NBER WORKING PAPER SERIES

AMERICA'S HOUSING SUPPLY PROBLEM:
THE CLOSING OF THE SUBURBAN FRONTIER?

Edward L. Glaeser
Joseph Gyourko

Working Paper 33876
http://www.nber.org/papers/w33876

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2025

Gyourko gratefully acknowledges the financial support of the Research Sponsor program at the Zell/Lurie Real Estate Center at Wharton. This is an earlier version of the paper prepared for the Spring 2025 Brookings Papers on Economic Activity (BPEA) Conference and the final version of this paper will be published in the Spring 2025 BPEA issue. We appreciate the comments of our discussants, Nate Baum-Snow and Raven Molloy, as well as the editors, Janice Eberly and Jon Steinsson, and conference participants on earlier versions of the paper. We also benefited from the excellent research assistance of Manya Gauba, Flora Gu, Braydon Neiszner, and Lydia Qin. Naturally, we are responsible for all content. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

At least one co-author has disclosed additional relationships of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w33876

America's Housing Supply Problem: The Closing of the Suburban Frontier?
Edward L. Glaeser and Joseph Gyourko
NBER Working Paper No. 33876
May 2025
JEL No. R14, R3, R31

ABSTRACT

Housing prices across much of America have hit historic highs, while less housing is being built. If the U.S. housing stock had expanded at the same rate from 2000-2020 as it did from 1980-2000, there would be 15 million more housing units. This paper analyzes the decline of America's new housing supply, focusing on large sunbelt markets such as Atlanta, Dallas, Miami and Phoenix that were once building superstars. New housing growth rates have decreased and converged across these and many other metros, and prices have risen most where new supply has fallen the most. A model illustrates that structural estimation of long-term supply elasticity is difficult because variables that make places more attractive are likely to change neighborhood composition, which itself is likely to influence permitting. Our framework also suggests that as barriers to building become more important and heterogeneous across place, the positive connection between building and home prices and the negative connection between building and density will both attenuate. We document both of these trends throughout America's housing markets. In the sunbelt, these changes manifest as substantially less building in lower density census tracts with higher home prices. America's suburban frontier appears to be closing.

Edward L. Glaeser
Harvard University
Department of Economics
and NBER
eglaeser@harvard.edu

Joseph Gyourko
University of Pennsylvania
and NBER
gyourko@wharton.upenn.edu

A data appendix is available at http://www.nber.org/data-appendix/w33876

I. Introduction

How has housing supply in America evolved over the past 50 years? Twenty years ago, Glaeser & Gyourko (2005) noted that America could be divided into growing sunbelt markets with elastic housing supply (e.g. Atlanta, Dallas, and Phoenix), high cost coastal markets (e.g., Boston, New York City, Los Angeles and San Francisco) with inelastic housing supply, and low demand erstwhile industrial cities (e.g., Cleveland, Detroit). In this paper, we document that the sunbelt markets are no longer so elastic. The combination of declining output and rising prices indicates that the supply of new housing has shifted downward.[1]

Real, constant-quality home prices hit historic highs in 2024, both for the nation and for many individual markets. At the start of 2025, national prices are about 15 percent above the peak reached just before the Global Financial Crisis (GFC). Local prices have never been higher for many housing markets ranging from Los Angeles to Dallas, Miami (FL), Tampa and Phoenix. The combination of high prices and high interest rates has increased the costs of homeownership and public anxiety about housing affordability.[2] Of course, high homeownership costs are not identical with high costs of shelter both because of the option to rent[3], and because we do not know how much today's new homeowners will benefit from future housing price appreciation.

From 2000-2024, Miami, Tampa and Phoenix ranked 1st, 5th, and 9th, in price growth across the twenty areas that make up the S&P CoreLogic Case-Shiller 20 City Composite Home Price NSA Index. Each of these areas experienced more price growth than the New York City

[1] The term 'housing supply' is used in two distinct ways in the literature: (1) the relationship between the total number of homes in an area and the price of housing, which can be termed static supply, and (2) the relationship between the number of new homes in an area and the price of housing, as studied by Topel and Rosen (1988), which we refer to as dynamic supply or new housing supply. Static supply is the appropriate concept when examining a spatial equilibrium, because old houses are a close substitute for new houses (Roback (1980), Louie, *et. al.* (2025)); dynamic supply is more relevant when focusing on changes in the ability to build (Topel and Rosen (1988) and this paper). We document that dynamic supply has declined significantly over the past 50 years, which also implies that static supply itself has become somewhat less elastic. Static supply rarely declines because housing is durable (Glaeser and Gyourko (2005)).

[2] One recent example is a *Wall Street Journal* article and podcast that investigated the rising cost of ownership in Chapel Hill, NC, just over the last 14 years. The article may be accessed here: https://www.wsj.com/podcasts/your-money-matters/how-one-house-in-north-carolina-shows-the-growing-cost-home-ownership/26ad7ea0-c128-48a0-ac10-c6a414df3a0e?page=1 .

[3] Raven Molloy, in her comments on our paper and in previous research (Molloy, Nathanson and Paciorek (2022)) correctly notes that housing services can be rented in any market, and that rents need not move commensurately with house prices. She and her coauthors document that rents often are not rising much in the most high-priced American housing markets; rather, the price-to-rent ratios in those places are rising. Our data is consistent with their argument, especially in coastal markets. Price-to-rent ratios are rising in the sunbelt markets, too, but by less. Real rents for the median tract in many sunbelt markets have been increasing, but again, not by as much as house prices.

area, whose prices still increased by a healthy 70 percent. Between 1975 and 1999, no sunbelt city (outside of California) was among the top twelve of the same 20 markets.[4]

We interpret these rising prices as reflecting a downward shift in supply rather than an upward shift in demand because the quantity of housing production has declined substantially over the last half century. As Figure 1 in the next section shows, the 1950s and 1960s were a golden age of building, with abundant housing production in any market with robust demand. From a base of 36 million housing units in 1950, the national stock increased by 50 million homes over the next three decades. Housing unit growth rates then dropped by more than one third between the 1970s and the next two decades.[5] In the 1980s and 1990s, the growth rate of housing was barely half that seen in the 1950s and 1960s. The first decade of the new century saw slightly less growth followed by even lower housing unit production in the 2010s. While recent years have seen some recovery in housing production, building levels remain far below their post-war heyday. Standard economic logic suggests that the combination of rising prices and slowing production of new units means that a tepid supply side plays an important role in explaining today's high prices. Since this paper does not estimate housing demand elasticities, we will not quantify how much lower prices would be today if housing supply had grown at the same rate between 2000 and 2020 as it did between 1980 and 2000, but an extra 15 million housing units would surely make a difference

Another key fact is that these national changes mask important changes across housing markets. As in the 1980s and 1990s, there is still little new supply today in either the previously supply-constrained coastal markets or the old industrial centers mired in economic decline. The striking change is the declining intensity of new housing production in major sunbelt and mountain state markets. The largest shifts in housing supply have occurred in areas that were once notable for abundant new housing production and moderate prices. Figure 2 below documents declining construction rates for six metropolitan area housing markets that will be a particular focus of this paper: Atlanta, Dallas, Detroit, Los Angeles, Miami and Phoenix. From

[4] Among the seven sunbelt markets in that index, Charlotte had the highest rank of 13 because of its quite modest 11% appreciation over that quarter century time period. Phoenix was 14th at 9%; Miami was 16th at 5%; Atlanta was 17th at 4%; Tampa was 18th at 3%, Dallas was 19th at -1% and Las Vegas was 20th at -4%. These figures pale in comparison to those that Glaeser & Gyourko (2018) identified as the supply constrained coastal markets of San Francisco (160%), Seattle (110%), Boston (96%), Los Angeles (87%), New York City (71%), and San Diego (69%).
[5] The critical distinction here is between dynamic supply (the production of new homes) and static supply (the total number of homes). The quantity of new homes fell significantly; the total number of homes did not.

the immediate postwar period through the 1970s, there was enormous heterogeneity in the rates of production, especially between the then relatively less populous sunbelt markets that faced robust demand. The 1980s saw the beginning of a convergence in these rates, and by the 2010s, each of these six markets had similarly low rates of housing supply growth. The limited data since the 2020 census suggests this situation has not changed materially.

This combination of facts raises the possibility that once elastically supplied housing markets such as Miami, Phoenix and Dallas are becoming more like the supply-constrained coastal markets that we identified decades ago.[6] One important change appears to be a reduction in new construction in moderate- to high-price, low density and typically suburban census tracts. Table 6 below shows that in the Miami metropolitan area, 44 percent of all new housing units supplied in the 1970s were in these attractive low density, higher price areas. However, that share had fallen to 12 percent by the 2010s. This pattern is repeated across many different markets and motivates the question posed in this paper's title.

We explore these changes more formally in the second part of our paper. There, we estimate "empirical" supply curves within metropolitan areas to understand the changes, especially in the sunbelt markets that had once been housing supply superstars. In Section III, we present a simple model of housing supply and demand. One central implication of our model is that over periods of (say) ten years of more, variables that shift demand will almost invariably shift supply as well. A factor that increases demand for a location may also bring in wealthier or better educated residents who may then alter the permitting environment. Two implications of our framework are that when supply limitations become more important, the positive correlation between price and construction will diminish and the negative correlation between price and density will move towards zero or flip sign.

Despite the difficulties of measuring the true underlying housing supply curve over longer time horizons, we believe that the actual empirical link between prices and construction,

[6] In related research, an important recent paper by Baum-Snow and Han (2024) estimates highly inelastic supply sides for many very local housing markets in urban areas across the country. This clearly is consistent with a slow rate of supply increase. Orlando and Redfearn (2024) posits that the nature of supply could be changing in previously elastically-supplied metropolitan areas such as Houston in ways that would lead to higher prices in equilibrium. More broadly, Baum-Snow (2023) highlights how housing supply constrains urban growth from the neighborhood level up. Baum-Snow (2023) also makes the important point that there can be benefits, not just costs, to such constraints. Gyourko and McCulloch (2024) provide a recent estimate of the benefits to incumbent residents of restricting density. We do not provide a full welfare analysis of this situation in this paper. Finally, Baum-Snow and Duranton's (2025) recent review also explores the link between changing supply conditions and housing affordability.

which we call the "empirical housing supply curve," is an inherently important object, even if we cannot be sure what parameters that curve actually represents. This schedule informs us about whether building is happening in places where there is more demand. A positive slope means that the market seems to be responding to demand signals, and that space is being produced where people value it most. A flat empirical housing supply curve suggests that we should expect housing supply to remain fixed even if prices rise. The empirical housing supply curve is also relevant for telling us about the size of the social losses due to limited housing construction, since expensive areas are likely to have the biggest gap between how much consumers value housing units and how much housing costs to build.

We find that the relationship between house price and new construction across census tracts is declining in almost all of America's metropolitan areas between 1970 and 2020. In Los Angeles, the relationship between price and new construction was weak even in the 1970s. But in most of the sunbelt, housing construction used to supply high demand areas within metropolitan areas. That has become much less true.[7]

Where did the empirical housing supply curve flatten most sharply? Variables such as the Wharton Residential Land Use Regulatory Index (WRLURI) that measure the strictness of land use regulation reliably predict the shift. The share of educated workers in the metropolitan area, which is also thought to drive land use regulation, is also correlated with the change. We provide no further evidence that land use regulation has led to the change in housing supply, but we believe that this is the most natural explanation for the shift.

The estimated relationship between density and the growth of housing was generally negative in the 1970s, but has become closer to zero or positive over time, which is also compatible with supply conditions gaining importance. While more work remains to be done on this issue, our evidence does not suggest that housing supply growth is slowing primarily because particular neighborhoods have become "built out."

There have been other changes and shocks to American housing markets. Real construction costs increased by 25% over the past two decades. A large fraction of the employees and establishments in the homebuilding sector left the sector after the GFC. Covid impacted supply chains and the demand for larger housing units. Most recently, rising interest

[7] This complements the well-documented fact that, across metropolitan areas, places that build a lot aren't expensive and places that are expensive don't build a lot (Glaeser and Gyourko, 2018).

rates have influenced both the demand for homes and the supply of homes for listing. As we will later discuss, some of these changes are economically material, but a core argument of this chapter is that the genesis of our current situation began long before the global financial crisis. This change is most prominent in America's once expanding suburbs, where the link between new building and high house prices has been declining for decades.

The next section of this paper documents key facts about American housing markets and how they have changed over time. Section III provides a model of changes in housing supply. Section IV outlines our empirical strategy and presents results for a select set of markets. The analysis is expanded to a much broader set of markets in Section V, and Section VI concludes.

II. The State of the American Housing Market

Economists have long identified rising prices and declining quantities of new units as evidence of an upward shift or tilt of the supply curve. In this section, we document three facts that suggest American housing supply has declined, helping make achieving homeownership more costly. First, we document a sharp decline in housing production over the last 50 years, as well as convergence in new supply rates over recent decades. Second, America's housing prices have continued to rise, both in absolute levels and relative to production costs and income. Third, the homebuilding industry has changed materially in recent decades. Real construction costs have risen by about 25 percent per home since the early 2000s. In addition, the construction industry suffered a huge negative shock from the GFC. Both homebuilder establishments and employment declined by over 50 percent between 2004-2022.

II.A. Data Sources

We use decennial census data from 1950-2020 and the 5-year ACS sample from 2023, which were downloaded from the IPUMs NHGIS files (https://www.nhgis.org/). We also work with national aggregate data, county-level data, and census-level tract data, which enables us to observe prices, housing quantities and demographics at different spatial levels over many decades.

Logan, *et. al*.'s (2014) Longitudinal Tract Database (LTDB) provides one excellent panel of tracts. Unfortunately, this widely-used data base is problematic for measuring the correlates of housing unit growth because tracts are defined based on their population in 2010. Consider a tract that is divided between 1990 and 2010 so that the populations of the two new tracts are roughly identical. Mechanically, the new tract that began with less population will register a faster growth rate, which may lead to a spurious negative relationship between initial population (or initial population density) and subsequent growth.[8] This may not be an issue for many of the largely cross sectional analyses using the LTDB, but it generates the scope for substantial bias in any regression involving the growth of population or households, not only when the explanatory variable is initial population or density but whenever the explanatory variables are correlated with past population levels within divided tracts.

Consequently, we construct a census tract database that harmonizes tract boundaries based on 1970 boundaries to ensure a geographically consistent measure of key economic variables across the United States over each decade from 1970-2020 and from 2020-2023. Because tract definitions can change each decade, our 'reverse LTDB' aligns historical tract definitions (1970) with source-year tract geometries from subsequent decades (e.g., 1980, 1990, … 2020) using spatial operations and area weighting. The resulting crosswalk enables consistent comparisons of demographic and economic data over time, even when tract boundaries have changed.[9]

The reverse LTDB provides several advantages. By working forward through time, our unit of observation is not determined by an endogenous outcome. Consistent geographies over time provide more consistent measures of density.[10] Finally, we can account for large additions or losses in units for specific tracts, which we have had trouble doing with the LTDB. Typically, the outliers in the reverse LTDB are correlated with major changes such as new infrastructure.

