

Feedback between Real Estate and Urban Economics

Todd Sinai
The Wharton School
University of Pennsylvania
and NBER

September 9, 2009

Abstract: This paper considers the implications of increasing land supply constraints in the U.S. on urban demand. First, because shifts in demand are now capitalized more into the price of land, house prices in some metropolitan areas have grown increasingly unaffordable to typical households. This might have an effect on the fundamental character of such cities. Second, the effect of home owners' financial interests as landowners on their decisions of about what regulations or investments in their communities to support may become stronger. Third, researchers may now be able to better use land prices to make inferences about urban demand. However, interpreting real estate prices is still tricky.

This paper was prepared for the Symposium in honor of the 50th Anniversary of the *Journal of Regional Science*. I am grateful to the Research Sponsors Program of the Zell-Lurie Real Estate Center at Wharton for research support and to Gilles Duranton, Joseph Gyourko, and Grace Wong for their helpful comments.

Characterizing the intersection of real estate finance and economics and urban economics turns out to be a not particularly straightforward thing. That perhaps should not come as a surprise, since neither field has a tidy definition, all wrapped up with crisp edges and neat corners, plus a bow for good measure. Instead, urban economics is broadly concerned with the study of cities and real estate is broadly concerned with the study of commercial and residential property. Since most of the world's real estate value is in cities, it is natural that the fields overlap considerably and somewhat surprising that they are not more fully integrated.

Indeed, those who study real estate and those who study urban economics are interested in many of the same phenomena. For example: Patterns of agglomeration – with households choosing to live in close proximity to other households, or firms choosing to locate their operations near other firms – and how that agglomeration might evolve over time. Urban growth – and where it might occur, and by how much. Incomes – and how they differ across space.

However, those who have focused on real estate and those who have focused on urban economics often have come at these topics from disparate points of view. To real estate practitioners real estate is an *input* to some broader goal. To some, real estate is an investment, an asset that one acquires to in order to produce a financial return. For their calculus, what matters is real estate's income earning potential – its rent – and its current and future prices. To others, real estate is a factor of production, akin to capital or labor, necessary for the operation of an enterprise. They tend to focus on the cost of obtaining real estate. By contrast, to urban economists, real estate is an *output* of a more general underlying process. The same forces that lead to the formation of cities make particular locations valuable.

These two viewpoints intersect via the market for land. One can think of urban economics as being in part about what affects the demand for particular locations. An

agglomeration economy, where a firm's productivity is determined in part by its proximity to other firms, is one example of such a demand shifter. Firms would have greater demand to locate near existing firms if there were positive spillovers to doing so. City amenities, such as weather or art museums, are other examples. When locations with such amenities are scarce, land commands rents. On the real estate side, the financial market transforms current and expected future rents into asset prices for the locations.

Because of this interconnectedness between real estate and urban economics, it is interesting to think of the implications of urban economics for real estate and vice versa. In this paper, I emphasize the role of land prices and ponder how rising prices could reinforce or deter the demand for certain locations that led to the price growth in the first place. I begin by discussing a necessary condition for growth in the price of land: Inelastic supply. Because supply constraints in the U.S. have increased, shifts in demand may be more capitalized into the price of land than in the past. This has several interesting implications. First, the price of real estate, relative to the national income distribution, has increased in some metropolitan areas over the very long run. For example, houses in some metropolitan areas, especially those on the west coast of the U.S., have slowly grown unaffordable to all but the highest-income decile or so of the national income distribution. I then discuss what this phenomenon might imply for the future of cities, given existing hypotheses about the determinants of urban growth. Second, when residents own real estate in an area where land is inelastically supplied, their decisions about what regulations or investments in their communities to support may be affected by their financial interest in obtaining a higher value for their location. Third, real estate prices may help researchers make inferences about urban demand. However, using them is tricky. Prices convey information, but the signal is somewhat noisy. For one, the extent of price capitalization is

determined by the elasticity of supply of land, which has been changing over time and across cities in the U.S. In addition, while real estate rents are determined by the supply and demand for space, we typically observe only real estate prices. Changes in those prices result not only from supply and demand fundamentals, but from other factors that influence the asset market, such as interest rates and the expectations of future growth.

The rest of this paper proceeds as follows: I first present how urban economics can be thought of as demand for a location and how the elasticity of land supply translates the demand into land prices. The evolution of the land supply elasticity over time is described. Next, I explore metropolitan area house prices between 1950 and 2000 and compare them to the national income distribution. I outline some potential implications of rapidly-growing house prices. In Section 3, I discuss why it might matter if households are real estate owners as well as users. Section 4 considers the role of asset market equilibrium in setting real estate prices and the difficulties in using them for inferences in empirical work. Lastly, Section 5 concludes.

1. USING REAL ESTATE RENTS AS A MEASURE OF URBAN DEMAND

A large portion of urban economics is concerned with the demand for urban location: Why is it that both firms and households locate in close proximity to other firms and households in cities? There are a number of potential reasons and, in all likelihood, all have held to some degree or at some point in time. Firms might wish to locate near other firms because of returns to agglomeration, whether through lower-cost transportation of goods and services between them, knowledge spillovers amongst them, or by having access to a thick pool of labor that accumulates around a large concentration of employers. Households might wish to live near other households because they enjoy them, or because it takes a sufficiently large concentration

of residents to make it profitable for firms to provide locally the goods and services, and governments to provide public amenities, that the residents want. Once those amenities are in place, the location would be more valuable to the marginal household.

One can search for evidence of these factors along a number of dimensions. A large strand of the literature tests whether firms are more productive when they have agglomerated by looking at measures of output. Another strand concentrates on the implication for workers: if cities are more productive, workers should receive higher wages. Other research considers firm locations. And yet another set of papers examine city growth: If there is a benefit to agglomeration, cities should expand in population and the number of firms, at least until the city becomes so large that it becomes too congested, unwieldy, and inefficient to administer.¹

However, if there is a benefit to a particular location – for whatever reason – the value may be in part capitalized into the price of the land. Demand for a type of location can manifest itself in two ways: in higher land rents and in greater supply. How much of the benefit is incorporated into the land rent depends upon the elasticity of supply of land that is substitutable for that particular location. (One unique location, of course, is perfectly inelastic, except to the degree that more uses can be put onto the same parcel by increasing the density.) If land supply is very elastic, little of the benefit will be reflected in the land rent as long as property prices exceed the cost of construction. Instead, if property values rise above construction costs, developers will simply add more ‘city’ to the existing stock until prices (and rents) fall to the level where it is no longer profitable to build. By contrast, if land supply is very inelastic, the city cannot expand, developers cannot build, and the benefits of location are capitalized into land rents.

That static process can be seen in a basic demand-supply framework, as in Figure 1, which plots demand and supply curves in rent-quantity space. An inelastic supply curve for urban locations is depicted with the S' supply curve whereas the S supply curve is more elastic. Where the demand curve for urban locations, D , intersects the supply curve is the clearing price, where all urban space is just filled. That price, C , is the rent, or the periodic cost of using a particular space. Suppose the demand curve for urban locations shifts out, to D' . If land is inelastically supplied, an increase in demand is capitalized fully into price, as rents rise from C to A . If land is more elastically supplied, the same increase in demand leads to a smaller increase in rents (from C to B).²

The degree of capitalization into land rents is important for empirical research in real estate or urban economics because it affects *where* and *how much* the symptoms of urban demand show up. Many common measures of urban demand, such as population growth, are affected by the elasticity of land supply. For example, consider an outward shift of the demand curve. That demand shift will be manifested in city growth and, eventually, a larger city if supply is perfectly elastic. As an empirical researcher, one could thus infer that demand for a city increased if the city grew. However, the same demand shock would be reflected solely in rents, with no city growth at all, if supply is perfectly inelastic. And, if the elasticity of supply is in between, some of the greater demand would appear in city growth and some in rent.

The flip side of this particular coin is that land rents themselves, if used carefully, could also provide information about the extent of urban demand. Greater demand translates into higher rent, *ceteris paribus*. And since rents are expressed in dollars, the increment in rent from higher demand, assuming supply is inelastic, can be interpreted as the value of whatever factors are inducing that higher demand.

A large set of empirical papers have used land prices to assign values to some feature of the urban economy. This capitalization strategy can be applied whenever the feature of value has a spatial component to its distribution. Papers that follow a Rosen (1979) and Roback (1982) view of spatial equilibrium, which theorizes that agents must trade off wages, land rents, and local amenities when choosing between cities, such as Blomquist, Berger, and Hoehn (1988) or Gyourko and Tracy (1989, 1991), have long found that differences in amenity levels or public finance across jurisdictions are capitalized into land rents and wages. Amenities, such as quality-of-life or efficient government, are frequently tied to a geographical location or a political jurisdiction. Thus people should be willing to pay a real estate premium or accept a lower wage to live in those jurisdictions. For example, Black (1999) estimates the value of better schools by seeing how much higher house prices are when the houses are located in the catchment area of a school with better test scores.³ Researchers in environmental economics have long estimated the cost of some environmental negative – a toxic waste dump, perhaps – by measuring how much less land is worth when it is in closer proximity to it. (Gallagher and Greenstone, 2008) Productivity, too, can be capitalized into real estate values when location affects output. Greenstone and Moretti (2004) estimate the value of productivity spillovers by seeing how much land prices rise when a firm chooses to locate in a particular area.⁴ If that firm provides positive externalities, the premium others would be willing to pay to locate close to it should go up, leading to higher land values. Van Nieuwerburg and Weil (2007) examine the relationship between local productivity shocks and the distribution of house prices.

