cincinnati	56.3%	662.5%	3.2%
Cleveland	60.3%	1208.6%	-0.2%
Columbus	56.3%	244.2%	11.5%
Detroit	102.1%	1214.6%	43.5%
Indianapolis	38.0%	605.6%	6.1%
Kansas City	35.5%	161.3%	11.7%
Milwaukee	79.7%	568.0%	9.7%
Minneapolis/St. Paul	83.6%	591.6%	13.3%
Pittsburgh	50.6%	682.1%	17.3%
Rochester	11.4%	52.6%	0.8%
St. Louis	48.2%	788.9%	9.3%
Southeast			
Atlanta	45.6%	104.6%	25.4%
Birmingham	46.0%	339.2%	6.5%
Charlotte	43.6%	45.1%	41.6%
Memphis	25.7%	181.5%	1.2%
Tampa	61.5%	199.6%	12.1%
Southwest			
Dallas	-6.8%	-26.5%	21.0%
Denver	54.6%	169.5%	11.9%
Fort Worth	-12.1%	-33.2%	5.0%
Houston	-1.0%	12.7%	-6.2%
New Orleans	20.3%	95.9%	-10.0%
Oklahoma City	-14.8%	-28.9%	-9.3%
Phoenix	37.4%	26.6%	54.0%
Salt Lake City	44.7%	537.6%	1.8%
San Antonio	-10.4%	-18.4%	-7.2%
East Coast			
Baltimore	100.3%	220.5%	19.2%
Boston	142.6%	266.6%	18.3%
Hartford	73.4%	229.7%	11.2%
Miami	102.7%	145.9%	41.2%
New York City	170.7%	466.4%	30.1%
Norfolk	77.2%	124.8%	11.6%
Philadelphia	109.7%	454.2%	19.7%
Providence	166.6%	805.1%	14.4%
Washington DC	120.2%	217.3%	35.0%
West Coast			
Anaheim	147.1%	166.0%	87.0%
Los Angeles	143.7%	215.7%	32.1%
Oakland	158.4%	232.5%	44.1%
Portland	117.0%	436.7%	19.3%
Sacramento	135.8%	299.9%	36.9%
San Bernardino	110.8%	161.3%	58.1%
San Diego	177.5%	241.6%	53.8%
San Francisco	179.4%	230.3%	27.4%
San Jose	162.7%	217.3%	45.6%
Seattle	125.5%	343.9%	23.7%

Table 4
Components of Home Value by Region of the U.S.:
Cumulative Changes from 1984 through 1998

	Home value	Land value	Structure value
	—— percent (cumulative) ——		
Full sample	21.7%	48.2%	5.3%
By region:			
Midwest	25.6%	207.7%	2.3%
Southeast	14.8%	53.0%	0.2%
Southwest	-9.0%	-17.2%	-4.3%
East Coast	23.9%	49.4%	7.6%
West Coast	38.8%	51.4%	19.9%
Cities within regions:			
Midwest			
Buffalo	29.1%	422.5%	8.4%
Chicago	44.6%	180.1%	9.6%
Cincinnati	29.4%	440.7%	-6.6%
Cleveland	36.9%	884.3%	-7.7%
Columbus	31.4%	165.6%	-0.6%
Detroit	64.7%	717.9%	30.3%
Indianapolis	23.0%	474.9%	-2.5%
Kansas City	5.8%	46.1%	-1.8%
Milwaukee	32.7%	250.3%	1.5%
Minneapolis/St. Paul	15.0%	137.8%	-2.0%
Pittsburgh	22.6%	209.1%	12.8%
Rochester	-1.5%	5.0%	-3.2%
St. Louis	10.3%	166.9%	2.1%
Southeast			
Atlanta	13.9%	29.0%	8.8%
Birmingham	22.2%	216.9%	-4.0%
Charlotte	26.5%	30.6%	21.3%
Memphis	12.3%	143.6%	-8.4%
Tampa	-1.3%	23.2%	-10.1%
Southwest			
Dallas	-22.5%	-43.8%	7.6%
Denver	12.0%	58.5%	-5.2%
Fort Worth	-24.3%	-50.0%	-3.4%
Houston	-21.1%	-45.6%	-11.8%
New Orleans	-6.5%	16.4%	-15.7%
Oklahoma City	-28.1%	-66.8%	-13.1%
Phoenix	-1.8%	-22.3%	29.7%
Salt Lake City	37.9%	542.1%	-6.0%
San Antonio	-25.0%	-62.7%	-10.0%
East Coast			
Baltimore	22.1%	46.7%	5.4%
Boston	33.9%	60.3%	7.3%
Hartford	14.7%	59.9%	-3.3%
Miami	12.3%	10.4%	15.0%
New York City	40.7%	93.8%	15.5%
Norfolk	2.6%	2.2%	2.8%
Philadelphia	30.9%	117.1%	8.4%
Providence	36.2%	175.8%	2.9%
Washington DC	19.8%	26.5%	13.9%
West Coast			
Anaheim	20.3%	11.4%	48.4%
Los Angeles	23.7%	32.1%	10.8%
Oakland	33.9%	42.4%	20.7%
Portland	72.6%	291.4%	5.7%
Sacramento	15.6%	21.2%	12.2%
San Bernardino	2.7%	-21.5%	28.0%
San Diego	25.6%	24.1%	28.3%
San Francisco	61.1%	74.4%	21.4%
San Jose	64.0%	81.7%	26.0%
Seattle	64.9%	183.9%	9.4%

