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Feedback between Real Estate and Urban Economics

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Abstract: This paper considers the effect land prices might have on urban demand. Because supply constraints have increased in the U.S., shifts in demand may be more capitalized into the price of land than in the past. This change has some interesting implications. For example, house prices in some metropolitan areas have grown unaffordable to all but the highest-income decile of households nationally and this might have an effect on the fundamental character of such cities. Second, since residents often own real estate, their decisions about what regulations or investments in their communities to support may now be affected by their financial interests as landowners. Third, researchers may now be able to use land prices to make better inferences about urban demand. However, interpreting real estate prices is tricky.

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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 neat edges and crisp corners, and a bow for good measure. Urban economics is broadly concerned with the study of cities. And real estate is broadly concerned with the study of real estate. 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 productive 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.

Agglomeration economies, where a firm's productivity is determined in part by its proximity to other firms, are 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 another. When those locations are scarce, land commands rents. In turn, the financial asset market transforms current and expected future rents into prices.

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 have increased in the U.S., 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 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 a higher value to 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.

Section 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. [Rosenthal and Strange (2004); Ellison *et al* (2009)] 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. [Waldfogel (2003)] Once those amenities are in place, the location is more valuable to the marginal household. [Glaeser *et al* (2001)]

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 cost of the land. 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 prices exceed the cost of construction. Instead, if land prices 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, developers cannot build, the city cannot expand, and the benefits of location are capitalized into land rents.

[1] This literature is too voluminous to properly reference in this article. See Rosenthal and Strange (2004) and Strange (2005) for an overview. For specific examples, see also: Glaeser *et al* (1992, 1995), Glaeser and Mare (2001), Glaeser and Saiz (2003), Glaeser and Tobio (2008), Greenstone *et al* (2008), Henderson *et al* (1995), Henderson (1997), Moretti (2003, 2004), Rauch (1993), Rosenthal and Strange (2003a), and Shapiro (2006).

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. First, suppose that the supply curve for urban locations is upwards-sloping. In the short-run, that supply curve might be nearly vertical (line *S'*) as city definitions 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.

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 called 'rent', which is the periodic cost of using a particular space. When the demand curve for urban locations shifts out, to *D'*, rents rise. When the supply of urban locations increases, so the supply curve shifts out, rents fall *ceteris paribus*.

In this simple framework, demand for a type of location can manifest itself in two ways: in higher rents and in greater supply. Which effect is larger depends upon the slope of the supply curve. If land is inelastically supplied, as with the *S'* supply curve, an increase in demand is capitalized fully into price, as rents rise from *C* to *A*. If land is more elastically supplied, as with the *S* supply curve, the same increase in demand leads to a smaller increase in rents (from *C* to *B*).

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.

Other common measures of urban demand may also be sensitive to the role that land supply plays in the city. Wages, for one, are dependent on land prices. Indeed, Rosen (1979) and Roback (1982) show that households trade off wages and land rents when choosing between cities. To compensate a household for high land prices, either wages or some other amenity of a city must be great enough. In a city with elastically supplied land, a firm would not have to pay as high wages and not all of the productivity surplus would necessarily accrue to labor.

The flip side of this particular coin is that land rents themselves can 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. Papers that follow a Rosen (1979) and Roback (1982) view of spatial equilibrium, such as Gyourko and Tracy (1991), have long recognized that differences in amenity levels or public finance across jurisdictions should be capitalized into land rents. 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 premium to live in those jurisdictions. More recently, 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. 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 productivity and the distribution of house prices.[2]

This capitalization strategy can be applied whenever the feature of value has a spatial component to its distribution. Following this logic, researchers have also estimated the value of more specific amenities by using house price capitalization.[3] 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. 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.

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

[2] 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.

[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.

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 vary 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 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.

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 first 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 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 can be radically revised 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.

Section 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. That pattern 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. Growing income-weighted population meant growing aggregate demand. Some elastically-supplied MSAs could accept all potential residents; 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 revealed as a shift from high housing-unit growth and low price growth to 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 10^{th} percentile-valued home would map to the national income distribution in that year.[4]

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[4] 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.