[8]Consider a tract which has a high density area with 2,000 units and a low density area with 0 units in 1990. Presume that the high density area population doubles in 20 years and the low density area sees its population stay the same. When the tract is split, the low density area is grouped with half of the high density area. The result is two tracts: one with high density that did actually grow, but the data indicates it did not; the other tract is lower density that did not actually grow per this example, but the data indicates that it did. This example illustrates how the data series could incorrectly assign growth to non-dense areas, and stagnant growth in dense areas.
[9] The details of the data creation, along with a comparison with the LTDB, can be found in a separate paper, *Reverse LTDB Technical Documentation Memo*, which is posted on our websites and is available upon request.
[10] We compare and contrast how the tract-level distribution of density changes over time in our *Reverse LTDB Technical Documentation Memo* using the Phoenix CBSA as an example. Using our 1970-based tract data, we show in Figure 3 below that there is a significant rise in density of about 1.5 units per acre for the median tract between 1970 and 2010, but density stopped growing in the 2010s. Using the LTDB finds that measured density remains extremely low through 1980, with the median tract having close to no housing in 1970. This level and time pattern is driven by the use of 2010 tract definitions. Because Phoenix's population exploded over the last half century, many physically small tracts were created by 2010. These tiny geographies are both plentiful in number and close to empty of housing until recent decades.

The reverse LTDB has two disadvantages. Starting in 1970 reduces the effective sample size, especially in initially low density suburban areas, because the number of tracts has increased over time. This reduces the precision of some of the regressions run in the latter part of this paper. Moreover, our 1970-based sample of tracts does not cover all of the counties that now lie within the fastest growing metropolitan areas.[11]

II.B. The Decline in the Intensity of Housing Production

Figure 1 documents the change in housing supply for the U.S. as a whole. The green bars show the total housing stock in the United States in decennial census years from 1950-2020 and for 2023. The solid line reports the average annual rate of change in the total stock over each time period. The labels for the housing stock are on the left side and the labels for annual percentage growth are on the right side of the figure.

The overall housing stock increased from 36 million units in 1950 to 144 million units in 2023. Somewhat amazingly, America built more than 50 million homes from 1950 to 1980.[12] In the 1950s, the housing stock grew at four percent per year. That rate declined every decade until the 2000s, when it flattened out at just over one percent per year. The construction rate then dropped again in the 2010s, when the average annual rate of growth in the stock was an anemic 0.64 percent per year.

The absolute level of production has also declined. There were almost 17 million units built in the 1960s and 19 million units in the 1970s. The era of Nixon, Ford and Carter was the high-water mark for the home building industry. In the 2010s, we added fewer than 8.5 million units to the housing stock.[13]

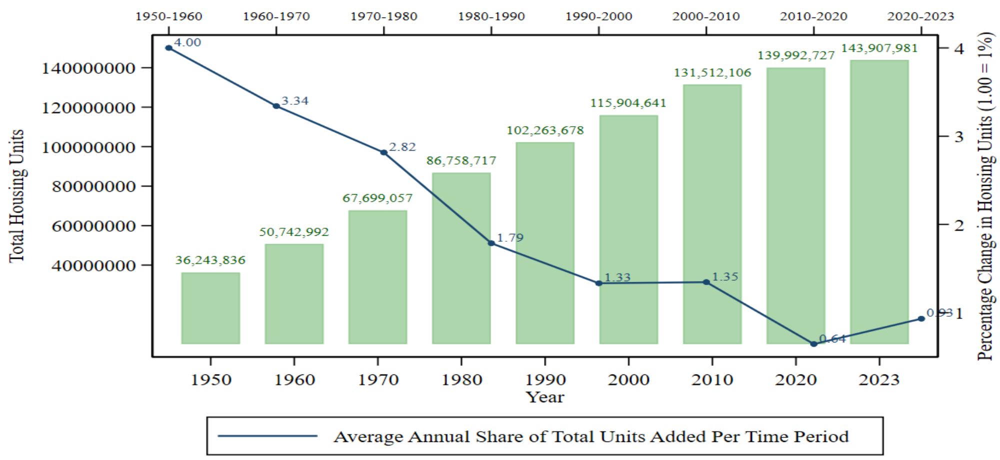
---

[11] Our *Reverse LTDB Technical Documentation Memo* (2025) includes a CBSA Coverage table that reports the tract count in our data and in the LTDB, as well as the share of the population covered by our tract boundaries. In Charlotte, for example, our 1970 tracts always capture at least 96 percent of the CBSA population in every decade from 1970-2020. In Austin, TX, however, we sometimes only capture 55 percent of the area population. This limitation leads us not to include markets such as Austin and Nashville in the analysis reported in the latter part of the paper.

[12] As described in the notes to the table, the 1950 and 1960 housing stock numbers are constructed using the count of homes built before 1950 and 1960, respectively, from 1970 census county-level data. See Appendix Discussion 1 for more on this decision.

[13] The flip side of this decline in production intensity is the falling depreciation rate of homes because of increasing amounts of rehab work and investment (Baum-Snow and Duranton (2025)).

Figure 1: The American Housing Stock and Its Growth, 1950-2023



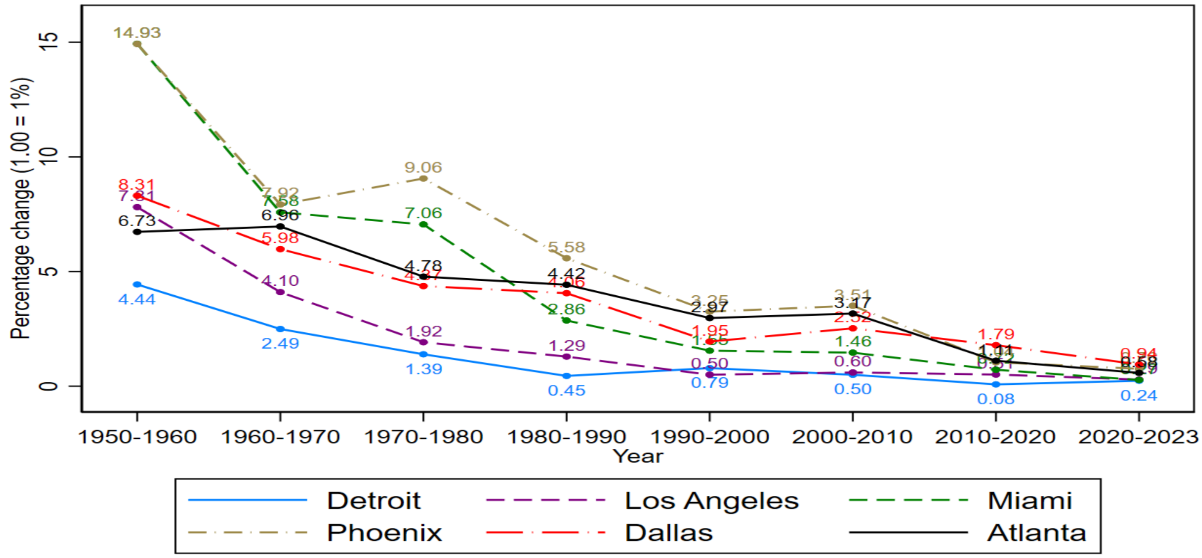
Note: Housing stock numbers for 1950 and 1960 are constructed using the count of homes built before 1950 and 1960, respectively, in the 1970 census. All others are from the decennial censuses (1970-2020) or built up from county level data from the 2019-2023 5-Year ACS estimates. See the discussion above in the data description subsection for more on these choices.

The average annual share added is calculated by dividing the percentage change over time period. For example, the 4.00% between 1950 and 1960 is calculated by ((50,742,992-36,243,836)/36,243,836)/10*100%.

Figure 2 shows the decline in building rates across our six focal markets: Atlanta, Dallas, Detroit, Los Angeles, Miami and Phoenix. This sextet is meant to capture three different parts of America. Detroit is the quintessential rustbelt metropolis, with low population growth and low prices. Los Angeles represents coastal America, with high prices and high levels of housing regulation. Atlanta, Dallas, Miami and Phoenix are four of the high-fliers of population growth over the last 50 years. Historically, they have been affordable places where it was easy to build. We are particularly interested in whether their permissive building environment remains.

Throughout the nearly three-quarter century time period we cover, Detroit and Los Angeles have remained at the bottom of the pack in terms of net housing unit production, but even so, their growth was impressive during the decades following the Second World War. In the 1950s, the housing stocks of Los Angeles and Detroit increased by over 7 and 4 percent per year, respectively. The city of Detroit's population crested in 1950, but the metropolitan area still experienced sizable suburban growth after that year. But since the 1960s, both areas have experienced far more modest housing growth. In three of the four decades between 1980 and 2020, Detroit's average annual growth rate has been 0.5 percent or less and Los Angeles' average annual growth rate has been 0.6 percent or less. Of course, as our data on housing prices show, Detroit's weak growth reflects limited demand, while Los Angeles' low growth reflects limited supply.

Figure 2: Average Annual Growth of Housing Units by Decade, Six Metropolitan Areas, 1950-2023



Note: The value for 2020-2023 is the average percentage change over three years. For the years 1950 and 1960, we construct CBSA-level aggregates from 1970's county-level census data on the number of homes built before 1950 and 1960. For each decade in 1970-2000, we construct CBSA-level aggregates from county-level census data from that year. In 2010, 2020 and 2023 we use 2006-2010, 2016-2020 and 2019-2023 5-year ACS county-level estimates to aggregate up to CBSA-level.

The other four sunbelt markets experienced extraordinary growth through the 1980s, and then lower but stable growth over the next two decades. Nevertheless, the growth of each of these areas follows a slightly different pattern. Miami and Phoenix both have extraordinary growth in the 1950s, but by the 1980s, Miami has the slowest growth of the four sunbelt areas. Dallas begins growing more slowly than Miami and Phoenix, but ends up with the fastest growth rate of the four during the 2010s. Atlanta begins with the slowest growth of the four areas, but has the second highest growth rate from 1980 to 2010. Despite the growth slowdown, Atlanta, Dallas and Phoenix all managed annual growth rates over 2.5 percent from 2000 to 2010. In the 2010s, the housing stocks of Atlanta, Miami and Phoenix each grew by less than 1.2 percent per year. Overall, there has been a great convergence in housing production across these six cities.[14]

Figure 3 confirms the slowdown is widespread with its examination of new supply growth rates over time across America's 50 largest metropolitan areas by population as of 2020. Along the horizontal axis, we show the growth rate in the number of housing units between 1980 and 2000. Along the vertical axis, we show the housing growth rate between 2000 and 2020, with the dashed line being at 45 degrees. The places that experienced high levels of growth from 1980 to 2000 had far lower levels of growth between 2000 and 2020, except for Houston and San

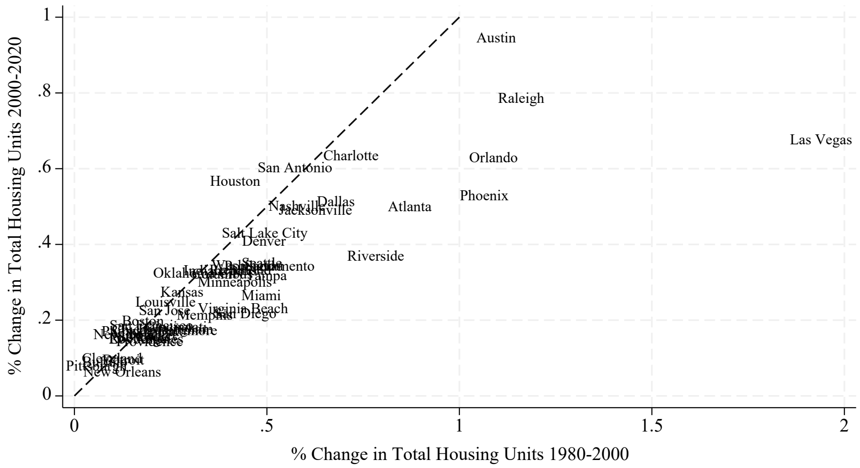
---

[14] Appendix Table 1 reports the analogous data for 18 additional CBSAs.

Antonio. The slowdowns of Atlanta and Phoenix are remarkable, but so are the reductions in the growth rates of Las Vegas, Orlando, Raleigh and Riverside, California.

Figure 3: Percentage Change in Housing Units Over Time, 2000-2020 vs. 1980-2000

Top 50 Markets by 2020 Population

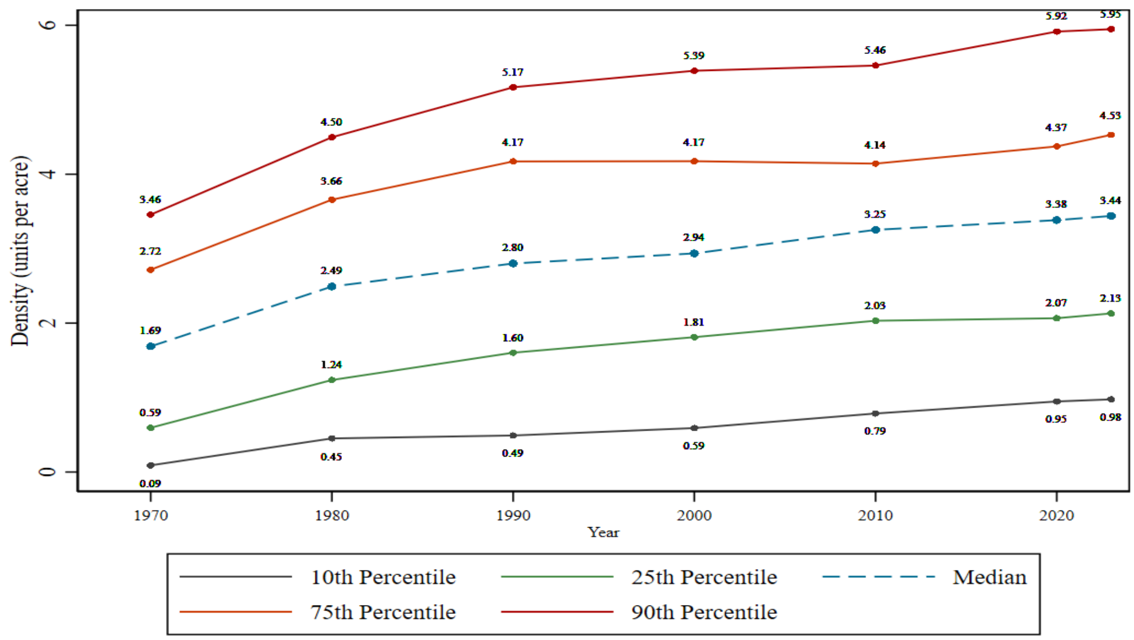


Note: Authors' calculations from decennial cencus data downloaded from NHGIS files are discussed in the text.

In principle, housing growth could decline because we have stopped packing more housing into a fixed area (densification) or because we have stopped extending the edges of metropolitan areas. Figure 4 examines the densification of Phoenix, with density defined as total housing units per acre, using census data with tracts defined in 1970. The middle of the five lines shows median tract level density which increased by almost 0.4 units per acre per decade from 1970 to 2010, raising the number of units per acre from 1.69 to 3.25. Between 2010 and 2020, median density only rose by 0.13 units per acre. Similarly, the density of the 75th percentile tract (the second highest line) rose dramatically from 1970 to 1990 but has remained essentially constant since that year. The 25th percentile tract (the second lowest line) has been steady since 2010, and while densification continues for the 10th percentile tract (bottom line), density remains quite low at this part of the distribution. Only the 90th percentile (top line) shows continued densification since 2010. Except for the densest tracts, these data are consistent with a density "wall", after which Phoenix tracts stop increasing density, either because of regulation or limited demand.[15]

[15] Results for 24 markets are included in Appendix Table 2.

Figure 4: The Distribution of Housing Density Over Time in the Phoenix Metro Area



Note: : Tract-level total unit density is constructed as the number of all housing units per acre in 1970-standardized tracts. The distribution is calculated in each year based on Phoenix's 1970 CBSA boundary.