While land rents can convey significant information about the demand for locations, interpreting that information can be difficult for at least two reasons. First, true rent is often difficult to observe. While the theoretical rent is a spot price, in practice rents that are paid are

often specified in a multi-year contract signed years earlier and which may not reflect current market conditions. In addition, when it comes to housing, renter households tend to be quite different than owner households and thus one cannot easily extrapolate from rent paid by renters to the rent that would be paid by owners were they to pay rent. (Smith and Smith, 2006)

Instead, we are much more likely to observe the price paid by a purchaser of property. (We will discuss the particular issues that arise when one observes prices rather than rents in empirical work in Section 4, below.)

Second, most research that studies the effect of something on land rents or prices assumes that land supply in an area or jurisdiction is perfectly inelastically supplied. Sometimes the assumption of a vertical supply curve is appropriate. But much of the time, it is not. Complicating the matter, the supply elasticity varies not only across jurisdictions, but over time within jurisdictions, and even can differ depending on the initial land value.

A series of recent papers have noted that an important component of why house prices vary across metropolitan areas have to do with differences in the elasticity of supply. The reasons for these cross-sectional differences in supply elasticity are varied. Saiz (2008) shows that the topography of an area is one factor. When much of a metropolitan area's footprint is steeply sloped or under water, it is more expensive to build new structures, leading to a lower elasticity of supply. Gyourko and Saiz (2006) point out that construction costs, too, vary considerably across metropolitan areas. While geographic constraints on construction do not change over time, how binding they are may vary considerably. As cities grow, eventually they may exhaust their easily-developable land. For example, the remaining land might be costly to develop or less desirable leading to a less elastic supply of land. Or, land use regulation – limits on new construction imposed by cities and towns – may have become more stringent, as argued

by Glaeser, Gyourko, and Saks (henceforth GGS) (2005a), Quigley and Raphael (2005), and Glaeser and Ward (2006). For an example of one such piece of evidence, GGS (2005b) estimates that the marginal value of building an additional floor on a high-rise building in Manhattan is much higher than the marginal cost of constructing the additional floor. The gap, they conclude, must be due to regulatory barriers or non-construction costs, such as lawsuits from opposed parties.

Circumstantial evidence of this kind of pattern is developed in Gyourko, Mayer, and Sinai (2006), henceforth GMS. A number of metropolitan areas in the U.S. appear to have become more supply constrained between 1950 and 2000, in that the rate of new home construction in those areas greatly diminished and concurrently the rate of house price growth rose. The authors take that to be evidence of a rotation of the supply curve in those metropolitan areas from more-horizontal to more-vertical.

Evidence of that same pattern can be seen in Table 1, which reports statistics on the inferred elasticity of supply, measured as the slope of the supply curve, across MSAs over a number of decades. The “slope of the supply curve” is defined as the ratio of the average house price growth over the prior 20 years to the average housing unit growth, as in GMS (2006). A separate slope is computed for each MSA in each year from 1970 to 2000. A higher number corresponds to more inelastic supply since it implies that a change in demand is reflected more in price changes than quantity changes.

The average slope (across equally-weighted MSAs) for each 20-year period is reported in the second column of Table 1. Over time, the supply curve has become somewhat more steeply upward-sloping, on average, ranging from 0.77 over the 1950 – 1970 period to 0.99 over 1980 – 2000. This indicates that housing supply in the U.S. became more inelastic, or less price

responsive, over this period. The third column reports the standard deviation (across MSAs) by year for the same supply statistic. The MSAs had tightly clustered slopes of their supply curves between 1950 and 1980. But by 1980 or so, the standard deviation increased considerably, almost tripling. This pattern suggests that a small tail of MSAs experienced large decreases in supply elasticity (higher slope numbers), generating more dispersion.

These changes in the elasticity of supply over time present a hurdle for empirical researchers working at the intersection of real estate and urban economics because it means that the extent to which urban demand is capitalized into land prices is not stable. Even if a researcher collects data on both land prices and new construction, the changing ratio of price growth to a new supply response to an underlying change in demand makes the evidence difficult to interpret.

A further complication arises from an important issue pointed out in Glaeser and Gyourko (2005): The elasticity of supply in a market depends on the relationship between real estate prices and construction costs. The reason is that new supply is constructed only when real estate prices are in excess of their cost of construction, so developers can make a profit. When prices are below construction costs – perhaps because of prior overbuilding that shifted the supply curve out, or because of a decline in demand relative to previous levels that shifted the demand curve in – supply is inelastic. Because real estate is long-lived, if demand falls supply cannot contract in the short run, leading to full price capitalization of the drop in demand. If demand rises, but not so much that prices exceed construction costs, it still is not worthwhile for new development to occur, and thus there again is full price capitalization. Glaeser and Gyourko argue that, because of the kink in the supply curve induced by construction costs, real estate supply is much more inelastic when prices are not high enough to justify new construction than

when prices are above construction costs. This argument is illustrated in Figure 2. As in Figure 1, the demand curve (D) is downward-sloping and we consider an outward shift to D' . Unlike in Figure 1, the supply curve, S'' , is kinked rather than linear. It is vertical up to a point and then slopes upwards. The kink point is where prices exceed construction costs. The points A and C are the same as in Figure 1: In the range where the supply curve is vertical, shifts in demand are fully capitalized into rent. But an equal-sized demand shock, from D' to D'' , that crosses the kink point is not fully capitalized into rent, since $F-A$ is smaller than $A-C$. Instead, some of the increase in demand is reflected in new construction, and thus higher Q , since construction is now profitable.

Despite the ephemeral nature of the elasticity of supply, much empirical work has assumed it to be either perfectly inelastic or perfectly elastic. The conclusions one draws about the underlying demand for a location are more tenuous when one recognizes that these extremes of supply elasticity or inelasticity are rarely reached. The most accessible avenue of research would be to take into account cross-sectional differences across space in the elasticity of supply of land. This could be done using the data in Saiz (2008) or Gyourko, Saiz, and Summers (2008). By way of example, Glaeser, Gyourko, and Saiz (2008) assess whether the amplitude and duration of house price bubbles vary with cross-sectional differences in the elasticity of supply. While it would be much more difficult to measure changes in the elasticity of supply within metropolitan areas over time, it would be a worthwhile research agenda.

2. THE FEEDBACK BETWEEN ASSET PRICES AND URBAN DEMAND

One of the potentially more interesting areas of intersection between urban economics and real estate is when real estate prices – which are driven by demand for a location –

themselves feed back and affect the characteristics that make an area desirable. These are issues of the dynamic evolution of cities and raise the question of how urban areas will fare in the future.

This phenomenon is especially salient now because only recently has land supply become fairly inelastic in some cities. As described in GMS (2006) and GMS (2009), in the 1950s, every MSA in the U.S. had easily-developable land remaining. By 1980, several MSAs became ‘filled-up’ in the sense that it became difficult or significantly more expensive to develop further within an MSA, and new construction dried up relative to price growth in those MSAs. That trend was exacerbated in 1990 and 2000.

According to GMS (2006), at least one of the reasons for this dynamic was the considerable growth in population and incomes that the U.S. experienced over the 1950-2000 time period combined with inherent tastes in the populace for some MSAs relative to others. A growing income-weighted population meant aggregate demand was growing, too. Some elastically-supplied MSAs could accept all potential residents; however, those with inelastic supply experienced price growth. Initially, all MSAs were elastically supplied. But as some cities started to reach physical or regulatory capacity, they shifted to more inelastic supply. In GMS (2006), this is manifested as a shift in an MSA from experiencing high housing-unit growth and low price growth to experiencing low housing-unit growth and high price growth.

It is instructive to look at the impact of this particular dynamic as it seems to have important implications for the future of over-demanded and under-supplied cities. Table 2 presents a measure of what fraction of U.S. households could reasonably afford to purchase houses in various MSAs, using as an affordability criteria that a household could pay three times its reported income. Using decennial Census data, I constructed the national income distribution,

and then asked, for each MSA, at what percentile the median-valued home and 10th percentile-valued home would map to the national income distribution in that year.⁵

For example, the top panel of Table 2 reports the 10 MSAs that were the least expensive in 2000. These MSAs include cities in states such as Texas and Oklahoma. In the leftmost panel, I report where the median value home in those 10 MSAs fall in the national income distribution for each decade from 1950 to 2000. The percentiles range from 5 to 30, with most being around 20 percent. That means a median-valued house in each of these MSAs could have been purchased for three times annual income by anywhere from 70 to 95 percent of U.S. households in that year, which is an indication that these MSAs were inexpensive relative to the country as a whole. The left panel of the top of Table 2 shows little change over time, as well.