For example, the top panel of Table 2 reports the 10 MSAs that were the least expensive at the 10th percentile 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 the U.S. population 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 house in the same 10 MSAs fall in the national income distribution. Such a house in these cities was affordable by 85 to 95 percent of the U.S. population with little change from 1950 to 2000. Clearly, for this set of MSAs, house prices did not rise relative to the national income distribution.

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. And 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.

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 works in support of economic returns to scale, by pricing those who would not contribute or benefit out of the city. 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? Is a city sustainable if such households cannot afford to live there?

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 consumptive, 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 *et al* (2001)] City amenities, such as restaurants, theater, 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 sufficient large audience to make production worthwhile. And 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 returns 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?

While low-income service providers, such as teachers, policemen, or gardeners, can command higher wages in a high-priced city, that is because they do not provide a public good. Their services are paid for by those who receive the benefits of them. When a portion of the population, by their mere presence, creates a *public* good, perhaps they may be crowded out by the free rider problem absent government intervention to subsidize their presence.

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 15 MSAs that experienced the largest declines in unaffordability. The list is comprised of declining cities: Cincinnati, Rochester, Buffalo, and St. Louis 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 10^{th} 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. 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.

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 10^{th} percentile valued houses.

Section 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 provides interesting food for thought: How might the evolution of urban areas be different as the set of stakeholders changes? In addition, this dynamic leads to empirical difficulty with using land prices. 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.

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.

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.

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 value raises their residents' property values or because it would increase the tax base. Perhaps business improvement districts 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.

Section 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 equilibrium. This zero-NPV equilibrium pricing rule can be written as:

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

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, ruling out deviations in price from fundamental value, equation (1) unravels to:

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

because the price at any time *t* is just equal to the present value of the future rents less a risk adjustment. Even with this assumption, 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 *et al* (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. Cambell *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 is 1.06 (with a standard error of 0.05), so 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. Since the intercept is close to zero, while high rent growth MSAs also have high price growth, 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 1.0, within the range of most of the sample the attenuation is offset by the intercept.

Section 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 couple of 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 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.

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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

	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					
MSA	1950	1960	1970	1980	1990	2000	1950	1960	1970	1980	1990	2000
The 10 least expensive MSAs…												
Brownsville	15	10	10	15	15	20	10	5	5	5	5	10
Enid	25	20	20	30	15	20	15	5	5	10	5	10
Joplin	15	10	15	25	15	20	10	5	5	5	5	10
McAllen	15	5	10	15	15	20	10	5	5	5	5	10
Abilene	25	20	20	25	20	20	15	5	5	10	5	10
Beaumont	25	20	20	25	20	20	15	5	10	10	5	10
Johnstown	25	20	15	25	20	20	10	5	5	10	5	10
Pine Bluff	15	20	20	25	20	20	10	5	5	5	5	10
Shermon-Denison	20	10	20	25	20	20	10	5	5	5	5	10
Steubenville-Weirton	25	30	25	30	20	20	15	5	10	10	5	10
The 15 most expensive MSAs…												
Boulder	25	40	40	60	55	75	15	10	20	60	30	45
Seattle	45	40	40	60	65	75	20	20	25	30	30	45
Nassau-Suffolk County	65	40	55	60	80	75	25	30	25	25	55	45
New York	65	N/A	55	60	90	75	25	N/A	30	25	55	45
San Diego	45	40	40	80	80	75	25	30	25	60	55	45
San Luis Obispo	25	30	30	60	90	75	15	10	15	30	55	45
Bergen-Passic	65	50	55	60	90	75	25	40	30	30	65	45
Oakland	65	40	40	80	90	85	25	20	25	30	55	45
Salinas	45	40	40	80	80	85	20	10	25	60	55	45
Ventura	45	40	40	80	90	75	15	20	25	60	80	50
Santa Rosa	45	40	40	80	90	85	20	10	20	60	55	50
Orange County	45	40	55	90	95	85	20	30	30	60	80	50
Santa Cruz	45	30	40	80	95	95	20	10	20	60	65	65
San Francisco	65	50	55	90	100	95	25	30	30	60	80	85
San Jose	65	40	55	90	95	95	25	30	30	60	80	85