Table 1 provides a more systematic look at densification by distance from the urban core for our six focal markets.[16] We show the percentage change in the number of housing units per acre by decade among tracts within 5 miles of the metro's center, within 5-10 miles of the center and more than ten miles out from the center.[17] In all of the markets, there has been a significant slowdown in densification in tracts more than 10 miles out from the urban core. In every market except for Detroit, this has been somewhat offset by increased building in the urban core, which largely reflects multi-unit housing. Construction in the middle-distance tracts is generally lower, but each city has its own pattern. In Phoenix, middle-distance growth declines in almost every decade. In Atlanta, Dallas, and Miami, middle-distance growth was significantly higher in the 1970s than in later decades, but there is little clear trend since the 1980s. There is no trend in middle-distance tracts in either Detroit or Los Angeles, as Los Angeles has experienced modest densification in almost every decade and Detroit has experienced modest declines in density in every decade.

[16] Results for an additional 18 markets are reported in Appendix Table 3.
[17] The center is defined as the tract in the LTDB that had the highest housing unit density in 1970.

Table 1: Decadal Percentage Change in Aggregate Total Units Density by Miles from City Center

CBSA	Miles from Center	1970-1980	1980-1990	1990-2000	2000-2010	2010-2020
Atlanta	0-5	-0.022	-0.004	0.001	0.143	0.134
	5-10	0.240	0.139	0.101	0.141	0.110
	10 Plus	0.912	0.781	0.352	0.303	0.098
Dallas	0-5	0.020	0.011	-0.010	0.062	0.155
	5-10	0.407	0.114	-0.010	0.010	0.157
	10 Plus	0.711	0.438	0.275	0.309	0.196
Miami	0-5	0.181	-0.014	0.030	0.146	0.162
	5-10	0.202	-0.012	0.091	0.045	0.041
	10 Plus	0.511	0.108	0.186	0.447	0.103
Phoenix	0-5	0.120	0.010	0.029	0.024	0.146
	5-10	0.922	0.234	0.108	0.125	0.066
	10 Plus	1.667	1.087	0.489	0.403	0.124
Los Angeles	0-5	0.061	-0.066	-0.001	0.120	0.068
	5-10	0.062	0.030	0.045	-0.001	0.063
	10 Plus	0.334	0.078	0.109	0.030	0.052
Detroit	0-5	-0.185	-0.216	-0.081	-0.120	-0.092
	5-10	-0.015	-0.058	-0.033	-0.065	-0.064
	10 Plus	0.343	0.124	0.142	0.075	0.035

Notes: All housing unit density in each distance-to-center ring is calculated by adding all housing units in each distance bin, and the dividing by the total acreage of the tracts in that distance bin. A tract is considered within a given distance-to-center bin if its centroid is in that distance bin. Using these decadal density measures, we compute the decadal percentage change for a distance-to-center bin within a given CBSA. Those results are reported in the table.

We are building less housing as a nation, especially in the outlying areas of once rapidly expanding Sunbelt metropolises, but that need not mean that the rate of new housing production is somehow problematic. Housing is a durable good, and we have a lot of old housing which is a substitute for new construction. Falling birth rates or lower net in-migration could have driven demand down. Only prices can help us determine whether the decline in housing production represents a shift in supply or demand. We turn to those data next.

II.C. The Rise in Housing Prices

In this section, we use the Federal Housing Finance Agency (FHFA) repeat sales price data from the mid-1970s through 2024. The indices are all normalized to equal 100 in the first quarter of 2000. These data are available at the national level and for many individual metropolitan areas, and the repeat sales structure hopefully controls for the quality of homes sold.

Figure 5 shows the price variation for our six focal markets.[18] Detroit's prices have mostly recovered from its post-GFC bust, but Detroit remains affordable, with prices close to those seen at the turn of the century. Los Angeles provides a canonical example of what happens when strong demand is met with limited new supply for decades. Los Angeles' prices are above their pre-GFC peak, more than double their 2000 level and more than four times their 1975 level. Among our six cities, Los Angeles experienced the highest growth over the entire 1975-2024 time span, but Miami's prices rose more from 2000 to 2024.[19] Real home prices in Miami have risen by 155 percent since their post-GFC nadir in 2012 and now cost nearly three times their levels in 1975 and 2000. Real constant-quality prices in Phoenix have risen by 157 percent from that city's 2011 post-GFC floor and are now nearly twice their levels in both 1975 and 2000. Dallas's housing is over 50 percent more costly than in 1975 and 2000, and it has experienced a 95 percent increase from its 2012 low. Atlanta's price increase since 2000 is a more modest 32 percent. The price volatility in the four fast growing Sunbelt markets' prices is also dramatically higher after 2000 than it was before that year, which suggests that housing has evolved from a readily produced commodity into a scarce asset.

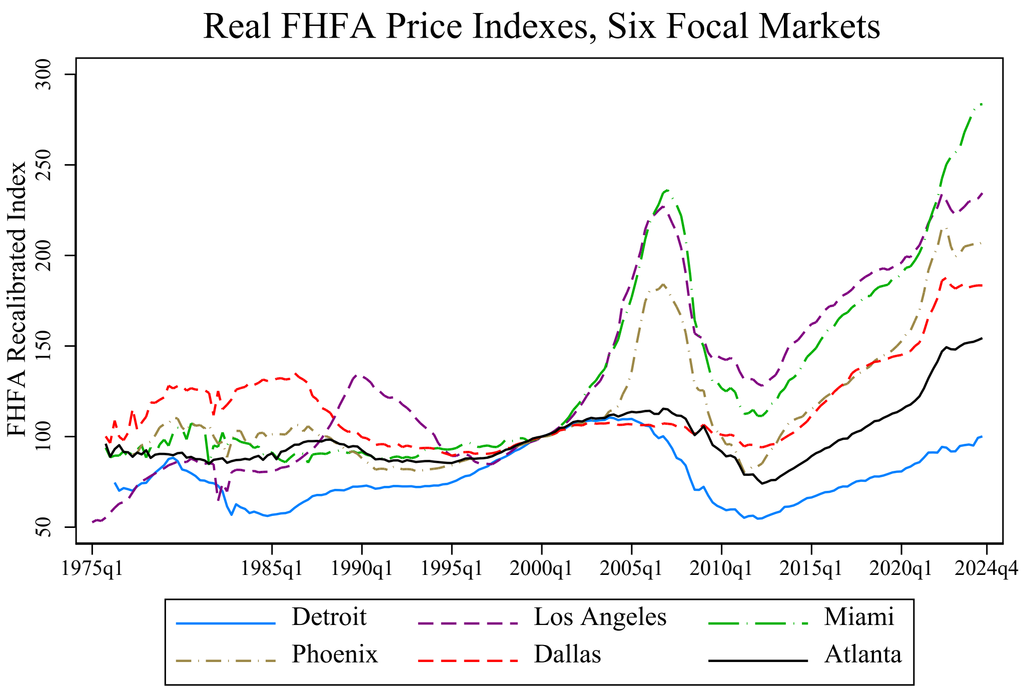
Figure 6 then shows the real price growth rate between 1980 and 2000 along the horizontal axis and the real price growth rate between 2000 and 2020 along the vertical axis for the broader set of 50 large metropolitan areas. This graph is, in a sense, the mirror of Figure 3, which showed that housing quantity growth rates had dropped dramatically after the millennium. In this case, price growth has risen dramatically over the last 20 years. This growth is not just in places like New York and Los Angeles, but also in Dallas, Miami, and Phoenix. The figure documents that our four sunbelt cities are not all that unusual, as price growth has also been higher recently in Riverside, Phoenix, Houston and Tampa.

---

[18] Appendix Figure 1 plots the aggregate data for the United States. That plot documents a total of four booms and three busts. The booms and busts have grown larger over time and both indices show a steady rise in national prices. In aggregate, real constant quality prices are well above their pre-GFC peaks, by over 15 percent. Both trends could reflect increasing limitations on housing supply. Our past work (Glaeser, Gyourko, and Saiz, 2008, Glaeser and Gyourko, 2018) documents that places facing greater housing constraints also experience more extreme housing booms and busts. In 2024, the country appears to be at the crest of the fourth boom, but while such booms have historically been followed by price drops, the decline in building means that new construction now plays less of a role in pushing prices downward.

[19] The indices start at slightly different times for individual markets. Los Angeles's series begins in 1975(1), with the others beginning in 1976 or 1977. This variation is a function of when the FHFA began publishing a given metropolitan area's series.

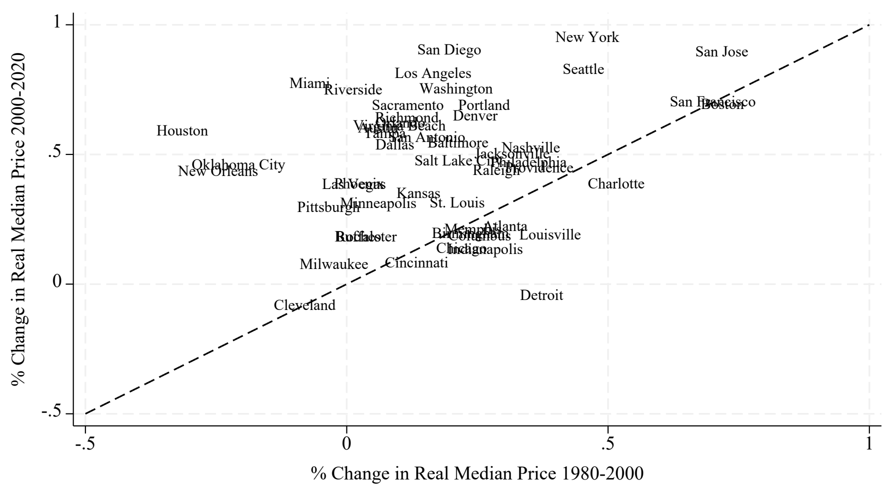
Figure 5: FHFA Repeat Sales Price Indices, Select Markets 1975-2024(4)



Note: The underlying data are from the FHFA House Price Index® (FHFA HPI®) data. 2000q1 = 100.

Figure 6: Percentage Change in House Prices Over Time, 2000-2020 vs. 1980-2000

Top 50 Markets by 2020 Population

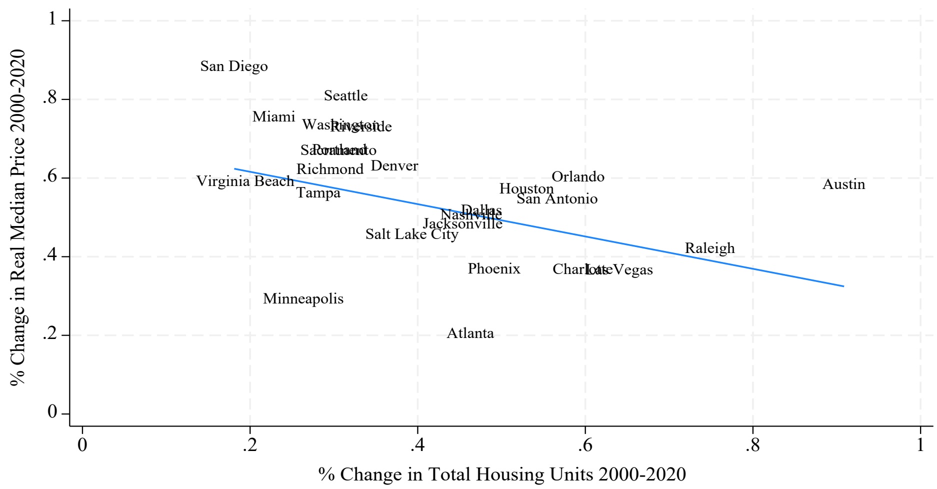


Note: Authors' calculations from decennial cencus data downloaded from NHGIS files are discussed in the text.

Figure 7 then looks at the connection between declining production and rising prices. In this plot, we have taken the 25 markets that were growing most quickly between 1980 and 2000 in Figure 3. There is a negative relationship between housing unit growth between 2000 and 2020, shown on the horizontal axis, and price growth, shown on the vertical access. There are, of course, outliers. Minneapolis experienced less housing unit growth and less price growth, and Austin's prices rose significantly despite enormous housing unit growth. Yet, the overall slope is negative and significant, as we estimate that a 10 percent increase in housing units is associated with about a 4 percent decrease in prices (t-statistic~-2.4).

Figure 7: Price Growth vs. Quantity Growth, 2000-2020

Top Half of Quantity Growth in 1980-2000



Note: Authors' calculations from decennial cencus data downloaded from NHGIS files are discussed in the text.

This negative correlation and the starkly rising prices that appear in so many markets is incompatible with the view that the decline in new construction is driven by a lack of housing demand. Basic economics tell us that sharply rising prices and declines in supply can only indicate a shift in supply. This supply shift could reflect regulation, or increased production costs in the building industry (as in Goolsbee and Syverson, 2022) or an absence of developable land.

The lack of land hypothesis seems somewhat incompatible with the enormous expanses of open country that surround Atlanta, Dallas and Phoenix, and with the fact that the median tract density in Phoenix is less than 3.5 homes per acre. One possibility is that rising prices for the metropolitan area as whole reflect a highly constrained and desirable interior with high and increasing prices, and an unconstrained and far less attractive urban fringe with low prices that are tied closely to construction costs. To investigate this possibility, we will look at the heterogeneity in housing price growth within these areas. We also will examine the distribution of prices across tracts relative to construction costs in the market region.

Appendix Table 4 reports how price-to-income (P/I) ratios have changed across the U.S. and for select metropolitan areas. Price growth has outpaced income growth generally, and especially so in more expensive tracts. For the 10th percentile tract in the nation, P/I=1.06 in 1970 and 2.08 in 2023. The nation's median tract's P/I ratio rose by 2.8 times over the same time period, from 1.77 in 1970 to 5.03 in 2023, while that for the 90th percentile increased by 3.4 times, from 3.00 to 10.08. These national changes are a mixture of markets such as Los Angeles and Phoenix. For example, the 90th percentile tract's P/I ratio in Los Angeles rose by 4.4 times, from 3.53 in 1970 to 15.37 in 2023. The analogous increase in Phoenix was only 2.62 times, from 2.97 in 1970 to 7.77 in 2023.

Another important change over time is the divergence of sunbelt markets such as Phoenix from markets such as Detroit. In 1970, the ratios of price-to-income look quite similar in Phoenix and Detroit. Table 2 shows this was still largely true in 2000, but by 2023, home prices in the typical tract (and more expensive ones) had escalated far more than average incomes in the Phoenix market than in the Detroit market.

Table 2: Price-to-Income Ratios in Phoenix and Detroit

	Phoenix			Detroit		
Year	**10th**	**50th**	**90th**	**10th**	**50th**	**90th**
1970	0.87	1.61	2.97	0.90	1.51	2.41
2000	1.60	2.43	4.57	0.73	2.25	4.63
2023	2.96	4.37	7.77	0.82	2.48	5.31

Notes: In each decade, the price-to-income ratio is constructed at the tract level by dividing the tract-level real median house price by the relevant CBSA-wide mean real income. For Phoenix and Detroit, we report the price-to-income ratios at each percentile within the CBSA.

We now turn to the relationship between prices and construction costs. In our earliest work, we focused on the gap between these two numbers, which we argued could be a measure of the impact of regulation under particular circumstances (Glaeser, Gyourko and Saks 2005). While we do not have measures of construction costs for all houses, we create a proxy for the minimum profitable production cost of a typical home.