A similar pattern is repeated for the rightmost panel of the top of Table 2, which reports where the 10th percentile (by value) houses in the same 10 MSAs fall in the national income distribution. Such houses in these cities were affordable by 85 to 95 percent of U.S. households from 1950 to 2000 and that degree of affordability changed little over this time period. Clearly, for this set of MSAs, house prices did not rise relative to the national income distribution.

The middle panel of Table 2 reports where the median (left panel) and 10th percentile (right panel) by value houses fall in the national income distribution for five MSAs at the middle of the house price distribution. Median houses in these MSAs were affordable to 60 to 80 percent of the national income distribution and a 10th percentile house could be afforded by 80 to 95 percent of households nationally, with little change over the 50-year sample period.

A quite different pattern can be found in the bottom panel of Table 2. The MSAs in this panel are the 15 most expensive out of the 316 in the data. These MSAs, which include much of coastal California, the New York area, Seattle, and Boulder, seem to have started out as fairly

typically priced. In the left panel, the median houses in these cities in 1950 were affordable by around half of U.S. families. (The actual points in the distribution range from the 25th to 65th percentiles.) That degree of affordability persisted through the 1970s. But starting around 1980, median house prices in these cities rose to higher points in the national income distribution, ranging from the 60th to the 90th percentile. By 2000, no more than 25 percent of the U.S. population could buy the median house for three times income in these MSAs and in Santa Cruz, San Francisco, and San Jose, just 5 percent of the U.S. population could.

The pattern repeats itself for the 10th percentile homes in these MSAs. Between 1950 and 1970, the 10th percentile homes could be purchased by the 10th to 30th percentile household in the U.S. But starting in 1980, the range increased to the 25th to 60th percentile of households and, by 2000, the 10th percentile home in these MSAs could be purchased by just 15 to 55 percent of U.S. households. This change in affordability is matched by a change in the resident population: GMS (2006) finds that cities such as these experience decreases in their number of low- and middle-income residents and increases in their number of high-income residents.⁶

The reason that this pattern is especially interesting is grounded in why it is that some cities are more desirable to certain segments of the population in the first place. GMS (2006) is agnostic about those reasons, but what if they are influenced by the level of prices? Does the desirability persist when (say) only 5 percent of the U.S. population can afford the median house and only 15 percent of the U.S. population can afford the 10th percentile house, as was the case in San Francisco?

It is not *a priori* clear whether the screening on income or wealth that high house prices imply is a good thing or a bad thing for cities. Perhaps if high-income households prefer to be around other high-income households, the market price mechanism reinforces the agglomeration

benefits. By pricing those who would not contribute to or benefit from the high-income agglomeration out of a city, a high clearing price could prevent dilution of the concentration of high income households. But what if the vibrancy of the city depends in part on heterogeneity in the population, such as in Jacobs (1969), especially heterogeneity that is correlated with differences in income? What if artists, or young chefs, or even the middle class help make cities attractive? One could imagine that an equilibrium might exist where prices merely would fall just enough to enable some of these beneficial households to live in the city, or perhaps such households would command higher wages in that city. Alternatively, one could surmise that if households that make a positive contribution also prefer to agglomerate amongst themselves, displacing a cluster of such residents out of a city could persist for the long-term or permanently since it would be difficult for such an agglomeration to rebuild. Or, a city could cycle between homogeneity and heterogeneity if moving is costly or slow to adjust. Lastly, if the positive externalities created by households who contribute to heterogeneity – or the negative externalities from those who displace them – are not internalized, it is not clear what equilibrium might arise.

For example, many explanations of urban growth and success depend on agglomeration externalities – positive spillovers between closely-located firms or households. Those externalities can be productive, in that firms can produce output more efficiently if agglomerated, or consumption-based, in that households enjoy a location more if surrounded by positive externality-producing households. In these cases, the value of a location is not necessarily inherent in the physical geography, but arises from who is there.

Take, for example, the consumption benefits of living in cities. (Glaeser, Kolko, and Saiz, 2001) City amenities, such as restaurants, theaters, or the social scene, arguably make a city

more attractive to potential residents and thus more valuable. But as Waldfogel has argued in a compelling series of papers (see, e.g., Waldfogel, 2003), what amenities are provided in a city, and at what level of quality, depends upon the composition of the residents. When residents share similar tastes, amenities (or products) arise endogenously to serve the local market. Given fixed costs of producing such amenities, goods, or services for the local market, there needs to be a sufficiently large audience to make production worthwhile. In addition, the quality and variety of products provided increase in the size of the market. In Waldfogel's framework, each resident potentially provides a positive externality to other residents who share similar preferences.

When a city enjoys elastic land supply, the return to the consumption agglomeration is not capitalized into land prices. Instead, the residents enjoy more surplus or perhaps firms can pay lower wages. But when a city is inelastically supplied, land prices will capitalize the returns to scale. As long as all the residents produce and enjoy the consumption externalities symmetrically, presumably house prices will rise just enough that the marginal resident is indifferent between moving in and enjoying the consumption amenities, or not.

But what if some residents benefit more from the consumption amenities and others produce them? In that case the beneficiaries of the externalities would have a higher willingness to pay for an area than the producers. When land is elastically supplied, this asymmetry does not matter since both types of households could purchase property at the cost of construction. But when land is inelastically supplied, the existence of a consumption agglomeration could drive prices high enough that only beneficiaries of the agglomeration would be willing to pay the premium to move into the city and externality producers would not. In the short run, this would not affect the existing agglomeration since the existing land owners would enjoy an increase in wealth – from the rise in prices – that would just enable them to remain in the city even if they

were producers of the externality. (Ortalo-Magné and Rady, 2008) But, over time, is the consumption agglomeration sustainable absent government intervention?⁷

While low-income service providers, such as teachers, policemen, or gardeners, can command higher wages in a high-priced city, that occurs because their services are paid for by those who receive the benefits of them. However, when some members of the population, by their mere presence, create a *public* good, it is difficult to generate appropriately higher wages for them. Due to the free rider problem, beneficiaries of the public good are unlikely to voluntarily pay high enough wages to lead to the optimal provision of the public good. Instead, government intervention may be necessary to subsidize the presence of public good providers. Some existing local public policies affect the composition of residents, presumably to manage externalities. Exclusionary zoning, where potential entrants into a community are barred from purchasing small plots of land, impose a minimum wealth threshold for residence since land consumption is constrained to be high. (Inman and Rubinfeld, 1979) On the other end of the spectrum, subsidized housing may be provided to enable low-income residents to live in a high-priced area. Another example is the practice of local governments giving incentives for firms to locate facilities in particular areas. Of course, the difficulty with explicitly subsidizing perceived contributors to the public good is that the government would need to be able to identify such residents and place a value on their contributions.

Not all MSAs have ended up so high-priced as to crowd out potential residents. The top panel of Table 3 reports the mapping from the median and 10th percentile house values to the national income distribution for the 10 MSAs that experienced the largest gains in affordability. The list is comprised of declining cities: Cincinnati, Rochester, and Milwaukee are among the MSAs. In 1950, the median houses in many of these MSAs were unaffordable to the median

household nationally, with the mapping into the percentile of the national income distribution reaching as much as the 65th percentile. But the exclusivity steadily declined over the next 50 years, so by 2000, their percentile in the national income distribution dropped by anywhere from 30 to 15 percentage points. (Less, if any, decline was seen for the 10th percentile homes in these MSAs.) In another example of how the land prices can feed back into how an urban area develops, Glaeser and Gyourko (2005) have argued that declining cities such as these – ones with existing stocks of housing and thus inelastic supply – can become magnets for low-income, low ability families whose collective presence deters higher-income families from locating there since the higher-income families would face an excessive local tax burden. Such high-income families can afford to live in other MSAs, while low-income families remain because house prices are below the cost of new construction in growing cities.⁸

The bottom panel of Table 3 shows a completely different set of cities, those that experienced the greatest increase in where their house values mapped into the national income distribution. Most of these MSAs span the west coast of the U.S. and experienced an increase in anywhere from 25 to 50 percentiles for their median valued houses and 15 to 60 percentiles for their 10th percentile valued houses.

Despite the focus on the MSAs at the extremes, most metropolitan areas did not experience much, if any, change in their affordability over the 1950 to 2000 time period. The middle panel of Table 3, which reports the mapping from the median and 10th percentile house values to the national income distribution for five MSAs around the median change in affordability, reflects this. Growth in the median and 10th percentile house prices in these median MSAs tracked growth in the median and 10th percentile incomes at the national level over the entire 1950 to 2000 sample period.