Notes: Data is from the U.S. Decennial Censuses, 1950-2000. Median and 10^{th} 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 10^{th} 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

	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					
MSA	1950	1960	1970	1980	1990	2000	1950	1960	1970	1980	1990	2000
The 15 MSAs with the largest decline…												
Cleveland	65	40	40	60	30	35	25	20	25	25	15	20
Cincinnati	65	40	30	30	30	35	20	10	15	15	15	20
Rochester	65	40	40	60	30	35	20	20	20	25	20	25
Elmira	45	30	25	25	25	20	20	10	15	10	10	10
El Paso	45	30	25	30	25	20	15	10	15	10	10	15
Binghamton	45	40	30	30	45	25	20	10	15	15	20	15
Waterloo-Cedar Falls	45	30	25	30	20	25	15	10	15	15	10	10
Utica-Rome	45	30	25	25	30	25	15	10	15	10	10	15
Milwaukee	65	40	40	60	45	45	25	30	25	25	20	20
Madison	65	40	40	60	45	45	20	20	20	30	25	30
Buffalo	45	40	30	30	30	30	25	20	20	10	15	20
Casper	45	40	25	60	25	30	15	10	15	30	10	15
St. Louis	45	40	25	30	30	30	15	10	15	10	10	15
Rochester	45	40	40	30	45	30	20	10	20	15	20	20
Rockford	45	40	30	30	30	30	20	10	20	15	10	20
The 15 MSAs with the largest rise…												
Portland	25	30	25	60	30	50	15	10	15	25	20	35
Bellingham	25	20	25	60	45	50	15	5	15	25	25	30
Wilmington	20	10	25	30	30	45	10	5	5	10	10	25
San Diego	45	40	40	80	80	75	25	30	25	60	55	45
Seattle	45	40	40	60	65	75	20	20	25	30	30	45
Ventura	45	40	40	80	90	75	15	20	25	60	80	50
San Francisco	65	50	55	90	100	95	25	30	30	60	80	85
San Jose	65	40	55	90	95	95	25	30	30	60	80	85
Santa Fe	25	30	25	60	55	65	10	5	15	25	30	35
Orange County	45	40	55	90	95	85	20	30	30	60	80	50
Salinas	45	40	40	80	80	85	20	10	25	60	55	45
Santa Rosa	45	40	40	80	90	85	20	10	20	60	55	50
Boulder	25	40	40	60	55	75	15	10	20	60	30	45
San Luis Obispo	25	30	30	60	90	75	15	10	15	30	55	45
Santa Cruz	45	30	40	80	95	95	20	10	20	60	65	65