The R.S. Means Company (now called Gordian) reports the per square foot construction cost for multiple sizes and qualities of homes. We estimate the cost of a 2,000ft^2 average-quality home in each year.[20] This home represents a good (not high) quality unit that meets all building code regulations in a community. This reference unit is smaller than newly-built homes in most

[20] The R.S Means Company produces cost estimates for four qualities of home: economy, average, custom and luxury, going from lowest to highest quality, and they provide metropolitan area indices, but they do not produce separate cost estimates for each quality-type for each area.

markets, but it is not smaller than most existing homes, which constitute the bulk of the stock that transacts.

To obtain a CBSA-specific estimate for a 2,000ft^2 home, we correct the national average square foot cost by CBSA-specific market index value (divided by 100 given how their data are reported). This physical construction cost estimate is an input into an estimate of overall production cost, which includes the cost of land (20 percent) and a builder's profit (17 percent on land and structure).[21] We define the Minimum Profitable Production Costs (MPPC) of a home as: $MPPC_c = A_c \times 2000 \times \left(\frac{1}{1-Land\ Share}\right) \times 1.17$,

where A is the square foot cost of providing the 2,000 square foot economy average quality home in CBSA *c*, 2,000 represents the square footage to scale up the per square foot costs on our reference building, Land Share is 20 percent[22], and 1.17 represents a 17 percent profit margin for developers.[23] We then estimate a price-to-minimum profitable production cost ratio using tract-level median prices in the numerator and our estimates of MPPC in the denominator. Hence, all variation in this ratio within a metropolitan area is driven by differences in prices in the numerator.[24]

Table 3 then reports the share of tracts in a given housing market with median house price at least 20 percent below our estimate of fundamental production costs, the share between 80 and 120 percent of production costs, and the share of tracts with median price at least 20 percent more than production costs. Prices can be significantly below construction costs either because a tract's housing has depreciated or because demand for a place has declined. Detroit, for example, never has a substantial number of tracts with median prices greater than 1.2 times MPPC, and always has a healthy majority of tracts with median prices below 0.8 times MPPC.

[21] These numbers follow Glaeser and Gyourko (2018).

[22] This is an assumption we (and others) have used before. It was chosen because land shares in elastically supplied housing markets typically are not more than 20 percent of total home costs. The goal is to have a cost that is associated with a relatively 'free' market.

[23] This is a typical margin noted by homebuilders in a survey we conducted some years ago. It is an average over a full housing cycle. It also is consistent with the 9%-11% internal rates of return that publicly traded homebuilders earn over time. The RS Means construction costs data also include a 15% margin for developers. This means our estimates for MPPC are conservatively large, making our P:MPPC an underestimate of the true value.

[24] We have experimented with different costs in the denominator. The basic patterns discussed below are not much affected if modestly different housing qualities are employed. The potential biases are as follows. Quality drift up will lead to our finding higher P/MPPC ratios over time. We try to counter this by making a conservative estimate of MPPC in the denominator, as described just above.

Los Angeles is our quintessential high demand, low supply coastal city and the fourth panel of Table 3 documents how virtually the entire housing stock of Los Angeles became more costly than the production costs of delivering those homes. Through 1980, most tracts have median house prices below or near our estimate of minimum profitable production costs, despite the fact that the share of tracts with a median price twenty percent or more above MPPC jumped from 5 to 25 percent during the 1970s. The change was an even starker during the 1980s. By 1990, over 60 percent of tracts in the Los Angeles metropolitan area had prices more than 1.2 times our estimate of production costs. Prices fell during the 1990s relative to production costs, but that reversed after 2000, and as of 2023, 93 percent of Los Angeles' tracts had median prices that were at least 20 percent higher than MPPC.

As of 1990, prices were less than 0.8 times production costs in at least 65 percent of the tracts in all four of the sunbelt cities, and prices were less than 1.2 times production costs in at least 82 percent of all tracts. While these metros were growing and Detroit was not, they weren't all that much less affordable than the Motor City. Atlanta and Miami diverged from the other two cities during the 1990s, and in 2000, the share of tracts with median prices above 1.2 times MPPC was over 20 percent in both areas. In Dallas and Phoenix, the share of tracts that expensive was less than 12 percent. By 2023, the share of tracts that had prices that were at least 1.2 times construction costs had risen to 23 percent in Dallas, 30 percent in Phoenix, 32 percent in Atlanta, and 41 percent in Miami. Unlike Los Angeles, these sunbelt metropolitan areas all have substantial inexpensive areas, where prices are less than 80 percent of construction costs, but by 2023, they also all have significant areas in which homes are significantly more costly to buy than to build. Increasingly, larger swaths of the sunbelt metropolises are starting to look more like Los Angeles.

Table 3: Share of Tracts in P:MPPC Bins - Six Focal Markets

CBSA	P:MPPC Bin	1970	1980	1990	2000	2010	2020	2023
Atlanta	P:MPPC < 0.8	0.835	0.818	0.727	0.553	0.539	0.555	0.416
	0.8 < P:MPPC < 1.2	0.097	0.140	0.135	0.193	0.233	0.202	0.267
	P:MPPC > 1.2	0.068	0.042	0.139	0.254	0.229	0.244	0.317
Dallas	P:MPPC < 0.8	0.876	0.838	0.791	0.754	0.776	0.684	0.527
	0.8 < P:MPPC < 1.2	0.099	0.092	0.115	0.131	0.121	0.146	0.230
	P:MPPC > 1.2	0.025	0.070	0.094	0.114	0.103	0.170	0.243
Detroit	P:MPPC < 0.8	0.934	0.903	0.899	0.752	0.895	0.912	0.884
	0.8 < P:MPPC < 1.2	0.049	0.072	0.065	0.165	0.079	0.067	0.087
	P:MPPC > 1.2	0.018	0.026	0.036	0.084	0.026	0.021	0.028
Los Angeles	P:MPPC < 0.8	0.856	0.383	0.085	0.149	0.015	0.019	0.011
	0.8 < P:MPPC < 1.2	0.096	0.361	0.292	0.451	0.096	0.232	0.057
	P:MPPC > 1.2	0.048	0.256	0.624	0.400	0.889	0.749	0.932
Miami	P:MPPC < 0.8	0.899	0.657	0.659	0.531	0.288	0.393	0.183
	0.8 < P:MPPC < 1.2	0.081	0.198	0.161	0.258	0.361	0.300	0.403
	P:MPPC > 1.2	0.020	0.145	0.180	0.210	0.351	0.307	0.413
Phoenix	P:MPPC < 0.8	0.955	0.839	0.825	0.683	0.535	0.588	0.346
	0.8 < P:MPPC < 1.2	0.036	0.106	0.122	0.229	0.287	0.268	0.355
	P:MPPC > 1.2	0.009	0.055	0.052	0.088	0.178	0.145	0.298

Notes: P:MPPC is calculated for each tract in each year by taking the real median home value (P), and then dividing it by the CBSA-level value of MPPC. We compute the share of tracts within a CBSA in the designated bins accordingly. See Appendix Table 5 for data on the broader set of 24 markets tracked in this paper.

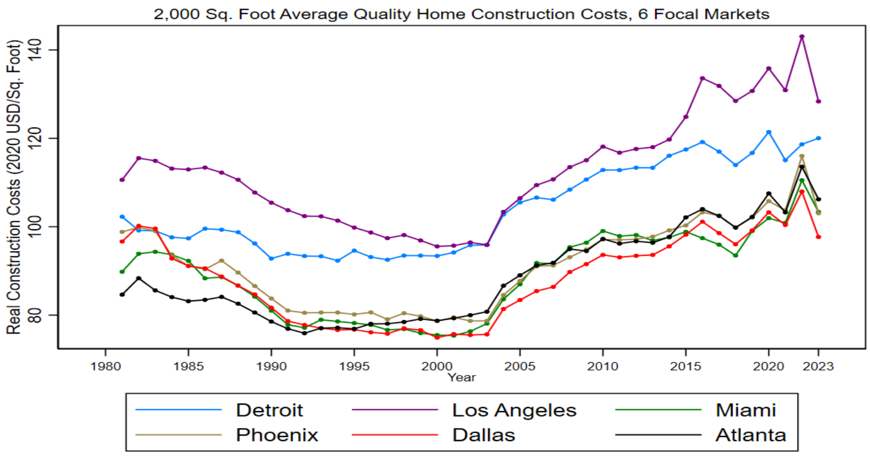
II.D. The Evolution of the Residential Construction Industry

The increasing gap between how much it costs to buy a home and the physical cost of production is happening in previously high supply growth sunbelt metropolises despite the fact that the physical costs of construction are also rising. This section also shows that those rising costs are accompanied by a sharp reduction in the overall employment and number of establishments in the construction industry.

II.E. The Changing Physical Cost of Housing Production

Figure 8 plots the per square foot construction costs across the six metropolitan areas discussed above. Costs are highest in the markets of Detroit and Los Angeles, while costs in the four sunbelt metros are lower and similar to each other. The R.S. Means data suggest the primary difference is due to labor costs, as the firm assumes that higher cost union labor is used in both Detroit and Los Angeles. The time patterns of costs covary positively and strongly across all markets. Until the mid-2000s, costs are either flat or declining in each market, but have increased by about 25 percent since then.

Figure 8: 2,000 Sq. Foot Average Quality Home Construction Costs



Note: The city-level square foot costs are taken from the RS Means Construction Cost books. We convert the costs into 2020 real USD values using non-seasonally adjusted all-items CPI for the nation.

That is an economically significant increase in general, and it roughly equals the real constant-quality price growth since the turn of the century discussed above in the Atlanta housing market. It dwarfs the appreciation in Detroit, which is another signal of how weak fundamentals are in that housing market. However, high production costs cannot account for the bulk of the constant quality price growth in the Dallas, Los Angeles, Miami or Phoenix markets.[25] At the national level, the FHFA repeat sales price index data reported in Appendix Figure 1 show that constant quality transactions values rose by 77 percent from 2000 to 2023, which suggests that perhaps one-half of the increase in housing costs can be linked to the higher cost of building *per se*. D'Amico, *et al.* (2024) argue that the slow productivity in the construction sector reflects the small scale of projects and businesses, which is in turn the result of either land use regulations or limited land availability. If so, then this rising cost of building is not distinct from land use regulation, but another example of the consequences of that regulation.

In sum, the rise of building costs may play a significant role in driving price growth in some markets, but it is neither the exclusive or dominant factor in America's most expensive markets (e.g., such as Los Angeles), nor in many major markets off the coasts and in the sunbelt.

[25] The same is true for a variety of other sunbelt markets such as Charlotte, Las Vegas and Tampa. Price appreciation this century also has been much higher than production cost increases in the major coastal markets.

II.F. The Decline of Construction Employment and Establishments.

We now look at the pattern of employment and establishments in homebuilding. Across the country as a whole, both series declined after the GFC, and never fully recovered. Yet in quickly growing markets such as Dallas and Houston, employment and establishments have both come back and are now above pre-GFC peak levels.

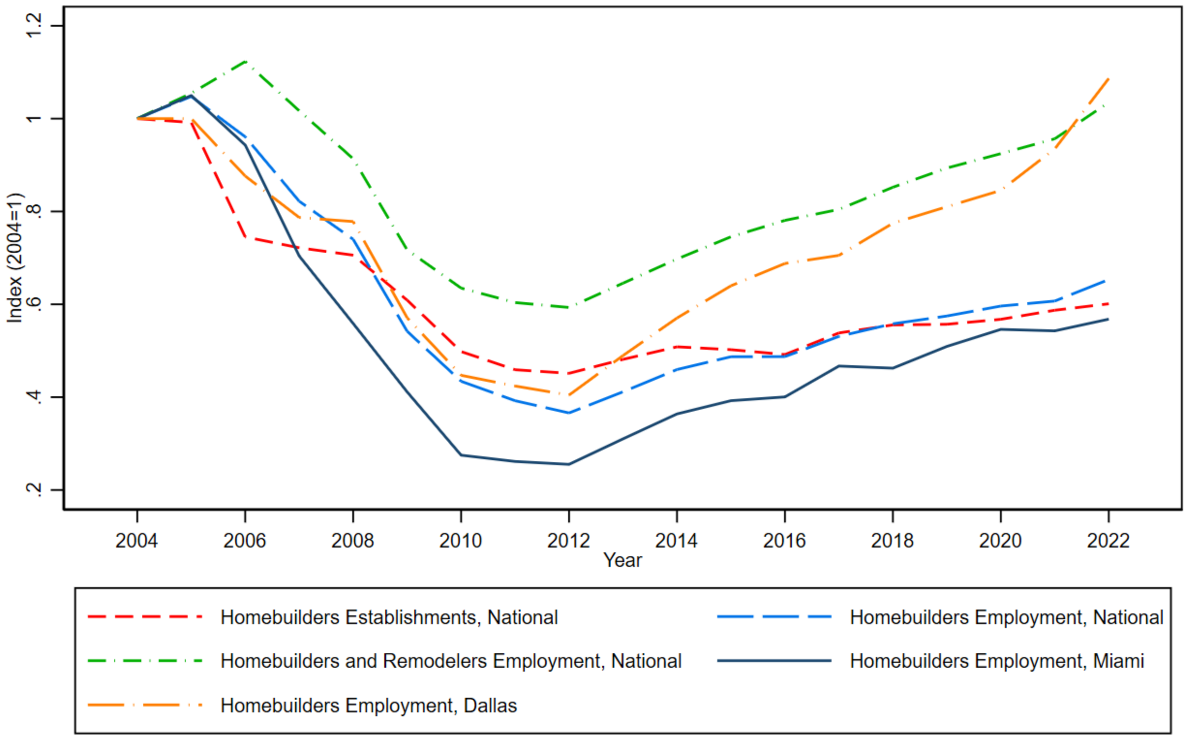
Figure 9 depicts these changes based on data from 146 major markets in homebuilding employment and establishments between 2004 and 2022. We define homebuilding as North American Industrial Classification System (NAICS) codes 236115 (single family housing construction), 236116 (multifamily housing construction) and 236117 (new housing for sale builders). In this figure, each series is indexed to have a value of one in 2004, with deviations from one indicating the percentage change relative to that year.

The negative shock from the GFC to the housing construction sector is apparent from the different lines which depict the change in establishments and employment, respectively. National homebuilder employment had dropped by 60 percent in 2012 and establishments had decreased by over half. Neither series has since recovered to the levels seen before the GFC. Do these persistent declines reflect the long-term effects of the GFC? Perhaps the enormous magnitude of the dislocation led to permanent losses in building-related entrepreneurial skill and human capital, or perhaps there was a change in the difficulty of home building? One way to distinguish between these hypotheses is to look at those metropolitan areas where we believe that building is or was relatively unfettered.

In Dallas, homebuilder employment has fully recovered from its post-GFC decline; in Miami, homebuilder employment languishes at barely half its 2004 level. These data indicate that it is possible to reconstitute a large employment base, even after a large negative shock. The construction industry is dominated by tiny firms, which suggests that barriers to entry are limited. Indeed, if there is less scrutiny of smaller firms for compliance with labor regulations, it may be easier for small firms to function in this industry. Small construction firms typically open and close rapidly, too. For example, in 2022 and 2023, almost one-fifth of establishments in residential building construction (NAICS 2361) were less than one year old according to the Business Dynamics database.[26] This is not unique to that year either, as 17.5 percent of all builders were born during every year since 2011.

[26] https://data.census.gov/table?q=BDSTIMESERIES.BDSNAICS&n=2361.