3. BEING AN OWNER AS WELL AS A RESIDENT

Another feedback mechanism between real estate and urban economics that has grown in importance as more areas have become inelastically supplied is that the political decision-makers are typically also property owners. When land supply was elastic, decisions about what amenities to provide or land use regulations to impose would not affect residents' wealth because property values would be unchanged. But when such decisions are capitalized into land values, as is the case when land supply is inelastic, property owners have a financial interest in the outcome even if they would not directly benefit from it. This point combines the gist of Fischel's (2001) home-voter hypothesis with a distinction between inelastic and elastically supplied areas.

For example, Hilber and Mayer (2009) show that in towns with inelastic land supply, families without children in schools are more likely to vote for increased school spending than similar families in towns where developable land is plentiful. The ostensible reason is that higher school quality raises property values in towns where it is hard to add to the housing stock because the higher demand for living there leads to higher rental values. Families in such a town not only get better schools when school spending increases, they get capital appreciation in their real estate. In towns where it is easy to build more housing, better quality schools do not lead to higher property values. Instead, they lead to more real estate development. A family without children in such a town would be less likely to support higher school spending since none of the benefit of better schools would accrue to them through housing capital gains.⁹

The effect outlined in Hilber and Mayer arises because the households making the decision over what local amenity to provide are also the property owners. When supply is

inelastic, their wealth depends on the desirability of their locality. Because of this relationship between how vested in the outcome a household is and the elasticity of supply, it is natural that the very places where land prices capitalize a greater fraction of the value of an amenity, amenities are more likely to be provided and in greater value.

The recent downturn in the housing market adds a complication to the relationship between home ownership and the provision of amenities. When house prices have fallen enough that home owners owe more on their mortgages than their houses are worth, providing local amenities or public services that raise house prices creates wealth for the lender rather than the homeowner. In that case, a home owner has less of an incentive to support the provision of such amenities. (Ferreira, Gyourko, and Tracy, 2008) This issue is especially salient when house price declines are pervasive throughout an entire jurisdiction because then the median voter may switch from a positive to negative equity position.

These issues provide interesting food for thought: How might the evolution of urban areas be different as the set of stakeholders changes? Does that evolution accelerate or slow down depending on whether home owners have positive equity in their homes?

In addition, this relationship between property ownership and amenity provision leads to an empirical difficulty with using land prices to measure outcomes. The very features of urban life that one wishes to value using land rent capitalization are themselves influenced by whether their creation leads to higher land prices.

Another example: In most urban research, appealing (or unappealing) features of an area are assumed to be exogenous, or the outcome of some process that has little to do with the supply of land. It is interesting to consider then what happens if this assumption is relaxed. Perhaps cities with limited land are more likely to invest in parks and green space (thus further

exacerbating their supply inelasticity!) because the amenity raises their residents' property values or because it would increase the tax base. Perhaps a business improvement district, which is when a group of commercial property owners collectively agree to tax themselves and use the proceeds to provide a set of common services, would be most successful when supply is inelastic because commercial property owners would have a greater incentive to participate when their financial contributions to the B.I.D. would be offset by the subsequent increase in their property values.

The fact that a homeowner's wealth, through their own house values, moves in lockstep with housing prices has proven to be powerful in other contexts. Ortalo-Magné and Rady (2008) use it to explain how households of divergent incomes can afford to live in the same (expensive) city: If the low-income households purchased their houses earlier, when housing was cheap, their wealth increased enough when their house prices rose to enable them to remain residents. Thus old-timer low-income households coexist with newcomer high-income households. Sinai and Souleles (2005) use it to explain why owning a house may reduce the risk of obtaining housing services. Ortalo-Magné and Prat (2007) contend that, in part, a desire to maximize one's own wealth leads homeowners to vote for regulations that limit new housing construction since the resulting inelastic supply could lead to higher house prices for them.

4. THE ROLE OF ASSET MARKET EQUILIBRIUM

The difficulty with – and the interesting thing about – prices is that they capitalize more than just the current spot rent. While rent represents the outcome of a spatial equilibrium, getting from rents to prices involves asset market equilibrium. That is, an investment in real estate should yield an equivalent risk-adjusted return to an investment in some other asset. Because of

this additional equilibrium, the price of real estate incorporates not only the underlying demand for that location, reflected in the *current* rent, but also the factors that determine the willingness of an owner to pay for a future stream of rental value. Those factors include interest rates, how rents might change in the future, future prices, and uncertainty.

An example of a simple pricing rule for real estate that satisfies asset price equilibrium is the price of a particular piece of real estate is equal to the expected present value of its rental value plus the expected present value of the sale price, less an adjustment for risk. (Meese and Wallace, 1994; Sinai and Souleles, 2005) For the sake of simplicity, this example leaves out complications such as any option value inherent in the investment or the possibility that prices could deviate from their fundamental values. This zero-NPV equilibrium pricing rule can be written as:

$$(1) \quad P_1 = E \left(\sum_{t=1}^T \frac{r_t}{(1+i_t)^t} + \frac{P_T}{(1+i_T)^T} \right) - \sum_{t=1}^T \frac{\pi_t}{(1+i_t)^t} - \frac{\Pi_T}{(1+i_T)^T}$$

where T is the holding period and i_t is the time-varying discount rate. The first term in Equation (1) is the expected present value of the rental stream from the real estate. The second term is the present value of the expected sale price, P_T . The last two terms in Equation (1) are present-value adjustments for the cost of the uncertainty surrounding future rents (π_t) and the future sale price (Π_T), respectively.

From Equation (1), one can see the difficulty in using real estate asset prices to proxy for rent. Current prices depend not only on current rent, but on expectations about future rents and prices, the path of interest rates (the discount rate), and future risk premia. If the same underlying factors that cause rent to change also cause those other variables to change, it becomes impossible to infer rental values solely from prices. For example, one can imagine that an economic boom in a city that led to higher rents might also increase (or, arguably, decrease)

uncertainty, leading to a simultaneous change in the rental value and the risk premium. Both changes would be reflected in the asset price. Or, irrational expectations of future prices that deviate from the present value of the expected rental stream could induce differences between value measured using prices versus rents.

If we assume all buyers and sellers of properties use the same pricing model, and rule out deviations in price from fundamental value, Equation (1) reduces to:

$$(2) \quad P_1 = E \left(\sum_{t=1}^{\infty} \frac{r_t}{(1+i_t)^t} \right) - \sum_{t=1}^{\infty} \frac{\pi_t}{(1+i_t)^t}$$

because the price at any time t is just equal to the present value of the future rents less a risk adjustment. Even with those assumptions, the asset price of real estate depends on the expectations of future rents as well as the current rent. If a shift in the demand curve led solely to a proportional change in the current and all future rents, price would be a fine proxy for the theoretically-appropriate rental value. But if the expected growth rate in rent changed along with the current rent, the capitalization into price would be magnified. Whether or not that induces mismeasurement depends on what the econometrician is trying to capture. And if the rent change is temporary, the measured percent change in price will depend on the proportion of the price that is due to current rental value versus the future value. In high expected rent growth cities, that portion is smaller than in low expected rent growth cities. (Himmelberg, Mayer, and Sinai, 2005)

Equation (2) can be simplified further by assuming time invariant discount rates, i , unchanging risk premia, π , and a constant growth rate of rent, g . In that case, Equation (2) reduces to the familiar static Gordon Growth Model: $P = r/(i - g)$. These are strong assumptions that we have little empirical evidence on. Campbell et al. (2006) and Glaeser and

Gyourko (2006) have produced some relevant details in the housing context, with the former showing that risk premia are not constant over time in national time series data and the latter showing that the rent and interest rate processes are mean-reverting.

Even the simple static Gordon Growth Model has important implications for researchers on the boundary of urban and real estate economics. For one, it emphasizes that changes in the growth rate of rents, g , may be even more important for real estate prices than changes in the level of rents, r . Since g can differ across cities, the relationship between price and rent – $P_k/r_k = 1/(i - g_k)$ -- will also vary across cities, k , as shown empirically for housing markets in Sinai and Souleles (2005) and GMS (2006). Second, if one assumes that g (and even π , from earlier) varies across cities in a way that is unobservable to the researcher but do not change over time, it follows that inferences about differences in rental value can be obtained from prices only by looking at within-market changes in log price and discarding the cross-sectional across-city variation (or imposing some theoretical structure on the relationship). This same point would hold for any unobservable factor that affected the gap between prices and rents differentially across cities. For example, in most available data we do not actually observe the unit price or rent of real estate. Rather, we observe the price per unit times the quantity purchased, as in a house price or monthly rent paid. Since the sample of properties over which prices are observed might be quite different than the sample of properties over which rent is observed, and those samples can vary across cities, the comparability of prices to rents might differ across cities. For these reasons, most researchers restrict their attention to within-city changes in prices, rents, or the ratio, though others try to make the measures more comparable (Smith and Smith, 2006).