Table 5
Components of Home Value by Region of the U.S.:
Cumulative Changes from 1999 through 2004

	Home value	Land value	Structure value
	— percent (cumulative) —		
Full sample	56.0%	105.0%	12.8%
By region:			
Midwest	27.6%	74.6%	9.4%
Southeast	26.1%	44.6%	15.4%
Southwest	24.2%	52.3%	10.0%
East Coast	77.0%	145.2%	13.5%
West Coast	81.0%	114.7%	17.7%
Cities within regions:			
Midwest			
Buffalo	16.8%	65.7%	4.4%
Chicago	42.6%	86.7%	13.4%
Cincinnati	20.8%	41.0%	10.5%
Cleveland	17.1%	33.0%	8.2%
Columbus	18.9%	29.6%	12.1%
Detroit	22.7%	60.7%	10.1%
Indianapolis	12.2%	22.8%	8.8%
Kansas City	28.1%	78.9%	13.7%
Milwaukee	35.5%	90.7%	8.1%
Minneapolis/St. Paul	59.6%	190.8%	15.6%
Pittsburgh	22.8%	153.0%	4.0%
Rochester	13.1%	45.2%	4.1%
St. Louis	34.4%	233.1%	7.0%
Southeast			
Atlanta	27.8%	58.7%	15.3%
Birmingham	19.5%	38.6%	11.0%
Charlotte	13.5%	11.2%	16.7%
Memphis	12.0%	15.6%	10.5%
Tampa	63.7%	143.1%	24.6%
Southwest			
Dallas	20.2%	30.8%	12.4%
Denver	38.0%	70.1%	18.1%
Fort Worth	16.1%	33.6%	8.7%
Houston	25.4%	107.2%	6.3%
New Orleans	28.7%	68.3%	6.7%
Oklahoma City	18.5%	113.9%	4.4%
Phoenix	39.9%	62.9%	18.7%
Salt Lake City	4.9%	-0.7%	8.3%
San Antonio	19.4%	118.8%	3.1%
East Coast			
Baltimore	64.1%	118.5%	13.1%
Boston	81.2%	128.6%	10.2%
Hartford	51.2%	106.2%	15.1%
Miami	80.5%	122.8%	22.8%
New York City	92.4%	192.3%	12.7%
Norfolk	72.8%	119.9%	8.6%
Philadelphia	60.2%	155.3%	10.5%
Providence	95.8%	228.2%	11.2%
Washington DC	83.8%	150.9%	18.5%
West Coast			
Anaheim	105.4%	138.8%	26.0%
Los Angeles	96.9%	139.0%	19.2%
Oakland	93.1%	133.5%	19.4%
Portland	25.7%	37.1%	12.9%
Sacramento	104.0%	230.0%	22.1%
San Bernardino	105.2%	232.8%	23.5%
San Diego	121.0%	175.2%	19.9%
San Francisco	73.5%	89.4%	5.0%
San Jose	60.2%	74.6%	15.6%
Seattle	36.8%	56.3%	13.1%

Table 6
Land's Share of Home Value by Region of the U.S., 1984 to 2004

	1984	1998	2004
	—— share ——		
Full sample	0.320	0.397	0.509
By region:			
Midwest	0.107	0.265	0.362
Southeast	0.267	0.359	0.415
Southwest	0.346	0.308	0.384
East Coast	0.376	0.461	0.644
West Coast	0.550	0.608	0.738
Cities within regions:			
Midwest			
Buffalo	0.050	0.202	0.287
Chicago	0.205	0.398	0.521
Cincinnati	0.081	0.337	0.393
Cleveland	0.050	0.360	0.408
Columbus	0.193	0.389	0.424
Detroit	0.050	0.248	0.325
Indianapolis	0.053	0.249	0.273
Kansas City	0.159	0.220	0.307
Milwaukee	0.125	0.331	0.466
Minneapolis/St. Paul	0.121	0.251	0.458
Pittsburgh	0.050	0.126	0.260
Rochester	0.205	0.219	0.281
St. Louis	0.050	0.121	0.300
Southeast			
Atlanta	0.255	0.288	0.358
Birmingham	0.119	0.308	0.357
Charlotte	0.559	0.577	0.565
Memphis	0.136	0.295	0.305
Tampa	0.264	0.329	0.489
Southwest			
Dallas	0.586	0.425	0.462
Denver	0.271	0.383	0.472
Fort Worth	0.448	0.296	0.341
Houston	0.274	0.189	0.312
New Orleans	0.286	0.357	0.466
Oklahoma City	0.279	0.129	0.233
Phoenix	0.606	0.479	0.558
Salt Lake City	0.080	0.373	0.353
San Antonio	0.284	0.141	0.258
East Coast			
Baltimore	0.403	0.484	0.645
Boston	0.501	0.600	0.757
Hartford	0.285	0.397	0.541
Miami	0.587	0.578	0.713
New York City	0.322	0.444	0.674
Norfolk	0.419	0.418	0.593
Philadelphia	0.207	0.343	0.547
Providence	0.193	0.390	0.654
Washington DC	0.467	0.493	0.674
West Coast			
Anaheim	0.760	0.704	0.819
Los Angeles	0.608	0.649	0.787
Oakland	0.607	0.646	0.781
Portland	0.234	0.531	0.579
Sacramento	0.376	0.394	0.638
San Bernardino	0.511	0.390	0.633
San Diego	0.658	0.651	0.811
San Francisco	0.749	0.811	0.885
San Jose	0.682	0.756	0.824
Seattle	0.318	0.548	0.626