Figure 9: Employment and Establishments in the Homebuilding and Remodeling Sectors, Nationally and by Select Market, 2004-2022



Note: We construct the homebuilding establishments and employment counts by aggregating over three NAICS codes: 236115 (single family housing construction), 236116 (multifamily housing construction), 236117 (new housing for sale builders). We also use NAICS code 236118 for residential remodelers employment. Miami and Dallas' CBSA data originate from the County Business Patterns (CBP) data, and are aggregated to the CBSA level. The National values are calculated by aggregating across all CBSA's in the data. The index plotted for each series scales all years by the 2004 value in its series. Thus each datapoint is the percentage change relative to the 2004 value.

The other line in Figure 9 plots the total number of employees nationally in the homebuilder and remodeler sectors combined.[27] In data not plotted here, there was a decline in both remodeling establishments and employment after the GFC, but the trend in both series reversed after 2010. That fact that employment in the combined sectors is back to 2004 levels indicates that remodeling employment increased sharply after the GFC. The growth in remodeling suggests both the flexibility of entry in this sector and that a significant amount of labor and entrepreneurial effort that had once been in homebuilding is now working in the less regulated sector of remodeling.[28]

[27] The remodeling subsector is in NAICS 236118.

[28] It also is the case that homebuilders have not been earning excessively high returns during the recent boom. Appendix Figure 2 plots the returns of over one dozen publicly-traded homebuilders who are part of the S&P SPDR Homebuilders ETF, along with those for the S&P500 Index. Homebuilders certainly do better than the typical S&P500 firm in good times, but that is to be expected. Homebuilding is a high beta sector. However, when one looks at 4, 10, or 15 year periods, builders have not enjoyed higher returns (absolutely or relative to the broader

III. A Framework for Understanding Changes in Housing Supply

In this section, we consider a one period investment model, which will relate to the housing change regressions in the next section. We label the beginning of the period 0 and the end of the period 1. Until Section IIIA, we assume that all households and all housing is homogeneous. The flow utility from owning a home is $\alpha_i D_i^{-\gamma_t} L^{\sigma}$, where L refers to the amount of land associated with the house, α_i captures an exogenous amenity value and D_i refers to the density level of the neighborhood as a whole. We let $D_{i,0}$ refer to the density as of period 0. The parameter γ_t is time indexed to suggest that density might be considerably less desirable during some periods, such as the 2000s, than in others such as the 1970s.

We assume that the price of a home at period 1 will equal $\alpha_i D_i^{-\gamma_t} L^{\sigma}/r$, which can be interpreted as the net present value of the infinite time horizon flow of utility from owning this housing, assuming that nothing ever changes in the future. If the equilibrium price of land equals P_L, then optimal land ownership implies $P_L = \sigma\alpha_i D_i^{-\gamma_t} L^{\sigma-1}/r$ for every household. Assuming away geographic constraints on land assembly so that each household can buy or sell land freely, then the identical homeowners assumption implies identical land ownership within the neighborhood, and then $D_i = \frac{1}{L}$ implies that $P_L = \sigma\alpha_i D_i^{1-\sigma-\gamma_t}/r$.

The physical cost of building a home equals C_t. Across the metropolitan area as a whole, this cost will be endogenous, but at the neighborhood level it can be treated as exogenous because we assume that each tract is an arbitrarily small part of the metropolitan region, just as each home is an arbitrarily small part of the neighborhood's housing stock. If the builder wants to acquire $1/D_i$ units of land for the home (or if the owner wants to subsequently add or subtract land), then the value of the house minus the land cost will equal $(1-\sigma)\alpha_i D_i^{1-\sigma-\gamma_t}/r$. As in Glaeser and Gyourko (2005), new housing will not get built if $\frac{(1-\sigma)\alpha_i D_{i,0}^{1-\sigma-\gamma_t}}{r} < C_t$.

We assume that there is also a cost of the permitting process, which is determined by neighborhood specific factors, density and housing growth over the time period. We also assume that this cost is proportional to construction costs, so that total permitting costs equal $\left(\rho_i D_i^{\theta_t}\left(\frac{D_i}{D_{i,0}}\right)^{\mu_t} - 1\right) C_t$, where ρ_i is a neighborhood-specific permitting cost, and θ_t and μ_t are

stock market) in the current boom period compared to past boom periods. Comparisons using longer 10 and 15-year periods reach the same conclusion.

potenitally time-varying parameters. We will assume that $\rho_i D_{i,0}^{\theta_t} \geq 1$ for all neighborhoods, so that these costs are always weakly positive.

Total production costs for a house with a standard lot will therefore equal $\rho_i D_i^{\theta_t} \left(\frac{D_i}{D_{i,0}}\right)^{\mu_t} C_t$. In a construction market equilibrium with a positive amount of building, the cost of building (structure plus land) must equal the price of housing which implies $\frac{(1-\sigma)\alpha_i D_i^{-\sigma-\gamma_t}}{r} = C_t \rho_i D_{i,0}^{\theta_t} \left(\frac{D_i}{D_{i,0}}\right)^{\theta_t+\mu_t}$.

This equality implies two equations that will lie at the heart of the supply curve estimation that follows:

$$(1)\ ln\left(\frac{D_i}{D_{i,0}}\right) = K_0 + \frac{1}{\theta_t+\mu_t} ln(P_H) - \frac{\theta_t}{\theta_t+\mu_t} ln(D_{i,0}) = K_I + \frac{ln(\alpha_i)-ln(\rho_i)}{\theta_t+\mu_t+\sigma+\gamma_t} - \frac{\sigma+\gamma_t+\theta_t}{\theta_t+\mu_t+\sigma+\gamma_t} ln(D_{i,0}),$$

and

$$(2)\ ln(P_H) = K_P + \frac{(\theta_t+\mu_t)ln(\alpha_i)+(\sigma+\gamma_t)ln(\rho_i)}{\theta_t+\mu_t+\sigma+\gamma_t} - \frac{\mu_t(\sigma+\gamma_t))}{\theta_t+\mu_t+\sigma+\gamma_t} ln(D_{i,0})$$

where the K_0, K_I and K_P terms reflect terms that are constant across neighborhoods. Amenities (α_i) positively predict prices and building. Local permiting difficulty (ρ_i) predicts higher prices and less building.

If we look across neighborhoods with a common value of $D_{i,0}$ and a positive level of construction, and if we assume that both $ln(\alpha_i)$ and $ln(\rho_i)$ are mean zero, then the univariate coefficient if $ln\left(\frac{D_i}{D_{i,0}}\right)$ is regressed on $ln(P_H)$ will equal:

$$(3)\ \frac{(\theta_t+\mu_t)Var(ln(\alpha_i))-(\sigma+\gamma_t)Var(ln(\rho_i))+(\sigma+\gamma_t-\theta_t-\mu_t)Cov(ln(\rho_i),ln(\alpha_i))}{(\theta_t+\mu_t)^2 Var(ln(\alpha_i))+(\sigma+\gamma_t)^2 Var(ln(\rho_i))+2(\theta_t+\mu_t)(\sigma+\gamma_t)Cov(ln(\alpha_i),ln(\rho_i))}.$$

This will only recover the "true" housing supply elastcity $\frac{1}{\theta_t+\mu_t}$ when the variance of ln(ρ_i)=0. If the two local shocks are orthogonal to one another (which seems unlikely to us), then the coefficient will be positive if and only if $Var(ln(\alpha_i)) > \frac{\sigma+\gamma_t}{\theta_t+\mu_t} Var(ln(\rho_i))$ or the variation in amenities is larger than the variance in the difficulty of getting approvals. If opposition to building has risen in some areas more than others, then $Var(ln(\rho_i))$ will have increased, which implies that the estimated coefficient when building is regressed on price should decline.

Similarly, the univariate coefficient if growth in density is regressed on initial density levels will be estimated by:

$$(4)\ \frac{1}{\theta_t+\mu_t+\sigma+\gamma_t}\left(\frac{Cov\Big((ln(\alpha_i),ln\big(D_{i,0}\big)\Big)}{Var\Big(ln\big(D_{i,0}\big)\Big)}-\frac{Cov\Big((ln(\rho_i),ln\big(D_{i,0}\big)\Big)}{Var\Big(ln\big(D_{i,0}\big)\Big)}-(\sigma+\gamma_t+\theta_t)\right).$$

The $\sigma+\gamma_t+\theta_t$ are the "structural" terms linking density and new construction, which sums together a preference term for density (γ_t), a preference term for land (σ), and the adverse impact of density on permitting (θ_t). The $Cov\Big((ln(\alpha_i), ln\big(D_{i,0}\big)\Big)$ term can be positive, if there was more historic building in nicer places, or negative if older dense areas are locating near current or past polluting industries or if they have just become run down.

We are particularly interested in $Cov\Big((ln(\rho_i), ln\big(D_{i,0}\big)\Big)$, which captures the link between density and the permitting environment. If places with less opposition to growth acquire more density over time, then this term will be negative and increase the estimated coefficient of growth on density. If the variance of $ln(\rho_i)$ increases over time, then we expect to see that the coefficient between initial density and growth will either get closer to zero or become positive because the positive correlation between density and the ease of building will become more important.[29]

III.A. Instrumental Variables

In the analysis that follows, we typically instrument for current prices with either lagged prices or geographic variation (such as distance to the central business district) or both. We do not know of any cross-sectional instrument that is correlated with α_i and not ρ_i, or correlated with ρ_i and not α_i, partially because amenities will shape the demographic composition of a neighborhood and the demographic composition of the neighborhood will determine the difficulty of permitting. The fact that both variables enter both equations makes the estimation of housing supply curves inherently challenging. Baum-Snow and Han (2023) solve this by focusing on a relatively short horizon (such as 2000 to 2006) and assume that shocks to labor demand will increase the demand for housing over the period without materially impacting the supply of housing.

[29] Glaeser and Ward (2009) report a strong positive correlation between building and initial density levels across towns in Greater Boston, which is compatible with that view that higher density areas have lower values of $ln(\rho_i)$.

To see this, we sketch a version of the model with two groups of people, which we label H- and L-types, which have different marginal utilities of cash and reservation locations. The L-types have a marginal utility of income equal to 1, while H-types have a marginal utility of income equal to $\frac{1}{\theta} < 1$. The reservation community for the L-types costs nothing and provides no housing-related welfare, hence they are willing to pay $\frac{\alpha_i D_i^{-\sigma-\gamma_t}}{r}$ to live in neighborhood i. The reservation community for the H-types costs P_H and provides housing related welfare of H_H, and hence the willingness to pay for any other community satisfies $\frac{\alpha_i D_i^{-\sigma-\gamma_t}}{r} - \frac{P_i}{\theta} = H_H - \frac{P_H}{\theta}$ so $P_i = P_H + \theta\left(\frac{\alpha_i D_i^{-\sigma-\gamma_t}}{r} - H_H\right)$. Moreover, we assume that ρ_i gets multiplied by $\vartheta > 1$ if the community is occupied entirely by H-types rather than L-types, which will lead to flatter supply curves in H-type neighborhoods.. This assumption reflects the possibility that more skilled individuals are also more effective in using political and legal processes to block construction near them. The H-types could also dislike density more, which is suggested by Gyourko and McCulloch (2024).

At a point in time, when density is fixed, there will be a marginal community which satisfies $\alpha_i D_i^{-\sigma-\gamma_t} = \frac{r(P_H-\theta H_H)}{(1-\theta)}$, at which H- and L-types are willing to pay the same amount, and H-types will live in communities for which $\alpha_i D_i^{-\sigma-\gamma_t} > \frac{r(P_H-\theta H_H)}{(1-\theta)}$ and L-types will live in communities in which $\alpha_i D_i^{-\sigma-\gamma_t} < \frac{r(P_H-\theta H_H)}{(1-\theta)}$. Demand-related instrumental variables typically purport to be shocks to α_i, and a shock to α_i could convert the neighborhood from being a L-type neighborhood to being an H-type neighborhood. This shock will then shift the supply curve as well. Assuming that demand for the city is growing everywhere, the growth in housing in the shocked community can be lower than in those communities which were not shocked because the increase in demand is also associated with a downward shift in the supply elasticity.

Neighborhood change doesn't happen instantaneously and even after an area gentrifies, it can take time for the permitting culture to change. Consequently, there can be short run (e.g., under ten year) shocks to either demand or supply that can essentially satisfy the exclusion restriction, but we are skeptical about any longer term shocks.[30] Moreover, it is hard to think of

[30] Consider a longer-term version of the Baum-Snow and Han (2023) instrument, which focuses on hyper-local labor demand. A formerly working-class neighborhood is near an office complex specializing in a particular type of

any permanent attribute, whether distance to the central business district or elevation that will serve as a valid instrument for either demand or supply. An amenity that impacts the difficulty of building (as in Saiz, 2011) is likely to attract people who like less density. These people may oppose new development, thereby leading ρ_i to rise. Moreover, their presence may lead to endogenous local amenities causing α_i to rise, perhaps by attracting more prosperous people who find it easier to stop new projects.

In the work that follows, we will look at decadal shifts in the housing stock, between 1970 and 2020. We focus on the coefficients on both price and density and their shifts over time. We will refer to the estimated object as the "empirical housing supply." The model suggests that interpreting both coefficients is fraught, but a downward shift in the link between price and construction is likely to mean that the variance of $ln(\rho_i)$ has increased relative to the variance of $ln(\alpha_i)$. A decline in the measured price elasticity can also occur if the parameters θ_t and μ_t increase. We will not try to estimate those parameters separately, but we will refer to those equations when we interpret the empirical results that follow.

The density coefficient is also difficult to interpret because density can be correlated with either amenities or permissiveness of the permitting environment. Nonetheless, if the relationship between density and construction, holding price constant, gets less negative or positive, then we will interpret this as evidence supporting the increased importance of supply conditions, as suggested by equation (4).

IV. Changes in the Empirical Housing Supply Curve in Six Metropolitan Areas

We now turn to our estimation of the empirical housing supply curve in six metropolitan areas. We first discuss our methodology and then turn to the results.

IV.A. Estimating the Empirical Housing Supply Curve

For all six cities (and for all other markets used in analysis reported later in the paper), we use our 1970-based tract level data. We use density levels as reflected in total housing units per acre and median housing value in the tract. We look at the five decades for which we have our 1970-based tract-level data: 1970-1980, 1980-1990, 1990-2000, 2000-2010 and 2010-2020.

---

business services. Nation-wide employment in this type of business service soars, and demand for the neighborhood grows from knowledge workers. These knowledge workers move in and also start attending community meetings to oppose new projects. Over five years, only the α_i changes, but over longer periods both the α_i and the ρ_i go up.

Our first specification uses naïve OLS, which is estimated for each metropolitan area:

(5) $\Delta \log\left(density_{i,t+1}\right) = \alpha + \beta_1^t \log\left(price_{i,t+1}\right) + \beta_2^t \log\left(density_{i,t}\right) + \epsilon_{i,t}$

where *i* indexes the individual census tracts and *t* denotes the starting decade. Thus, if t=1970, then t+1=1980, so that $\Delta \log\left(density_{i,t+1}\right)$ = log($density_{i,1980}$)- log($density_{i,1970}$), with each subsequent decade defined analogously. This specification exactly follows the first part of the equality in equation (1). If we thought that we had instruments that correlated with demand (but not supply) in 1990 or 2000, then we would actually be able to interpret β_1^{1970} as $\frac{1}{\theta_t+\mu_t}$.