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

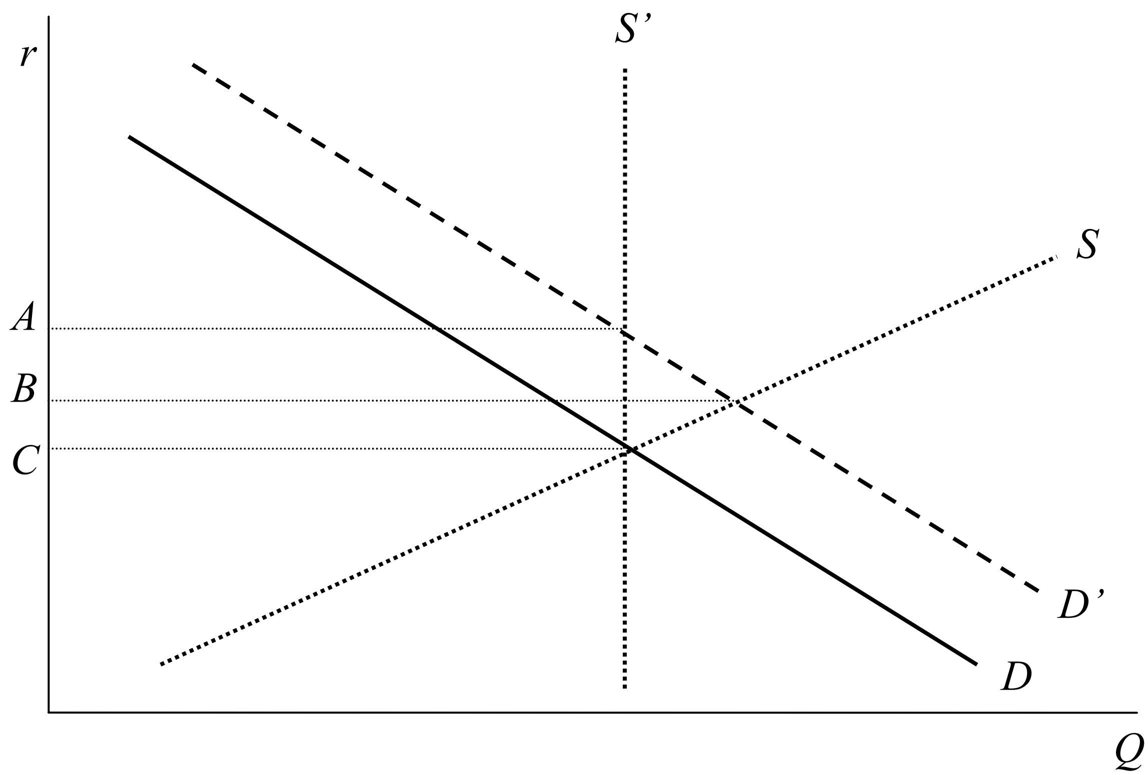


Figure 2: Supply and Demand for Real Estate with a Kinked Supply Curve

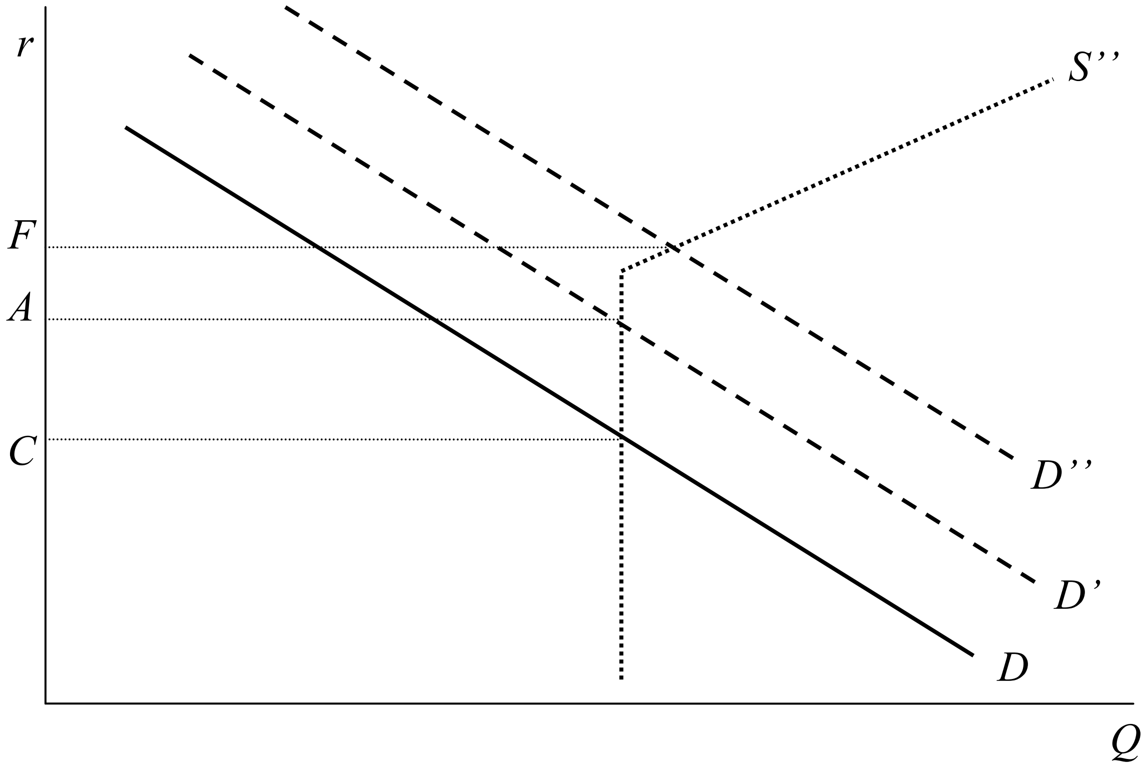