Overall, the Gordon Growth relationship needs to be true on average if researchers wish to proxy for within-city changes in rent using changes in real estate prices without including

additional controls. In particular, it implies that the growth rate of prices should track the growth rate of rents since $\ln(P_t) - \ln(P_{t-1}) = \ln(r_t) - \ln(r_{t-1})$ in each metropolitan area if g is constant within MSA. To check this, in Figure 3 I have plotted the annual average growth rate in real house/apartment rents and real house prices for 316 Metropolitan Statistical Areas (MSAs) over the 1950-2000 period. The data comes from the decennial U.S. Census, which reports the distributions of rents paid by renters and self-reported house values for owners at the county level in a number of discrete bins. (The number and boundaries of the bins varies across Censuses.) I aggregated the county level data in each Census year to the MSA level and, assigning the midpoint value of each rent or price bin to any household in that bin, computed the population-weighted average rent and price by MSA and Census year. After deflating by the CPI, I calculated the geometric growth rate over the 1950-2000 period.

Figure 3 shows that long-run growth rates in rent and prices are quite correlated and track each other nearly one-for-one, with rent growth and price growth tightly clustered around a straight line. The coefficient on the bivariate regression line, which is the thick line in Figure 3, is 1.06 (with a standard error of 0.05), approximately parallel to the 45-degree line (the thin line). This implies that a one-percentage point higher long-run rent growth in an MSA corresponds to an approximately one-percentage point higher long-run price growth on average. Overall, the correlation between the two growth rates is 0.75 and the R-squared of the bivariate regression is 0.56.

Although the slope of the regression line parallels the 45-degree line, the intercept of the regression line is higher. For the low-rent growth portion of the sample, long run price growth ends up being about double rent growth.

This relationship between price and rent growth holds less well over shorter horizons, reflecting that there might be temporary deviations from the average in the other parameters in Equation (1). Figure 4 plots the 20-year average growth rates in real rents and prices for each of the 316 MSAs, treating as independent the 1950-1970, 1960-1980, 1970-1990, and 1980-2000 periods. The correlation between the 20-year growth rates in rents and prices is 0.52 and the R-squared of the bivariate regression is just 0.27. This result is consistent with the finding in Gallin (2004) that the relationship between rents and prices varies over time but is mean-reverting. Despite the greater noise, on average 20-year price changes are again about the same as 20-year rent changes. Although the estimated coefficient of 0.65 (0.03) is attenuated from the 1.0 of the 45-degree line, within the range of most of the sample the attenuation is offset by a higher intercept on the regression line. This pattern can be seen in Figure 4 by comparing the thick (regression) line and the thin (45-degree) line.

5. CONCLUSION

Since 1950, the U.S. has experienced increasing inelasticity of land supply in a subset of its metropolitan areas. The resulting greater capitalization of demand into land rents and prices emphasizes the importance of the overlap between real estate and urban economics. Namely, how does demand for urban areas affect real estate prices, and what can we learn from them? And, how do rising real estate prices affect the evolution of urban areas?

This paper described a few stylized empirical facts and outlined some of the potential causes and implications. One fact was that house prices in some metropolitan areas have grown increasingly expensive, relative to the national income distribution, over the last 50 years. In some California cities, by 2000 the median valued house was affordable by just 5 percent of the

national population and the 10th percentile house by just 15 percent. By contrast, in a number of other metropolitan areas, house prices became either no less unaffordable or, in the case of some declining cities, more affordable to the bulk of the U.S. population. Another fact was that, on average, house price growth was a reasonable proxy for the growth in rental value. Not only was this a useful confirmation of a key prediction of the asset market equilibrium concept, but it suggested that, at least in a long-run setting, prices reasonably substitute for rents in empirical work.

Interesting questions and challenges remain well beyond those discussed in this paper. Fortunately for empirical researchers, the quantity and quality of data on real estate has improved tremendously. House price indices are available for most metropolitan areas since 1980. Transactions data for individual houses, from sources such as DataQuick, are becoming more common. Other providers have collected decades of data on rents for commercial real estate. Advances in geographic information systems, discussed elsewhere in this volume, enable matching of local characteristics to real estate data.

¹ This literature is too voluminous to properly reference in this article. See Rosenthal and Strange (2004), Moretti (2004) and Strange (2005) for overviews, as well as the papers by Bacolod *et al*, Glaeser and Resseger, and Puga in this volume.

² In the short-run, the supply curve might be nearly vertical (line S') as city boundaries are pretty much set and development of new housing or commercial space in existing cities is a slow process. Beyond the short-run, if the price of urban space is high enough, the market may create more urban locations, leading the supply curve to be flatter than vertical (line S). One can imagine that existing cities could either expand their boundaries or increase their density (by

building more space within the same boundaries). Or, new cities that substitute for existing cities could arise, increasing the aggregate supply of urban locations.

³ For other capitalization studies, see: Oates (1969); Bayer *et al* (2007); and Cellini *et al* (2009), which concludes that investments in school facilities have a positive value net of fiscal cost since constructing them yield increases in house values.

⁴ While most theories focus on land rents and prices, most empirical work considers properties, i.e. bundles of land and structures. Land isolates the value of location since how much to spend on the structure atop the land is an independent choice. However, unimproved land is rarely traded and what is, is not a representative sample. Thus, most empirical researchers use property rents and prices. See Davis and Heathcote (2007) for an aggregate decomposition of properties into structures and land rents.

⁵ Although much of the discussion in this paper centers around housing markets, I would be remiss not to highlight that urban economics and *commercial* real estate overlap as well. Companies use land just like residents do.

⁶ One should not take the exact numbers in this exercise too literally. First, rather than comparing the price of a constant unit of land across MSAs, Table 2 compares the value of a house across MSAs. House value reflects land and structure, and quantity as well as price. The size and quality of the housing structure, or the quantity of land, reflected in the median and 10th percentile values might vary across MSAs. Second, the Census reports house values and incomes in bins, so the percentiles are measured with noise.

⁷ One could draw analogies to various strands of the Tiebout literature – see Scotchmer (2002) for a summary of club models in particular. It seems likely that at best the agglomeration would be inefficiently sized and at worst equilibrium may not exist.

⁸ Alternatively, urban living may lead to greater development of cognitive skills. (Bacolod *et al* (2010))

⁹ This point is related to the literature on Tiebout sorting with public goods and voting. See Epple and Nechyba (2004) for a synopsis.

References

- Bayer, Patrick, Fernando Ferreira, and Robert McMillan (2007). "A Unified Framework for Measuring Preferences for Schools and Neighborhoods," *The Journal of Political Economy*, 115 (4), 588-638.
- Bacolod, Marigee, Bernardo Blum, and William Strange (2010). "Elements of Skill: Traits, Intelligences, and Agglomeration." *Journal of Regional Science*, XXXX.
- Black, Sandra (1999). "Do Better Schools Matter? Parental Valuation of Elementary Education," *Quarterly Journal of Economics*, 114 (2), May, 577-599.
- Blomquist, Glenn C., Mark C. Berger and John P. Hoehn. 1988. 'New Estimates of Quality of Life in Urban Areas,' *The American Economic Review*, 78(1), 89-107.
- Campbell, Sean, Morris Davis, Joshua Gallin, and Robert Martin (2006). "A Trend and Variance Decomposition of the Rent-Price Ratio in Housing Markets," *mimeo*, April.
- Cellini, Stephanie, Fernando Ferreira, and Jesse Rothstein (2009). "The Value of School Facility Investments: Evidence from a Dynamic Regression Discontinuity Design," *mimeo*, March.
- Davis, Morris, and Jonathan Heathcote (2007). "The Price and Quantity of Residential Land in the United States," *Journal of Monetary Economics*, (54), 2595-2620.
- Epple, Dennis and Thomas Nechyba. 2004. 'Fiscal Decentralization,' in J.V. Henderson and J.F. Thisse (eds.), *Handbook of Regional and Urban Economics Vol. 4*. Amsterdam: Elsevier, pp. 2423-2480.
- Ferreira, Fernando, Joseph Gyourko, and Joseph Tracy. 2008. "Housing Busts and Household Mobility," *NBER Working Paper 14310*, September.
- Fischel, William. 2001. "Homevoters, Municipal Corporate Governance, and the Benefit View of the Property Tax," *National Tax Journal*, 54(1), 157-173.
- Gallagher, Justin and Michael Greenstone (2008). "Does Hazardous Waste Matter? Evidence from the Housing Market and the Superfund Program," *Quarterly Journal of Economics*, (XX), YYYY.
- Gallin, Joshua (2004). "The Long-Run Relationship between House Prices and Rents," *Federal Reserve Board Working Paper*, September.
- Glaeser, Edward and Joseph Gyourko (2006). "Housing Dynamics", *NBER Working Paper No. 12787*, December 2006.