We utilize an instrumental variable strategy that will reduce some of the issues with (5), but still fail to identify the core theoretical supply elasticity, which is why we refer to them as empirical housing supply elasticities. Our instrumental variables equations have the following second stage where future price is instrumented with different variables:

(6)$\Delta \log\left(density_{i,t+1}\right) = \alpha + \lambda_1^t \log\left(\widehat{price_{i,t+1}}\right) + \lambda_2^t \log\left(density_{i,t}\right) + \epsilon_{i,t}$,

and where $\log\left(\widehat{price_{i,t+1}}\right)$ indicates that the coefficient on the logarithm of price at the end of the period is estimated using instrumental variables. In Tables 4 and 5, we report results with the following first stage:

(7) $\log\left(price_{i,t+1}\right) = \alpha + \delta_1 distance_i + \delta_2 distance_i^2 + \sum_{q=i}^{8} \delta_q I_q^{Loc} + \delta_4^t \log\left(price_{i,t}\right) + u_{i,t}$.

In this specification, the distance terms refer to the distance from the centroid of the metropolitan area's central tract. We have supplemented distance by subdividing the metropolitan area into eight octants, by drawing circles around the central tracts. The terms I_q^{Loc} are indicator values that take on a value of one if the tract is in a particular octant.[31] This approach relies on the fact that distance to the central business district can be an amenity. Particular geographic parts of the city may also have different amenity levels. Of course, particular parts of the city may also have more difficult building conditions, perhaps because they have higher amenity levels. Finally, we also use the initial period price as an instrument for price at the end of the period.

This is our primary specification, which reduces the downward bias in the supply curve elasticity that comes from the negative impact of new supply on price. But instrumenting for current price with lagged price is essentially equivalent to regressing housing supply growth on

[31] If zero degrees is a line due east from the centroid, then the octants include tracts that are between -22.5 degrees and 22.5 degrees, 22.5 degrees and 67.5 degrees and so forth. See Appendix Figure 3 for an example using the Atlanta metropolitan area.

the initial period price, and this still will not recover $\frac{1}{\theta_t+\mu_t}$ unless there is no variation across census tracts in the difficulty of building. The goal is to create a better first stage fit, and to reduce the direct impact of building on price. We now turn to our results for the six metropolitan areas.

IV.B. Empirical Housing Supply Curves across Six Metropolitan Areas

Tables 4 and 5 report our results across our six primary markets. Table 4 shows results for tracts that are within 10 miles of the metropolitan area, and Table 5 shows results that are further out. We think of the inner sample as capturing central city or urban tracts and the outer sample capturing suburban areas. Both tables show results from equation (6) with the first stage from equation (7), which uses both location controls and lagged price as instruments. Results for the naïve OLS and the two other IVs that used only price or location controls as instruments are available in Appendix Tables 6a and 6b. We discuss the price coefficients in both tables first and then conclude with an interpretation of the density coefficients.

The price coefficient declines over time for almost all cities in both time periods in both samples, and Appendix Tables 6.A and 6.B document that this pattern also holds for three other specifications (ordinary least squares, IV just using lagged price and IV just using geographic information). The only exceptions are in the close-in tracts in Atlanta and Detroit. Infill development appears to be particularly important in Atlanta. Detroit is losing housing within its urban core, and unsurprisingly, it is losing more housing where prices are lowest.

The change in new housing supply is most visible in the changing relationship between price and building among the suburban tracts. There used to be substantial building in high priced tracts more than 10 miles out during the 1970s, especially in Dallas and Phoenix, where our estimated price elasticities are 0.72 and 0.65 respectively. By the 2010s, that phenomenon had largely disappeared, and Table 5 reports price elasticities below 0.1 for all of the metropolitan areas. We estimated smaller elasticities in the 1970s for Atlanta and Miami (0.3 and 0.25 respectively), but in the 2010s, the estimated elasticities for both areas are not statistically distinct from zero. Appendix Table 6.B shows that in the three other specifications across all four cities, the supply elasticity in the 2010s is always less than one-fourth of the supply elasticity in the 1970s.

Table 4: Regression Tables of Delta Log All Unit Density on Initial Period Log Price for 6 CBSAs (Within 10 miles)

Coefficient	CBSA					
		1970	*1980*	*1990*	*2000*	*2010*
Log Price		0.089	0.178	0.127	0.112	0.146
Log Price SE		*(0.055)*	*(0.038)*	*(0.035)*	*(0.048)*	*(0.030)*
Density	Atlanta	-0.210	-0.024	-0.135	-0.115	0.005
Density SE		*(0.043)*	*(0.041)*	*(0.077)*	*(0.056)*	*(0.029)*
R2/Wald F		81.879	168.049	118.739	64.308	72.521
# Obs		167	167	164	160	146
Log Price		*0.232*	*0.059*	*0.081*	*0.006*	*0.017*
Log Price SE		(0.067)	(0.025)	(0.033)	(0.021)	(0.015)
Density	Dallas	*-0.243*	*-0.054*	*-0.149*	*-0.125*	*-0.005*
Density SE		(0.070)	(0.032)	(0.043)	(0.044)	(0.033)
R2/Wald F		157.176	311.531	216.836	222.305	296.882
# Obs		*200*	*197*	*194*	*192*	*181*
Log Price		0.147	0.106	0.048	0.076	-0.034
Log Price SE		*(0.043)*	*(0.045)*	*(0.022)*	*(0.048)*	*(0.024)*
Density	Miami	-0.015	-0.188	0.008	-0.012	-0.001
Density SE		(0.023)	(0.081)	(0.023)	(0.026)	(0.028)
R2/Wald F		*134.651*	*1418.405*	*684.530*	*230.400*	*373.123*
# Obs		108	107	106	104	99
Log Price		*0.363*	*0.137*	*0.052*	*0.102*	*0.035*
Log Price SE		(0.073)	(0.067)	(0.023)	(0.091)	(0.022)
Density	Phoenix	-0.325	-0.058	-0.067	-0.118	0.022
Density SE		*(0.048)*	*(0.051)*	*(0.045)*	*(0.070)*	*(0.033)*
R2/Wald F		130.835	89.320	166.686	97.381	117.984
# Obs		*158*	*156*	*154*	*154*	*148*
Log Price		0.100	0.019	-0.007	0.037	-0.006
Log Price SE		(0.015)	(0.017)	(0.010)	(0.022)	(0.008)
Density	Los Angeles	*-0.015*	*-0.005*	*-0.003*	*-0.094*	*-0.007*
Density SE		(0.015)	(0.019)	(0.008)	(0.032)	(0.006)
R2/Wald F		*252.782*	*476.234*	*177.365*	*232.059*	*255.320*
# Obs		636	630	618	608	583
Log Price		0.142	0.233	0.158	0.203	0.170
Log Price SE		(0.051)	(0.037)	(0.015)	(0.031)	(0.020)
Density	Detroit	-0.217	-0.097	0.006	-0.118	-0.030
Density SE		(0.044)	(0.042)	(0.015)	(0.046)	(0.027)
R2/Wald F		68.943	5845.502	242.008	114.861	101.992
# Obs		491	486	477	469	440

Notes: The results reported are from estimation of equation (6) in the text with the first stage from equation (7), which uses both location controls and lagged price as instruments. For each CBSA, the final row in the sub-panel corresponds to the *Kleibergen-Paap rk Wald F statistic* for the first stage regression.

Table 5: Regression Tables of Delta Log All Unit Density on Initial Period Log Price for 6 CBSAs (Outside 10 miles)

Coefficient	CBSA					
		1970	*1980*	*1990*	*2000*	*2010*
Log Price	Atlanta	0.298	0.325	0.183	0.053	0.021
Log Price SE		(0.155)	(0.111)	(0.076)	(0.040)	(0.017)
Density		-0.140	-0.151	-0.172	-0.192	-0.026
Density SE		(0.032)	(0.023)	(0.026)	(0.028)	(0.010)
R2/Wald F		24.122	24.561	167.542	109.818	173.212
# Obs		80	80	80	80	73
Log Price	Dallas	0.723	0.447	0.219	0.148	0.071
Log Price SE		(0.069)	(0.059)	(0.030)	(0.047)	(0.023)
Density		-0.151	-0.096	-0.067	-0.095	-0.044
Density SE		(0.014)	(0.010)	(0.006)	(0.012)	(0.007)
R2/Wald F		83.086	248.971	325.151	96.469	218.719
# Obs		337	336	335	331	291
Log Price	Miami	0.248	0.186	0.069	0.077	-0.000
Log Price SE		(0.076)	(0.041)	(0.028)	(0.051)	(0.015)
Density		-0.314	-0.150	-0.059	-0.069	-0.011
Density SE		(0.037)	(0.027)	(0.016)	(0.023)	(0.011)
R2/Wald F		102.356	82.662	218.729	92.932	224.072
# Obs		310	309	307	306	277
Log Price	Phoenix	0.645	0.434	0.263	-0.233	0.098
Log Price SE		(0.227)	(0.130)	(0.088)	(0.155)	(0.046)
Density		-0.194	-0.038	-0.057	-0.130	-0.034
Density SE		(0.055)	(0.019)	(0.016)	(0.043)	(0.013)
R2/Wald F		20849.441	3689.113	2280.118	1916.108	161.486
# Obs		74	72	72	72	62
Log Price	Los Angeles	0.169	0.012	0.008	-0.029	-0.030
Log Price SE		(0.030)	(0.019)	(0.010)	(0.014)	(0.009)
Density		-0.144	-0.081	-0.030	-0.045	-0.019
Density SE		(0.017)	(0.014)	(0.006)	(0.013)	(0.007)
R2/Wald F		249.445	267.250	277.753	327.195	263.673
# Obs		1245	1241	1236	1229	1188
Log Price	Detroit	0.201	0.102	0.055	0.088	0.041
Log Price SE		(0.044)	(0.025)	(0.027)	(0.035)	(0.011)
Density		-0.148	-0.060	-0.100	-0.051	-0.014
Density SE		(0.014)	(0.007)	(0.015)	(0.006)	(0.006)
R2/Wald F		128.880	996.375	516.773	162.663	335.172
# Obs		572	569	564	562	553

Notes: The results reported are from estimation of equation (6) in the text with first stage from equation (7), which uses both location controls and lagged price as instruments. For each CBSA, the final row in the sub-panel corresponds to the *Kleibergen-Paap rk Wald F statistic* for the first stage regression.

Figure 10 then plots the shifting empirical supply curves over time for the four sunbelt metros based on the regression results reported in Tables 4 and 5. The plotted lines depict the predicted housing supply as a function of price. Since these supply curves also depend on tract level density, we fix the density for each metropolitan area at the median tract level in that year. To make units comparable, the x-axis shows the log of price relative to the median price across the metropolitan area. Subtracting the area median is just adjusting the constant. We report predicted supply for (log) price-to-median tract price ratios that run from -0.5 to +0.5. Across each decade starting with the 1970s, there always are many cases within that domain range. The solid lines reflect the results for distant tracts and the dotted lines reflect the more central tracts. We report results for three decades: the 1970s, the 1990s and the 2010s.

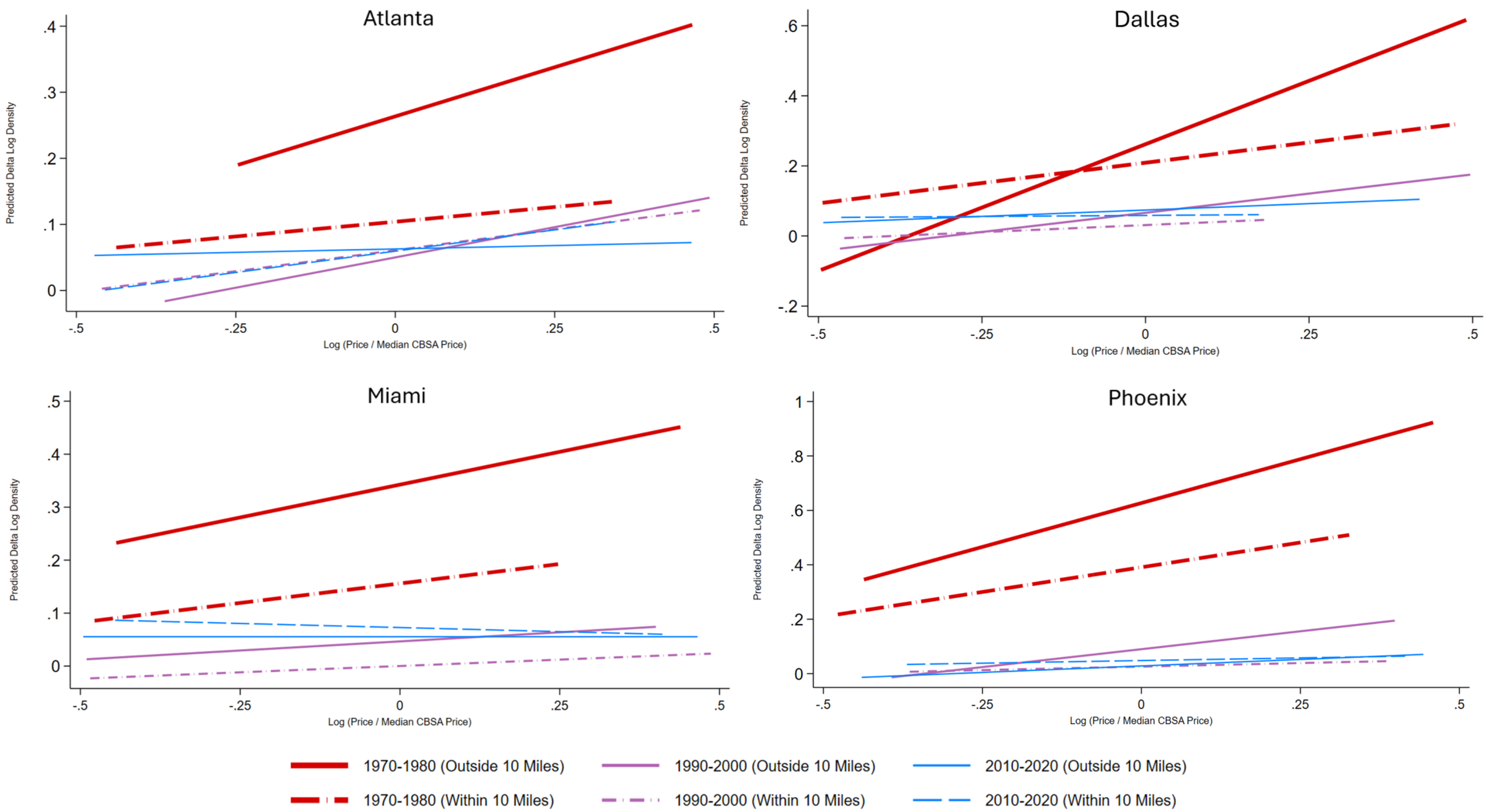
The pattern of results is quite similar across the four sunbelt markets. The empirical supply curve among suburban tracts in the 1970s (thick solid line) always is steeper than the supply curve for more central tracts (thick dotted line). Except for Dallas, the suburban line always is above the city line throughout our domain. In addition, the 1970s lines always are above those for the 1990s and 2010s. By the end of our data in the 2010s, the schedules have shifted down and flattened considerably, which is compatible with the decline in homebuilding discussed above. The lines for the 1990s show that this change began before the 2010s. High prices in the suburban parts of these metro areas no longer stimulate much new building, possibly because the residents of these areas have made it difficult to permit new projects.

Figure 11 reports the analogous results for Los Angeles and Detroit. The pattern for Los Angeles is similar to that for the sunbelt markets, but there is much less building, which is reflected in the narrow range of the y-axis and the supply function. Detroit does have a positive slope in more recent decades, but this represents not growth but decline, as shown by the negative values predicted for the 1990s and 2010s. The least valuable properties are abandoned first.

