American Economic Review: Papers & Proceedings 2013, 103(3): 1–42
http://dx.doi.org/10.1257/aer.103.3.1

RICHARD T. ELY LECTURE

A Nation of Gamblers: Real Estate Speculation and American History†

By Edward L. Glaeser*

> *Generally speaking, the prudent purchase of land is a better investment for the ordinary man than stocks and bonds, because in the former case he does not pit his judgment against the machinations of a board.*
>
> —Richard T. Ely, 1920

I. Introduction

Between January 2000 and March 2006, the Case-Shiller 20 city real estate price index rose by 76 percent in real terms, and then declined by 36 percent between March 2006 and May 2009, leaving real prices today only 7 percent higher than they were at the turn of the millennium. Figure 1 shows the time series of price for 281 metropolitan areas based on the Federal Housing Finance Agency's (FHFA) repeat sales price index. The figure displays different paths for the warmest fourth of metropolitan areas and the rest.[1] Figure 2 shows the relationship between the change in the logarithm of FHFA prices between 2000 and 2006, and the change in the logarithm of FHFA prices between 2006 and 2012. The figure illustrates both the remarkable amount of mean reversion

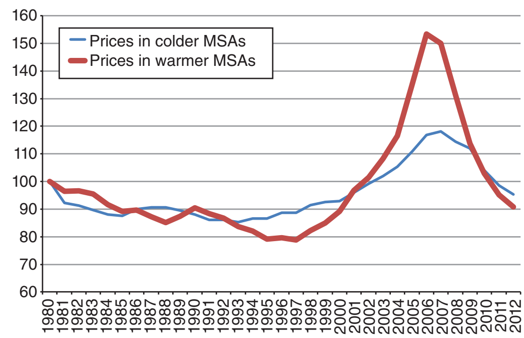

Figure 1. Housing Price Growth for Warm versus Cold MSAs, 1980–2012

Note: FHFA-corrected housing values indexed to 1980 (1980 = 100).

Source: Data from the US census and the Federal Housing Finance Agency (FHFA) http://www.fhfa.gov/Default.aspx?Page=87.

(the regression coefficient is −0.85) across areas and the tremendous heterogeneity across the United States.

Economists have now studied this Great Housing Convulsion extensively (e.g., Mian and Sufi 2009; papers in Glaeser and Sinai forthcoming), but many questions remain unresolved. Why did spectacular booms and busts occur when and where they did? Were buyers largely rational, or were their beliefs inconsistent with any sensible model of housing prices? What role did credit markets play in fueling the boom or causing the bust? What are the policy implications of the Great Convulsion?

In the spirit of Nicholas and Scherbina (2011); Goetzmann and Newman (2010); and Shiller (2008), this lecture attempts to use America's

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† To view additional materials, and author disclosure statement,visit the article page at http://dx.doi.org/10.1257/aer.103.3.1.

[1] The warmest fourth is defined based on January temperatures. I correct the price index for inflation, scaled it to have a value of one in 2000 and then multiplied by the census 2000 self-reported housing value in 2012 dollars.

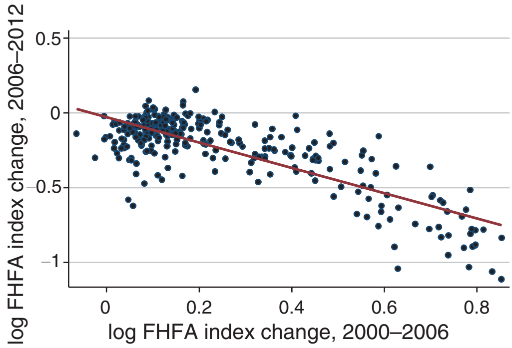

Figure 2. Mean Reversion in MSA Housing Prices 2000–2006 and 2006–2012

Source: Price data from the Federal Housing Finance Agency (FHFA) http://www.fhfa.gov/Default.aspx?Page=87.

long history of real estate speculation to shed light on recent events. I briefly study nine episodes, from the frontier lands of the 1790s to today, and draw six key lessons from the past.

The first and most obvious lesson of this history is that America has always been a nation of real estate speculators. Price and construction convulsions have been common in both rural and urban areas. Real estate is a particularly democratic asset that attracts the mighty, like George Washington and Benjamin Franklin, and the modest, like the small farmers in Kent, Connecticut, who were buying and selling land parcels rapidly in 1755 (Grant 1955). Real estate speculation was an integral part of the "winning of the west," the construction of our cities, and the transformation of American home life, from tenements to mini-mansions.

The second lesson is that these boom-bust cycles can generate significant social costs, primarily through ensuing financial chaos. This fact implies some urgency to rethinking the national and local policies that impact housing markets. If buyers are particularly prone to engage in wishful thinking about future price appreciation, then policies that encourage homeowner borrowing, such as providing underpriced default options, can create larger social losses.