- _____ (2005). “Urban Decline and Durable Housing,” *Journal of Political Economy*, 113 (2), 345-375.
- Glaeser, Edward, Joseph Gyourko, and Raven Saks (2005a). “Why Have House Prices Gone Up?” *American Economic Review*, 95(2): 329-333.
- _____ (2005b) “Why Is Manhattan So Expensive? Regulation and the Rise in House Prices”, *Journal of Law and Economics*, 48(2): 331-370.
- Glaeser, Edward, Jed Kolko and Albert Saiz (2001). “Consumer Cities”, *Journal of Economic Geography*, 1(1): 27-50.
- Glaeser, Edward, and Matthew Resseger (2010). “The Complementarity Between Cities and Skills,” *Journal of Regional Science*, XXXXXX.
- Glaeser, Edward, and Bryce Ward (2006). “The Causes and Consequences of Land Use Regulation: Evidence from Greater Boston,” *mimeo*, October.
- Greenstone, Michael and Enrico Moretti (2004). “Bidding for Industrial Plants: Does Winning a ‘Million Dollar Plant’ Increase Welfare?” *mimeo*.
- Gyourko, Joseph, Christopher Mayer and Todd Sinai (2006). “Superstar Cities”, *NBER Working Paper No. 12355*, June.
- _____ (2009). “Dispersion in House Price and Income Growth Across Markets: Facts and Theories.” In *The Economics of Agglomeration*, Edward Glaeser, ed.
- Gyourko, Joseph, and Albert Saiz (2006). “Construction Costs and the Supply of Housing Structure”, *Journal of Regional Science*, 46 (4): November, 661-680.
- Gyourko, Joseph, Albert Saiz and Anita Summers (2008). “A New Measure of the Local Regulatory Environment for Housing Markets”, *Urban Studies*, 45(3): 693-721.
- Gyourko, Joseph and Joseph Tracy. (1989). ‘The Importance of Local Fiscal Conditions in Analyzing Local Labor Markets,’ *The Journal of Political Economy*, 97(5), 1208-1231.
- _____ (1991). “The Structure of Local Public Finance and the Quality of Life”, *Journal of Political Economy*, 99(4): 774-806.
- Hilber, Christian and Christopher Mayer (2009). “Why do households without children support local public schools? Linking house price capitalization to school spending,” *Journal of Urban Economics*, 65 (1), January: 74-90.

- Himmelberg, Charles, Christopher Mayer and Todd Sinai. 2005. "Assessing High House Prices: Bubbles, Fundamentals, and Misperceptions," *Journal of Economic Perspectives*, 19(4), Fall, 67-92.
- Inman, Robert and Daniel Rubinfeld. 1979. "The judicial pursuit of local fiscal equity," *Harvard Law Review*, 92(5), 1662-1750.
- Jacobs, Jane (1969). *The Economy of Cities*. New York: Vintage.
- Meese, Richard and Nancy Wallace (1994), "Testing the Present Value Relation for Housing Prices: Should I Leave My House in San Francisco?" *Journal of Urban Economics*, 35, 245-266.
- Moretti, Enrico (2004). "Human Capital Externalities in Cities" in J.V. Henderson and J-F. Thisse (eds) *Handbook of Urban and Regional Economics*, Volume 4.
- Oates, Wallace E. (1969), "The Effects of Property Taxes and Local Public Spending on Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hypothesis," *Journal of Political Economy* 77(6), p. 957-71.
- Ortalo-Magné, Francois and Andrea Prat (2007). "The Political Economy of Housing Supply: Homeowners, Workers, and Voters," *mimeo*, January.
- Ortalo-Magné, Francois and Sven Rady (2008). "Heterogeneity within communities: A stochastic model with tenure choice," *Journal of Urban Economics*, 64, 1-17.
- Puga, Diego (2010). "The Magnitude and Causes of Agglomeration Economies," *Journal of Regional Science*, XXXXX.
- Quigley, John and Steven Raphael (2005). "Regulation and the High Cost of Housing in California," *American Economic Review*, 95, May 323-328.
- Roback, Jennifer (1982). "Wages, Rents, and the Quality of Life", *Journal of Political Economy*, 90(2): 1257-78.
- Rosen, Sherwin (1979). "Wage-Based Indexes of Urban Quality of Life" in P. Mieszkowski and M. Straszheim (eds.), *Current Issues in Urban Economics*. Baltimore, MD: Johns Hopkins University Press.
- Rosenthal, Stuart and William Strange (2003a). "Geography, Industrial Organization, and Agglomeration", *Review of Economics and Statistics*, 85(2): 377-393.
- _____ (2004). "Evidence on the Nature and Sources of Agglomeration Economies," *Handbook of Urban and Regional Economics*, J.V. Henderson and J.-F. Thisse, eds.
- Saiz, Albert (2008). "On Local Housing Supply Elasticity," *mimeo*, July.

Scotchmer, Suzanne. 2002. 'Local public goods and clubs,' in A.J. Auerbach and M. Feldstein (eds.), *Handbook of Public Economics Vol.4*. Amsterdam: Elsevier, pp. 1997-2042.

Smith, Gary and Margaret Hwang Smith (2006). "Bubble, Bubble, Where's the Housing Bubble," *Brooking Papers on Economic Activity*, 1: 1-50

Strange, William (2005). "Agglomeration," *New Palgrave Dictionary of Economics*, 2nd Edition.

Van Nieuwerburg, Stijn and Pierre-Olivier Weil (2007). "Why Has House Price Dispersion Gone Up?" *NYU-Stern Working Paper*, September.

Waldfogel, Joel (2003). "Preference Externalities: An Empirical Study of Who Benefits Whom in Differentiated Product Markets" *RAND Journal of Economics*.

Table 1: Changing land supply elasticities across MSAs, 1950-2000

Year	Average slope of the supply curve	Standard deviation of the slope of the supply curve
1950 – 1970	0.77	0.58
1960 – 1980	0.85	0.46
1970 – 1990	0.87	1.23
1980 – 2000	0.99	1.79

Notes: Data is from the U.S. Decennial Census, 1950 – 2000. The “slope of the supply curve” is defined as the ratio of the average house price growth over the prior 20 years to the average housing unit growth, as in Gyourko, Mayer, and Sinai (2006). A separate slope is computed for each MSA in each year from 1970 to 2000. A higher number corresponds to more inelastic supply since it implies that a change in demand is reflected more in price changes than quantity changes.

Table 2: Trends in the affordability of typical homes, by MSA

MSA	The percentile of the national income distribution where family income is above one-third of the...											
	...Median-value home in the MSA						...10th percentile-value home in the MSA					
	1950	1960	1970	1980	1990	2000	1950	1960	1970	1980	1990	2000
<u>10 least expensive MSAs...</u>												
1 Brownsville	15	10	10	15	15	20	10	5	5	5	5	10
2 Enid	25	20	20	30	15	20	15	5	5	10	5	10
3 Joplin	15	10	15	25	15	20	10	5	5	5	5	10
4 McAllen	15	5	10	15	15	20	10	5	5	5	5	10
5 Abilene	25	20	20	25	20	20	15	5	5	10	5	10
6 Beaumont	25	20	20	25	20	20	15	5	10	10	5	10
7 Johnstown	25	20	15	25	20	20	10	5	5	10	5	10
8 Pine Bluff	15	20	20	25	20	20	10	5	5	5	5	10
9 Sherman-Denison	20	10	20	25	20	20	10	5	5	5	5	10
10 Steubenville-Weirton	25	30	25	30	20	20	15	5	10	10	5	10
<u>5 median MSAs...</u>												
Akron	45	40	30	30	30	35	20	20	15	15	10	20
Asheville	25	20	25	30	30	35	10	5	10	10	10	20
Athens	20	30	25	30	30	35	10	5	10	10	10	20
Auburn-Opelika	20	20	25	30	30	35	10	5	10	10	10	20
Bloomington	25	30	25	30	30	35	15	5	15	15	10	20
<u>15 most expensive MSAs...</u>												
1 San Jose	65	40	55	90	95	95	25	30	30	60	80	85
2 San Francisco	65	50	55	90	100	95	25	30	30	60	80	85
3 Santa Cruz	45	30	40	80	95	95	20	10	20	60	65	65
4 Orange County	45	40	55	90	95	85	20	30	30	60	80	50
5 Santa Rosa	45	40	40	80	90	85	20	10	20	60	55	50
6 Ventura	45	40	40	80	90	75	15	20	25	60	80	50
7 Salinas	45	40	40	80	80	85	20	10	25	60	55	45
8 Oakland	65	40	40	80	90	85	25	20	25	30	55	45
9 Bergen-Passic	65	50	55	60	90	75	25	40	30	30	65	45
10 San Luis Obispo	25	30	30	60	90	75	15	10	15	30	55	45
11 San Diego	45	40	40	80	80	75	25	30	25	60	55	45
12 New York	65	N/A	55	60	90	75	25	N/A	30	25	55	45
13 Nassau-Suffolk County	65	40	55	60	80	75	25	30	25	25	55	45
14 Seattle	45	40	40	60	65	75	20	20	25	30	30	45
15 Boulder	25	40	40	60	55	75	15	10	20	60	30	45

Notes: Data is from the U.S. Decennial Censuses, 1950-2000. Median and 10th percentile house values at the MSA level are compared to the income distribution at the national level. The number reported in a cell is the percentile of the national income distribution in a given year that is mapped to by the median (or 10th percentile) house value in the corresponding MSA in the given year. The rule for mapping is that the income percentile is where the national income is one-third of the MSA's house value. The "N/A" for New York occurs because of data limitations in the Census in 1960.