We now turn to the coefficients on density, which generally rise over time. In Table 4, the density coefficients among closer-in tracts are almost always negative and generally statistically significant in the 1970s and 1980s. In almost every case, the coefficients get closer to zero over time. Appendix Table 6.A shows the same pattern for our three other specifications. Table 5 and Appendix Table 6.B show that the same basic pattern is true in more distant tracts. The coefficients are almost always negative, and decline in magnitude over time.

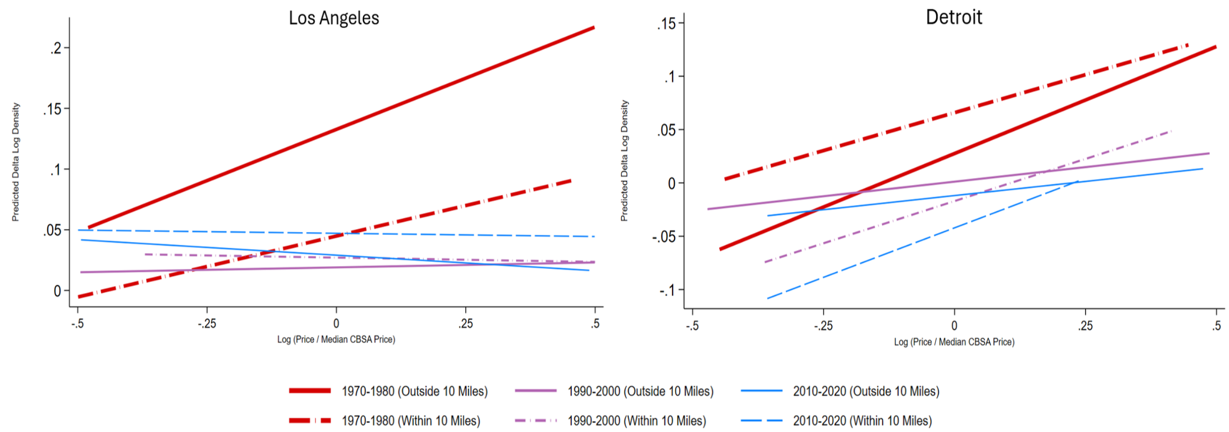
The negative coefficients indicate the higher density does limit building, which is consistent with a 'density wall' hypothesis, which posits that the supply slump reflects the fact America's suburbs are just running out of land. However, these coefficients are small and getting smaller. A coefficient of -0.25 (which is larger than all but two density coefficients reported in Tables 4 and 5) means that an enormous 50 percent increase in density is only associated with about a 12.5 percent reduction in the production of single unit housing.

Figure 10: Empirical Housing Supply Curves for 4 Sunbelt Markets



Note: Authors' calculations using the regression results from Tables 4 and 5. When computing predicted values, log all housing unit density is held constant at the CBSA-level median.

Figure 11: Empirical Housing Supply Curves for Los Angeles and Detroit



Note: Authors' calculations using the regression results from Tables 4 and 5. When computing predicted values, log all housing unit density is held constant at the CBSA-level median.

A coefficient of -0.05 (which is larger than any coefficient estimated for the 2010s) means that a 50 percent density increase would reduce construction by only 2.5 percent. While density does matter for construction, American housing supply is not declining primarily because we are hitting a density wall.

While these linear specifications yield important insights, we are also interested in potential interaction effects. To gain insight into their possible role, we turn from regression specifications to manipulation of tract-level density and price data. Initially, we assigned each tract into one of three price categories as well as one of four density categories.

The price bins are based on the tract's price-to-marginal physical costs of construction (MPPC) ratio defined above. We classify tracts as cheap (median price is less than 80 percent of MPPC), moderate (price is between 80 and 120 percent of MPPC), and expensive (price is at least 20 percent higher than MPPC). We also grouped tracts into four density bins: less than 0.5 housing units per acre, from 0.5 to 1.5 housing units per acre, from 1.5 to 2.5 housing units per acre, and tracts with more than 2.5 units per acre. There are 12 possible cells and cross-tabulation tables were created across all possible price-density categories for each decade from the 1970s through the 2010s for each metropolitan area.

For presentation purposes, we group the moderate and expensive tracts together and call them "high price." We also group the density bins together if they have below 1.5 units per acre or above 1.5 units per acre. Combining these two density and two price categories, we show the changes in building activity in Low Density/Low Price tracts, Low Density/High Price tracts, High Density/Low Price tracts, and High Density/High Price tracts over time in Table 6.

Increases in the share of housing units built in Low Density/Low Price tracts tend to be modest. This number has not risen substantially over time except in the Atlanta market and we see this as reflecting limited demand for frequently quite far off tracts.[32] Relatively low numbers of housing units are built in High Density/Low Price tracts, too, but these shares have typically risen over time, especially in the Los Angeles and Miami markets. In those cities, where demand is robust almost everywhere, it can be easier to add multifamily units in already dense, if not high value, tracts. This process is often associated with gentrification.

There is near universal decline in the amount of growth in high price, low density areas, both in absolute levels and as a share of total construction. It has become harder over time to build in low density, higher house price areas in major markets such as Atlanta (50 percentage point decline in share and a 69 percent decline in units built from the 1970s to the 2010s), Los Angeles (a 20 percentage point decline in share and an 81 percent decline in units built) and Miami (a 23 percentage point decline in share and a 92 percent decline in total units). The one major exception is Dallas, which is also unusual in building as much during the 2010s as it did in the 1980s. In the Phoenix market, the share of homes built in low density, high price areas has not declined but the actual number of units built in these areas was 30 percent lower in the 2010s than in the 1970s.[33] Detroit's growth was anemic in the 2010s, but what little there was occurred in high density, low cost areas.

Building in high cost, high density areas has increased as a share of total production in every city except for Los Angeles. Atlanta and Dallas are actually building more in the high density, high cost areas now than in the past, but in Atlanta's case, the new units are nowhere near enough to offset the reduced production in lower density areas. In Detroit, Miami, Phoenix and Los Angeles, production in high density, high cost areas is lower in absolute terms in the

[32] It also is the case that there was a relatively high share of production in these types of tracts in the 1970s (and only in the 1970s) in the Miami and Phoenix markets. The analogous share in the Dallas metro has hovered around 11-13 percent from the 1970s through the 2010s.

[33] We suspect absence of a decline in share reflects a cost of using our 1970-based tract boundaries. In Phoenix, what are now outlying suburbs were very large census tracts with low populations in 1970. They have seen much growth, especially in more recent decades. However, the acreage of these 1970-defined tracts is so large that they still are defined as low density by our metric. One possible implication is that any growing metro area which sees its share of building in low density, higher priced tracts not falling likely has physical capacity to continue growing its suburbs.

2010s than the 1970s, even though such building is a larger share of production. We interpret these results as suggesting that building everywhere has become more difficult, but the change is most dramatic in the pricier suburbs.

Table 6: New Housing Shares Over Time by Price and Density, 6 CBSAs

CBSA	Year	Total change in units	Low Density/Low Price	Low Density/ High Price	High Density/Low Price	High Density/ High Price
Atlanta	1970s	231,118	0.059	0.901	-0.004	0.044
	1980s	297,572	0.045	0.884	0.019	0.052
	1990s	258,881	0.046	0.860	0.001	0.093
	2000s	331,861	0.320	0.508	0.051	0.121
	2010s	164,869	0.204	0.395	0.053	0.347
Dallas	1970s	347,958	0.136	0.694	0.005	0.165
	1980s	389,433	0.126	0.674	0.020	0.180
	1990s	338,408	0.110	0.753	-0.002	0.139
	2000s	497,227	0.138	0.722	0.023	0.118
	2010s	444,406	0.136	0.570	0.041	0.252
Detroit	1970s	258,898	0.039	0.828	-0.005	0.138
	1980s	115,810	0.016	1.001	-0.247	0.229
	1990s	145,227	0.003	1.001	-0.171	0.167
	2000s	75,078	0.021	1.161	-0.397	0.215
	2010s	36,451	0.052	1.121	-0.696	0.523
Los Angeles	1970s	577,763	0.049	0.412	0.039	0.500
	1980s	453,678	0.082	0.359	0.166	0.394
	1990s	211,335	0.074	0.433	0.167	0.326
	2000s	188,100	0.145	0.413	0.186	0.256
	2010s	231,359	0.057	0.196	0.278	0.470
Miami	1970s	595,427	0.238	0.444	0.083	0.236
	1980s	416,262	0.039	0.654	0.055	0.252
	1990s	299,419	0.051	0.596	0.099	0.253
	2000s	275,001	0.091	0.267	0.170	0.472
	2010s	179,585	0.064	0.121	0.262	0.552
Phoenix	1970s	286,947	0.178	0.627	0.046	0.149
	1980s	292,202	0.060	0.637	0.044	0.259
	1990s	300,577	0.014	0.817	0.011	0.159
	2000s	378,479	0.075	0.775	0.030	0.119
	2010s	177,490	0.027	0.696	0.063	0.214

Notes: Low Density tracts are defined as those with less than 1.5 units per acre, while High Density tracts have more than 1.5 units per acre. Low Price tracts are defined as those whose median price is less than 80% of the CBSA-level mean house price. High Price tracts are those whose median price is 80%+ of the CBSA median. See Appendix Table 7 for results on the other 18 markets we track throughout the paper.

V. Changes in the Empirical Housing Supply Curve across the U.S.

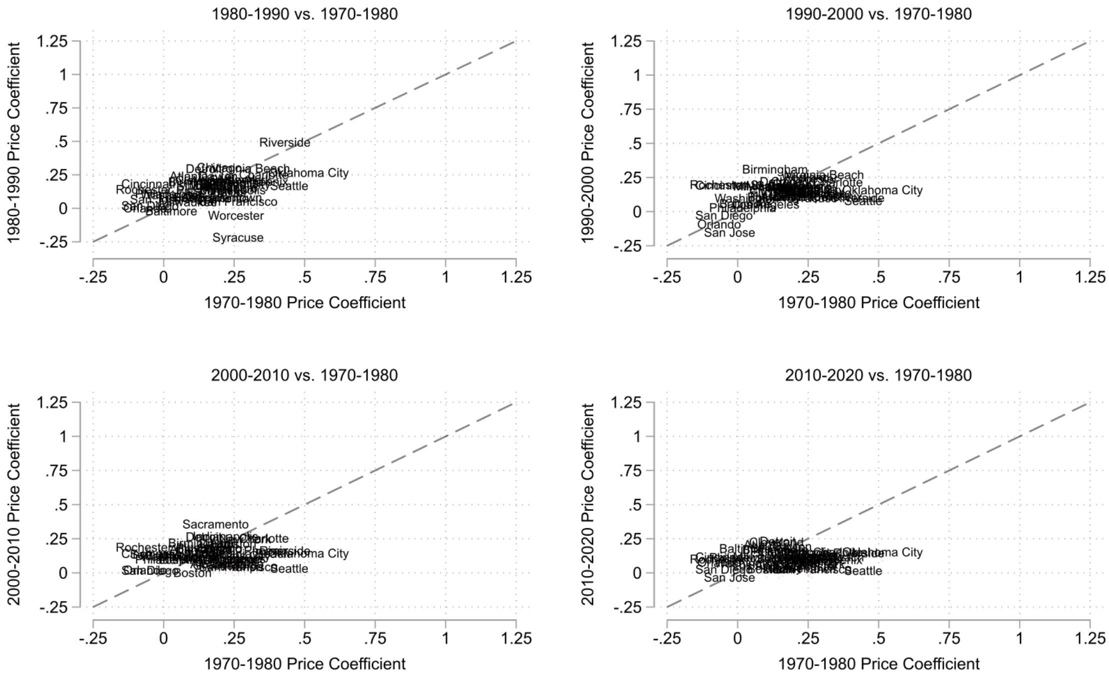
We now turn to our results for a broader set of 44 large metropolitan areas listed in Appendix Table 8. This sample again begins with the 50 largest metropolitan areas, but also requires at least 70 percent of the area's population to be covered in each decade by 1970-defined tract areas, and for the area to have at least 50 tracts both within and beyond 10 miles of the urban core for us to credibly use both location controls and lagged price as instruments.

Figures 12 and 13 each present four plots of the price elasticity coefficients from metropolitan areas, with each plot comparing the coefficients from the 1970s decadal estimations to those from the 1980s, 1990s, 2000s and 2010s. Each comparison uses instrumental variable results using both lagged price and geographic variables as instruments as described above. The 1970-80 estimated coefficient always is reported on the horizontal-axis, with the other decade's coefficient on the vertical-axis. The dotted lines represent the 45-degree line (not fitted values) so a market above that line had a higher estimated price coefficient for a later decade than it did in the 1970s.

The vast majority of markets are below the 45-degree line, especially among the tracts more than 10 miles out (Figure 13). For the tracts within 10 miles of the urban core depicted in Figure 12, only 13 markets are above the 45 degree line in the 1980s, 8 in the 1990s, 12 in the 2000s and 9 in the 2010s. Among the farther out tracts more than 10 miles beyond the core, there never are more than 8 metros above the 45 degree line in any of the plots. The major difference between the inner and outer areas is that the supply elasticities were much higher in the 1970s in the outer areas, which provided much more room to go down. Price elasticities fell over time in most American housing markets, especially in outlying census tracts far from the urban core, not just in the six focal areas tracked throughout our paper.

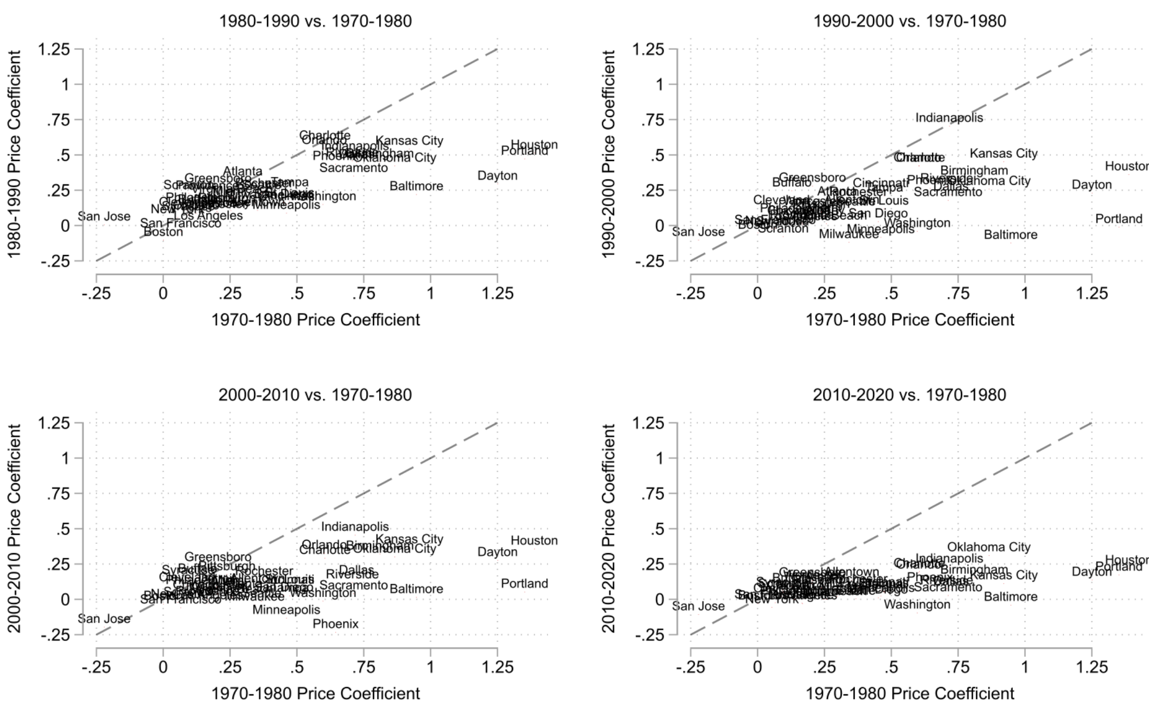
Figures 14 and 15 report the analogous plots using the density coefficients. As with our six focal markets, density coefficients for this broader sample of metro areas almost always are negative. Most markets are above the 45 degree line, indicating that the density coefficients generally rose (i.e., became less negative) over time. For tracts within 10 miles of the metro core, 12 markets are below the 45 degree line in the 1980s , 8 in the 1990s, 10 in the 2000s comparison and none in the 2010s versus 1970s comparison. Among tracts more than 10 miles out, there never are more than 4 markets below the 45 degree lines in any cross-decade comparison. The negative correlation between density and growth has diminished or reversed across America, not just in our six focal markets. These facts are compatible with the view that unobserved heterogeneity in supply conditions increasingly determine where America builds.