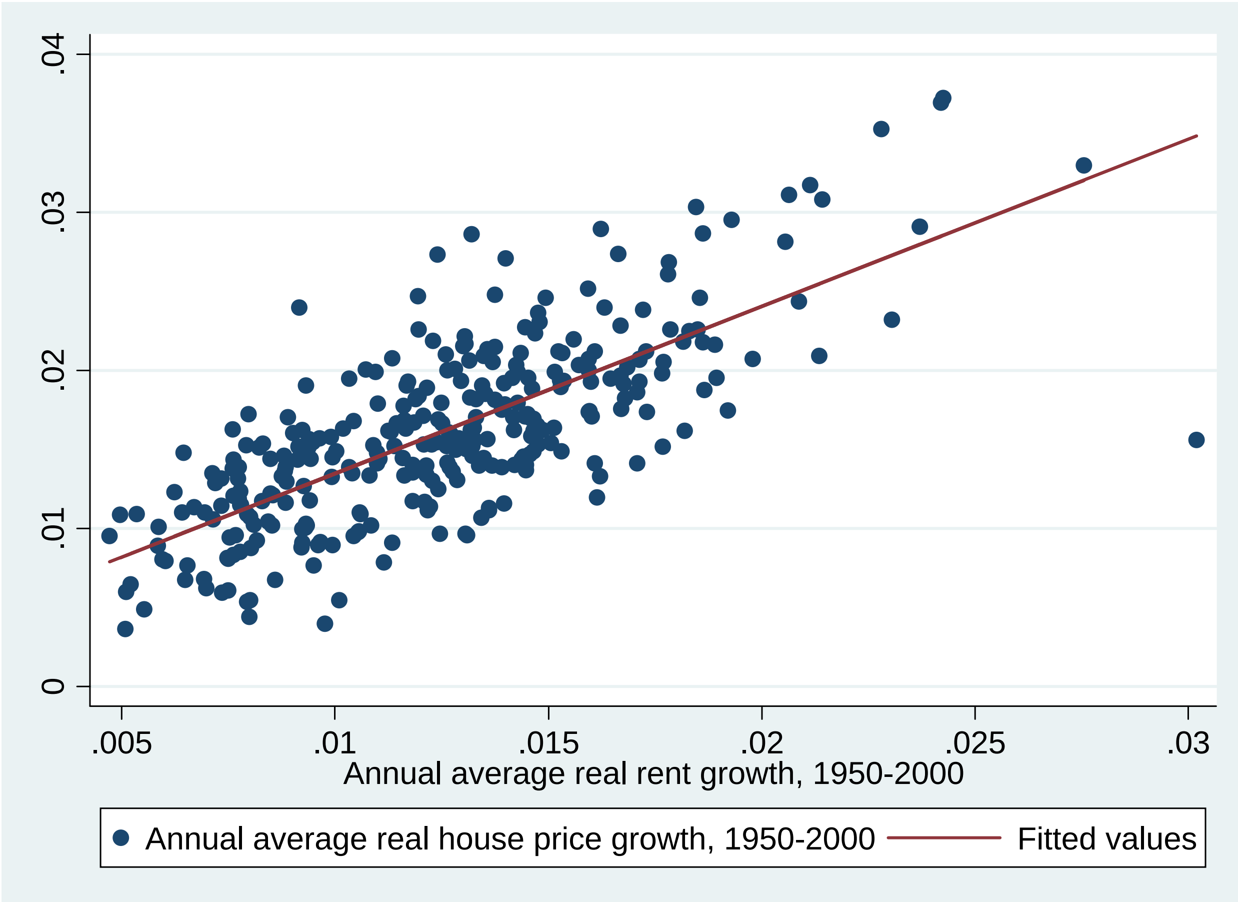


Figure 3: The relationship between long-run rent and house price growth



Notes: Data is from the U.S. Decennial Censuses, 1950-2000.

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.