Table 3: Trends in the affordability of typical homes, for MSAs with the largest changes over time

MSA	The percentile of the national income distribution where family income is above one-third of the...											
	...Median-value home in the MSA						...10th percentile-value home in the MSA					
	1950	1960	1970	1980	1990	2000	1950	1960	1970	1980	1990	2000
<u>10 MSAs with the largest decline...</u>												
1 Cleveland	65	40	40	60	30	35	25	20	25	25	15	20
2 Cincinnati	65	40	30	30	30	35	20	10	15	15	15	20
3 Rochester	65	40	40	60	30	35	20	20	20	25	20	25
4 Elmira	45	30	25	25	25	20	20	10	15	10	10	10
5 El Paso	45	30	25	30	25	20	15	10	15	10	10	15
6 Binghamton	45	40	30	30	45	25	20	10	15	15	20	15
7 Waterloo-Cedar Falls	45	30	25	30	20	25	15	10	15	15	10	10
8 Utica-Rome	45	30	25	25	30	25	15	10	15	10	10	15
9 Milwaukee	65	40	40	60	45	45	25	30	25	25	20	20
10 Madison	65	40	40	60	45	45	20	20	20	30	25	30
<u>5 MSAs with the median growth...</u>												
Corvallis	45	40	30	60	30	50	15	10	15	30	20	35
Eau Claire	25	20	25	30	25	30	15	5	10	15	10	20
Evansville	25	20	20	30	25	30	15	5	10	10	10	15
Fayetteville	25	20	20	30	25	30	10	5	10	10	10	20
Florence	25	20	25	30	25	30	10	5	10	10	10	15
<u>15 MSAs with the largest rise...</u>												
1 Santa Cruz	45	30	40	80	95	95	20	10	20	60	65	65
2 San Luis Obispo	25	30	30	60	90	75	15	10	15	30	55	45
3 Boulder	25	40	40	60	55	75	15	10	20	60	30	45
4 Santa Rosa	45	40	40	80	90	85	20	10	20	60	55	50
5 Salinas	45	40	40	80	80	85	20	10	25	60	55	45
6 Orange County	45	40	55	90	95	85	20	30	30	60	80	50
7 Santa Fe	25	30	25	60	55	65	10	5	15	25	30	35
8 San Jose	65	40	55	90	95	95	25	30	30	60	80	85
9 San Francisco	65	50	55	90	100	95	25	30	30	60	80	85
10 Ventura	45	40	40	80	90	75	15	20	25	60	80	50
11 Seattle	45	40	40	60	65	75	20	20	25	30	30	45
12 San Diego	45	40	40	80	80	75	25	30	25	60	55	45
13 Wilmington	20	10	25	30	30	45	10	5	5	10	10	25
14 Bellingham	25	20	25	60	45	50	15	5	15	25	25	30
15 Portland	25	30	25	60	30	50	15	10	15	25	20	35

Notes: Data is from the U.S. Decennial Censuses, 1950-2000. Median and 10th percentile house values at the MSA level are compared to the income distribution at the national level. The number reported in a cell is the percentile of the national income distribution in a given year that is mapped to by the median (or 10th percentile) house value in the corresponding MSA in the given year. The rule for mapping is that the income percentile is where the national income is one-third of the MSA's house value.