Figure 12: Changes in Price Coefficients Over Time, All Housing Unit Sample, Tracts Within 10 Miles of the Metro Center



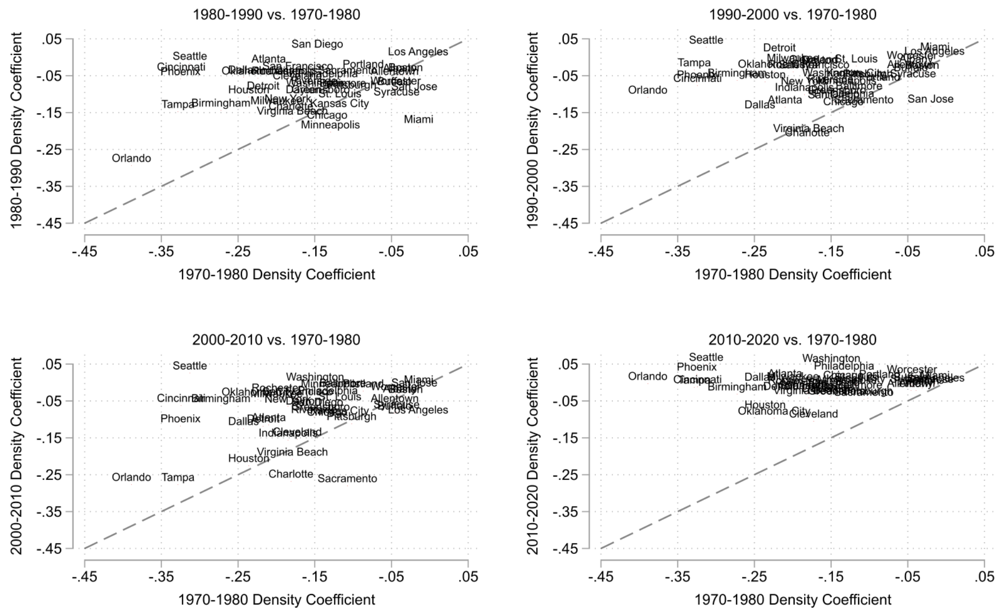
Note: Authors' calculations are described in text.

Figure 13: Changes in Price Coefficients Over Time, All Housing Unit Sample, Tracts>10 Miles from the Metro Center



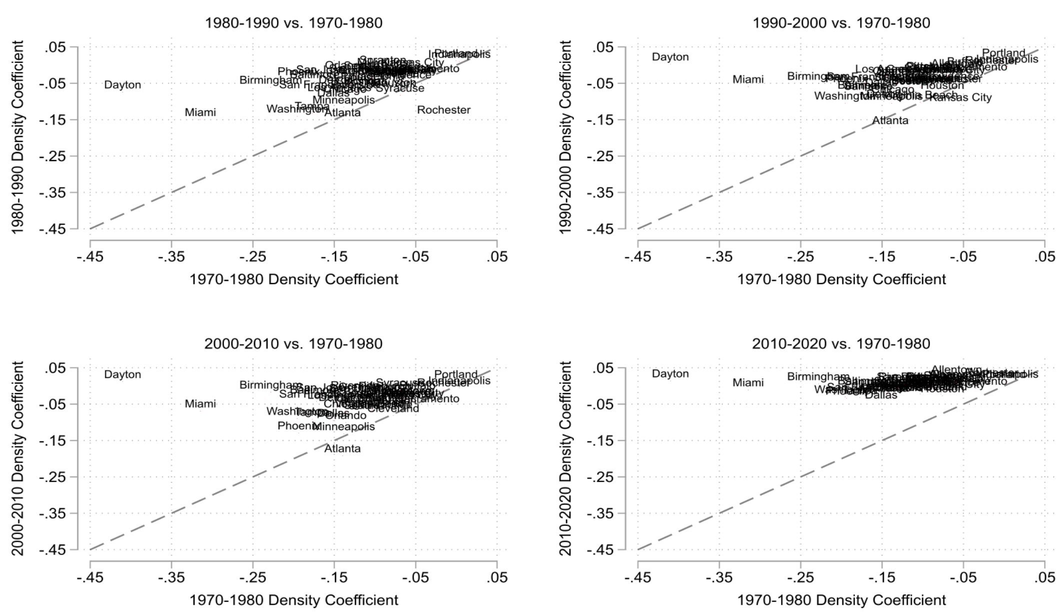
Note: Authors' calculations are described in text.

Figure 14: Changes in Density Coefficients Over Time, All Housing Unit Sample, Tracts Within 10 Miles of the Metro Center



Note: Authors' calculations are described in text.

Figure 15: Changes in Density Coefficients Over Time, All Housing Unit Sample, Tracts > 10 Miles from the Metro Center



Note: Authors' calculations are described in text.

Our last empirical exercise is to regress the current decade's price elasticity on the previous decade's price coefficient using our primary IV specification's coefficient estimates from each decadal period on the previous decades' price coefficient[34] and three other variables: the Wharton Residential Land Use Regulation Index (WRLURI), the share with a college degree at the start of the previous decade, and the average change in density in the CBSA over the decadal period. For this final exercise, we run these specifications at the CBSA level, where *c* denotes a CBSA, and *t* denotes the decade in the equations below.[35]

Table 7 reports the results from estimating the following equations.

(8a) $\widehat{\lambda_{1,c}^{t+1}} = \alpha + \psi_{1,c}^{t}(\widehat{\lambda_{1,c}^{t}}) + WRLURI_c + u_c.$

(8b) $\widehat{\lambda_{1,c}^{t+1}} = \alpha + \psi_{1,c}^{t}(\widehat{\lambda_{1,c}^{t}}) + \overline{share\ educated_{t,c}} + u_c$, and

(8c) $\widehat{\lambda_{1,c}^{t+1}} = \alpha + \psi_{1,c}^{t}(\widehat{\lambda_{1,c}^{t}}) + \overline{\Delta log\ (density_{t+1})}_c + u_c,$

As expected, the estimated ψ's are positive. These coefficients are lowest in the last column that regresses the 2010s on the 2000s, which is consistent with the general decline in building intensity after the GFC. The estimated coefficient on the Wharton index is always negative and at least weakly significant. This is not always the case for the other two variables, but the coefficients on education are always negative. The coefficients on density are generally insignificant and switch signs.

Table 7: Regressing Decadal Price Elasticity on Previous Decade Price Elasticity and Covariates, All Units

Coefficients	Decadal Specifications			
(a) *WRLURI*	*(1980 on 1970)*	*(1990 on 1980)*	*(2000 on 1990)*	*(2010 on 2000)*
$\psi_{1,c}^{t}$	0.279	0.394	0.459	0.147
	(0.042)	*(0.070)*	*(0.088)*	*(0.094)*
WRLURI	-0.047	-0.067	-0.045	-0.058
	(0.026)	*(0.021)*	*(0.020)*	*(0.020)*
(b) *Share Educated*	*(1980 on 1970)*	*(1990 on 1980)*	*(2000 on 1990)*	*(2010 on 2000)*
$\psi_{1,c}^{t}$	0.301	0.419	0.509	0.234
	(0.041)	*(0.072)*	*(0.086)*	*(0.093)*
$\overline{share\ educated_{t,c}}$	-0.741	-0.464	-0.235	-0.222
	(0.257)	*(0.216)*	*(0.202(*	*(0.200)*
(c) *Lagged Density*	*(1980 on 1970)*	*(1990 on 1980)*	*(2000 on 1990)*	*(2010 on 2000)*
$\psi_{1,c}^{t}$	0.289	0.485	0.544	0.298
	(0.050)	*(0.074)*	*(0.082)*	*(0.089)*
$\overline{\Delta log\ (density_{t+1})_c}$	-0.003	-0.219	-0.168	0.292
	(0.093)	*(0.112)*	*(0.142)*	*(0.129)*

Note: The reported results are taken from estimations of equations 8a, 8b, and 8c as described in the text.

[34] For example, we regress $(\widehat{\lambda_{1,c}^{1980}})$ on $(\widehat{\lambda_{1,c}^{1970}})$ from equation (6). Then, we roll through the decadal pairs regressing $(\widehat{\lambda_{1,c}^{1990}})$ on $(\widehat{\lambda_{1,c}^{1980}})$, $(\widehat{\lambda_{1,c}^{2000}})$ on $(\widehat{\lambda_{1,c}^{1990}})$, and finally $(\widehat{\lambda_{1,c}^{2010}})$ on $(\widehat{\lambda_{1,c}^{2000}})$. These are the columns of Table 7.

[35] That is, we do not disaggregate tracts within a CBSA into those within and beyond 10 miles of the metro center. This allows us to use more markets in the regression analysis (82 instead of 44). Standard errors are in parentheses.

VI. Conclusion

The supply curve for new housing in America has shifted dramatically over the last fifty years. Real, constant-quality prices are at historically high levels in many major markets, most notably in sunbelt areas, such as Miami, Tampa-St. Petersburg, Phoenix and Atlanta. Building levels have declined dramatically, especially in higher price, lower density areas. The positive correlation between price and construction and the negative correlation between density and construction have both attenuated in recent decades. These facts are compatible with the view that local barriers to construction increasing determine where America grows.

While some short-term factors surely contributed to today's high housing costs, including Covid's impact on supply chains and increasing interest rates which lowered the supply of older homes because of the mortgage lock-in effect, this paper argues that the genesis of today's high housing prices lies further back in time. Real construction costs have risen by about one-third since the turn of the century, which is important, but can explain only a fraction of today's prices in many markets. The GFC damaged the construction sector, but supply started to shift downwards before 2006.

We have not estimated the demand elasticities that would be necessary to know what prices would be if construction rose to 1970s levels, but if the housing stock had grown by the same rate between 2000 and 2020 that it did between 1980 and 2000, then America would have 15 million more housing units. The key driver appears to be that the intensity of housing production has dropped substantially over time, especially in many expanding sunbelt markets that were once housing production superstars. More generally, there is a marked convergence in the pace of housing unit production across markets throughout the country: Miami has become far more like Los Angeles.

There has been a significant flattening of the empirical housing supply curve in these places. Our inelastic coastal markets already experienced this by 1990, because in these places, supply conditions have long driven new construction more than demand in those places. Within metropolitan areas, we now build less in the highest demand neighborhoods, just as we have long built less in the highest demand metropolitan areas. There is dramatically less building, especially in low density, higher price census tracts. The suburban frontier seems to be closing in some of our largest, and previously fastest growing markets. The negative relationship between density and the construction of housing has also attenuated or reversed, which is also compatible with the increasing importance of supply conditions.

To us, this suggests that American housing markets increasingly follow the model put forth by Mancur Olsen (1982). In his view, insiders increasingly use regulations to protect their own rents and keep outsiders out. If existing homeowners in high price areas have become better at controlling land use regulations and stopping new construction, then we should expect to see a decreasing link between high prices and new construction, which is exactly what the data shows.

VII. Selected References

Baum-Snow, Nathaniel (2023). "Constraints on City and Neighborhood Growth: The Central Role of Housing Supply", *Journal of Economic Perspectives*, 37(2): 53-74.

Baum-Snow, Nathaniel and Gilles Duranton (2025). "Housing Supply and Housing Affordability", mimeo.

Baum-Snow, Nathaniel and Lu Han (2024). "The Microgeography of Housing Supply", *Journal of Political Economy*, 132(6): 1793-2178.

D'Amico, Leonardo, Edward L. Glaeser, Joseph Gyourko, William Kerr and Giacomo A. M. Ponzetto, (2024). "Why Has Construction Productivity Stagnated? The Role of Land Use Regulation", NBER Working Paper 33188, November 2024.

Glaeser, Edward and Joseph Gyourko (2005). "Urban Decline and Durable Housing", *Journal of Political Economy*, 113(2): 345-375.

Glaeser, Edward and Joseph Gyourko, (2018). "The Economic Implications of Housing Supply", *Journal of Economic Perspectives*, 32(1): 3-30.

Glaeser, Edward, Joseph Gyourko and Albert Saiz (2008). "Housing Supply and Housing Bubbles", *Journal of Urban Economics*, 64(2): 198-217.

Glaeser, Edward, Joseph Gyourko and Raven Saks (2005). "Why Have Housing Prices Gone Up?", *American Economic Review*, 95(2): 329-333.

Glaeser, Edward and Bryce Ward (2009). "The Causes and Consequences of Land Use Regulation", *Journal of Urban Economics*, 65(3): 265-278.

Goolsbee, Austan and Chad Syverson (2023). "The Strange and Awful Path of Productivity in the U.S. Construction Sector", Working Paper 2023-04. University of Chicago, Becker-Friedman Institute for Economics.

Gyourko, Joseph and Raven Molloy. (2015). "Regulation and Housing Supply", Chapter 19 in

Handbook of Regional and Urban Economics, edited by J. Vernon Henderson, Gilles Duranton and William Strange, 5:1289-1337.

Gyourko, Joseph and Sean McCulloch (2024). "The Distaste for Density", NBER Working Paper No. 33078.

Gyourko, Joseph and Albert Saiz (2006). "Construction Costs and the Supply of Housing Structure", *Journal of Regional Science*, 46(4): 661-680.

Logan, John, Zengwang Xu and Brian J. Stults. (2014). "Interpolating U.S. Decennial Census Tract Data from as Early as 1970 to 2010: A Longitudinal Tract Database", *The Professionial Geographer*, 66(3): 412-420.

Molloy, Raven, Charles G. Nathanson and Andrew Paciorek (2022). "Housing Supply and Affordability: Evidence from Rents, Housing Consumption, and Household Location", *Journal of Urban Economics*, 129(May): 1-21.

Olsen, Mancur. (1982). *The Rise and Decline of Nations*. Yale University Press: New Haven, CT.

Orlando, Anthony W. and Christian L. Redfearn (2024). "Houston: You Have a Problem: How Large Cities Accommodate More Housing", *Real Estate Economics*, 52(4): 1045-1074.

Saiz, Albert (2010). "The Geographic Determinants of Housing Supply", *Quarterly Journal of Economics*, 125(3): 1253-1296.

Schuyler, Louie, Mondragon, John and Jonathen Weiland (2025). "Supply Constraints Do Not Explain House Price and Quantity Growth Across U.S. Cities," *National Bureau of Economic Research* Working Paper # 33576.

Topel, Robert and Sherwin Rosen (1988). "Housing Investment in the United States", *Journal of Political Economy*, 96(4): 718-740.