Figure 1: Supply and Demand for Real Estate

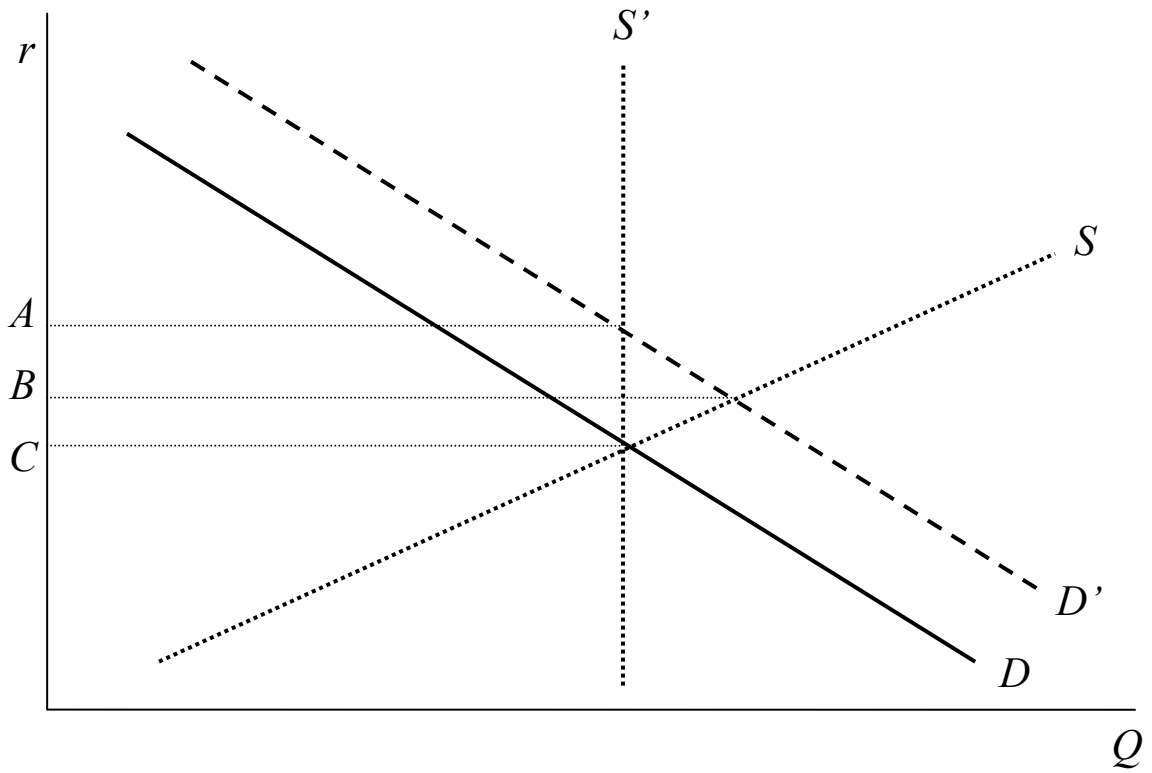


Figure 2: Supply and Demand for Real Estate with a Kinked Supply Curve

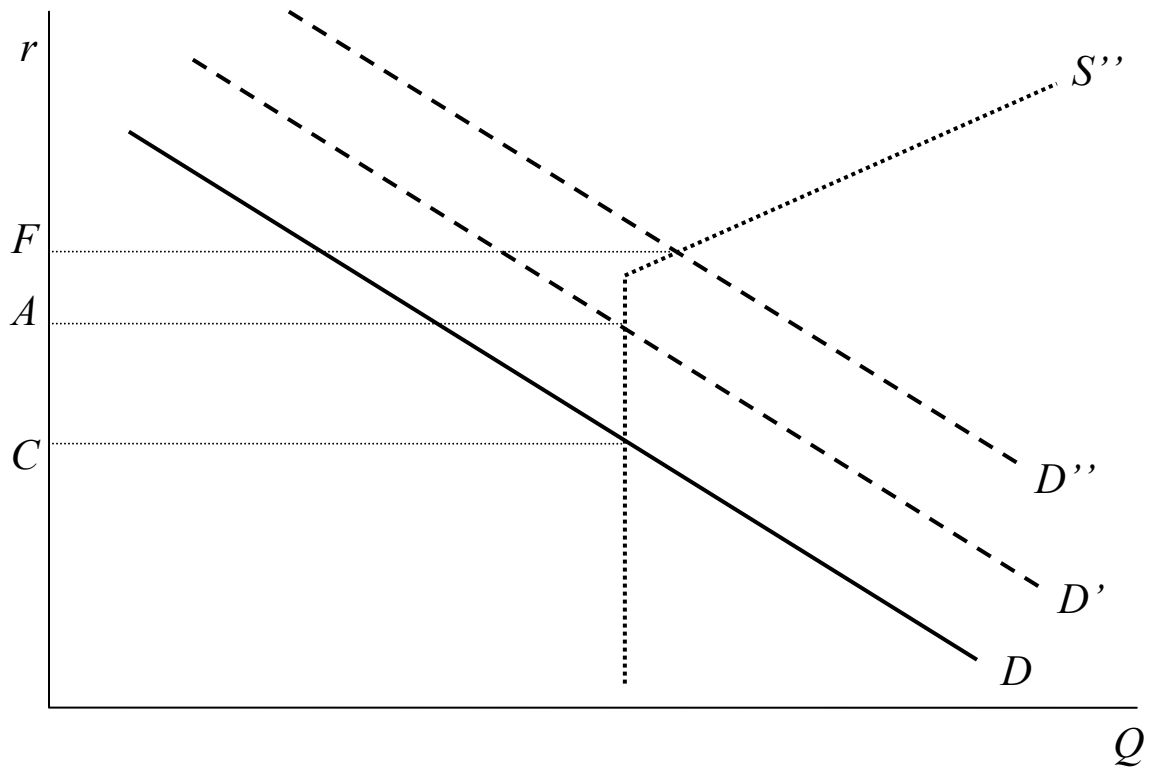
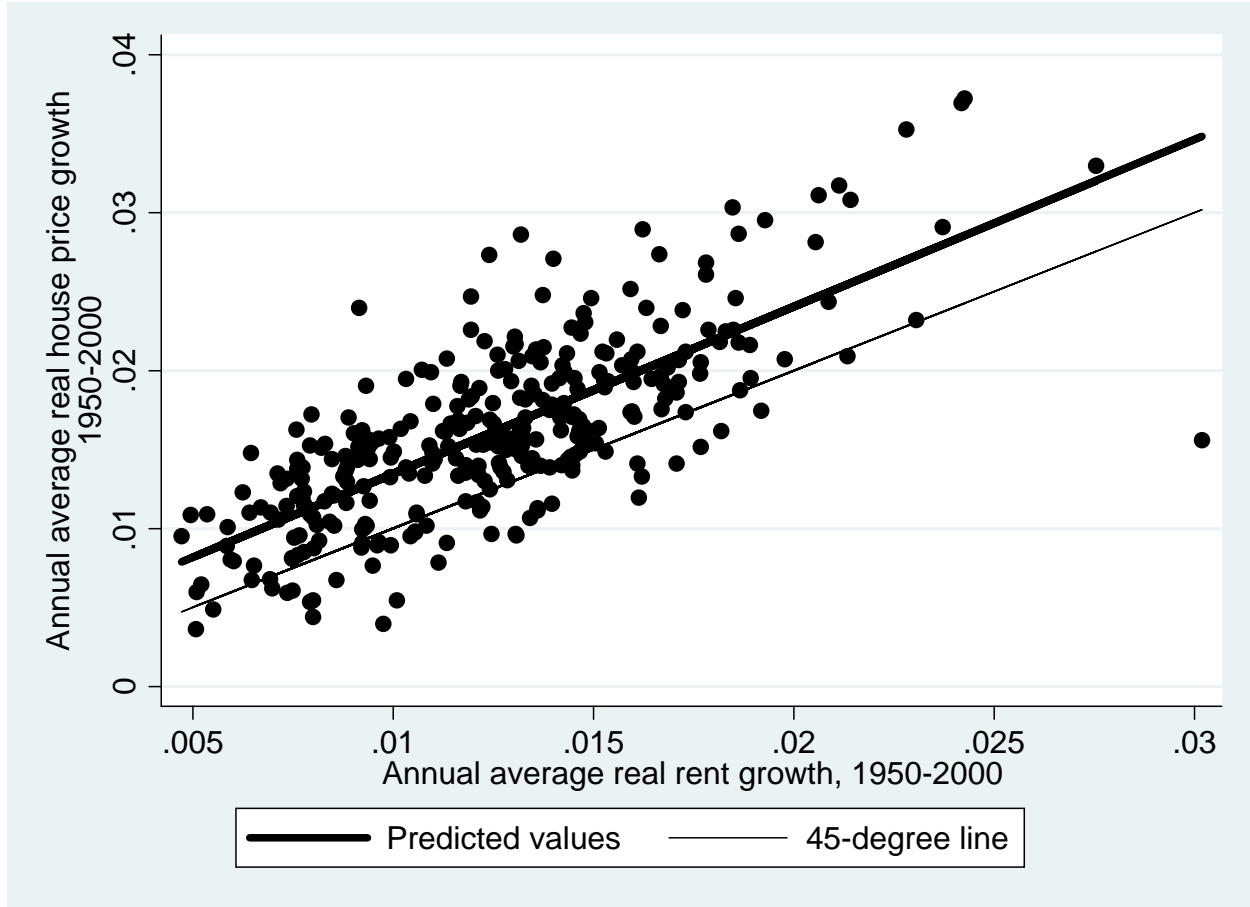
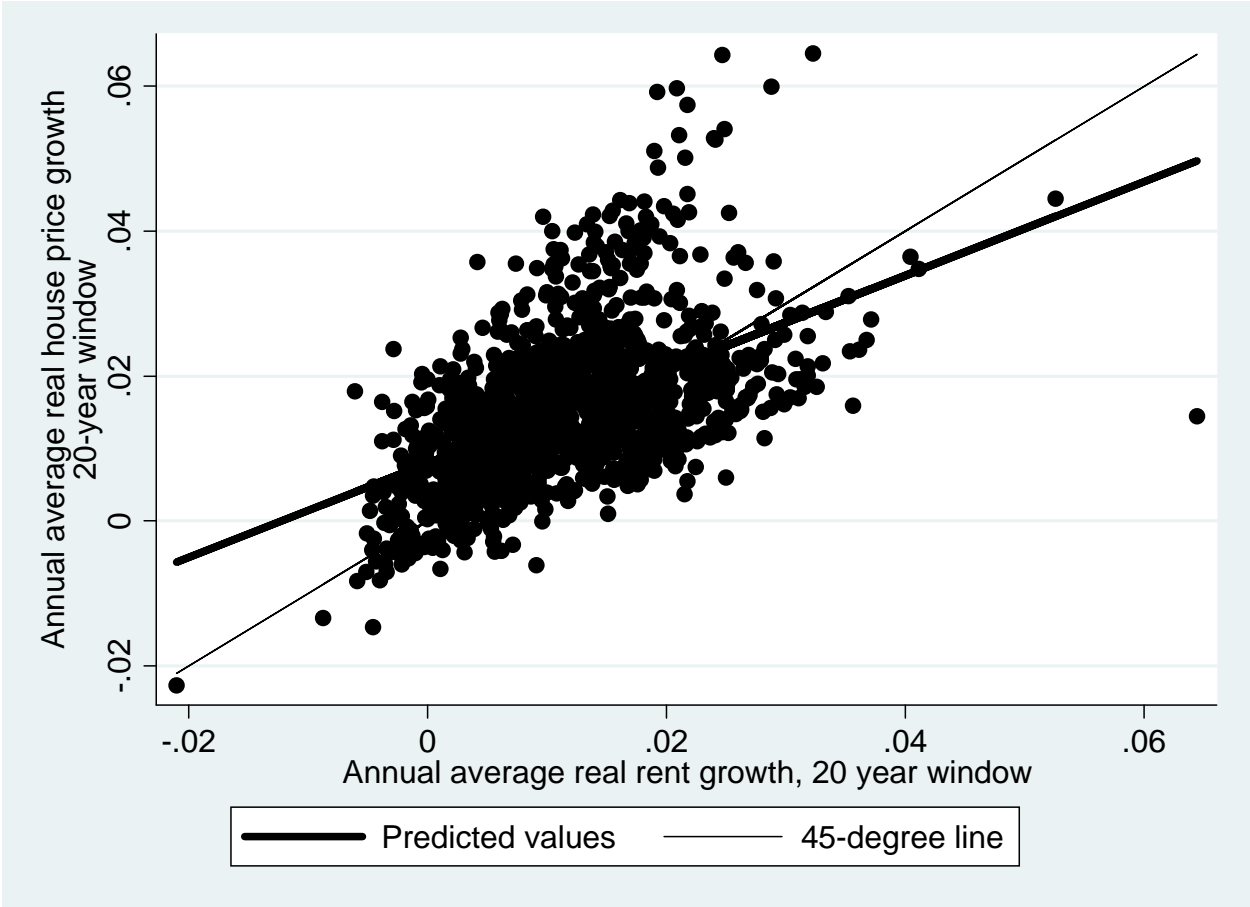


Figure 3: The relationship between long-run rent and house price growth



Notes: Data is from the U.S. Decennial Censuses, 1950-2000. Each dot corresponds to an MSA average growth rate over the 1950-2000 period.

Figure 4: The relationship between 20-year rent and house price growth, 1970-2000



Notes: Data is from the U.S. Decennial Censuses, 1950-2000. Each dot corresponds to an MSA average growth rate during a 20-year period between 1950 and 2000, so there are four dots per MSA.