The third lesson is that the high prices paid during the boom and the low prices paid during the bust are typically compatible with reasonable models of housing valuation and defensible beliefs about future price growth. The farmers in Iowa in 1910 had experienced 15 years of rising real wheat prices and 40 years of rising wheat yields. High land prices were understandable. Manhattan's builders in 1929 could justify their land purchases based on current office rents and reasonable capitalization rates (Clark and Kingston 1930). Distinguished real estate economists (Himmelberg, Mayer, and Sinai 2005) examined price-to-rent ratios in 2004 and argued that they seemed reasonable given plausible expectations about future price growth and current capital costs.

The fourth major lesson is that while low interest rates have been less important in generating price booms, underpriced default options can often help explain high prices. The great Chicago land boom of 1836–1837 was coincident with the chartering of two new state-supported Illinois banks. Securitization of mortgages for builders in the 1920s appears to have decreased the downsides of development (Goetzmann and Newman 2010). Increased credit availability also boosted prices during the recent boom (Mian and Sufi 2009).

The fifth lesson is that the dominant mistake that investors make is to underestimate the impact that elastic long-run supply of land, structures and crops will have on future land values. Land buyers during Alabama's 1819 land boom look sensible given then-current cotton prices and trends. Land values depreciated as cotton prices fell with increased US and worldwide supply. Similarly the skyscraper builders of the 1920s seem to have underestimated the impact that vast increases in office and apartment space would have on long-term rents. Home buyers in Las Vegas and Phoenix in 2005 seem to have misunderstood the almost perfectly elastic supply of homes in America's deserts.

The sixth lesson is that the Great Convulsion of the past 12 years is unlike previous booms in at least one major way. In every previous episode there was significant uncertainty about major economic trends that would impact land values and housing prices. In the late eighteenth century, it was unclear how quickly transportation costs could fall and how fast Americans would move west. Those trends were still unclear in 1887 in California. The future appeal of dense downtowns, like Chicago and New York, was unsure in 1835 and still unsure a century later. There is no obvious equivalent source of uncertainty during the post-2001 period.

While the conventional economic approach to housing has been to eschew nonrational or non-Bayesian expectations, there is a strong countercurrent in real estate economics, where scholars like Kindleberger (1978) and Shiller (2008) almost discard rationality altogether. As of 2013, Shiller seems far wiser than the hyper-rationalists, but real estate economists lack a clear theoretical alternative to the assumption that buyers are rational and face no cognitive limits.

In Section II of this paper, I discuss four different conceptions of market malfunction—arbitragibility, irrationality, limited cognition, and ordinary error—and apply these conceptions to real estate markets. A market can be arbitraged if any reasonable, well-informed person can make large profits risklessly, but few, if any, of our past land booms were that easy to game, partially because of short-selling constraints and high-risk levels. A market is irrational if no coherent model of real estate values can justify existing prices. A market displays limited cognition if prices are not compatible with a well formulated general equilibrium model that incorporates all available information. A market displays ordinary error if an extraordinary forecaster would have bought, even though unpredictable subsequent events caused prices to drop significantly.

Most real estate markets, during extreme booms and busts, lie somewhere between limited cognition and ordinary error. Reasonable models, such as the finance-based net present value Gordon growth formula or the geography-based Rosen-Roback model, can typically justify prices during booms and busts. Buyers' primary error appears to be a failure to internalize Marshall's (1890) dictum that "the value of a thing tends in the long-run to correspond to its cost of production." But that error is better seen as limited cognition—failing to use a sophisticated model of global supply and demand—than as "lacking usual or normal mental clarity or coherence," one of Merriam-Webster's definition of irrationality.

After discussing irrationality and housing markets in Section II, I turn to the history of real estate convulsions in the United States. In Section III, I follow Ely and Wehrwein (1940) and focus on rural land value episodes. I discuss Robert Morris' investments in western land that ended in his 1798 bankruptcy and may have helped cause the financial crisis of 1797. I then turn to 1818, where property values rose dramatically, especially in Huntsville, Alabama, and then collapsed in the Crisis of 1819. Finally, I examine the period from 1900–1930 where rural land, particularly in Iowa, prices first rose dramatically, reaching historic heights in the early teens, before dropping during the 1920s, almost ten years before the Great Depression.

In Section IV, I turn to urban real estate. Luckily, Hoyt (1933) has provided us with 100 years of land values in Chicago, and I focus first on that city and its 1830s boom. I then turn to Los Angeles in the 1880s and finish with New York during the 1910–1940 period, relying on the evidence provided by Nicholas and Scherbina (2011).

Section V turns to metropolitan booms that spread far from the urban core. I briefly discuss the boom that didn't happen between 1945 and 1960, when credit conditions changed drastically, but prices stayed relatively flat due to elastic supply (Fetter 2010). I then turn to the mini-boom of the 1970s and 1980s, especially in California. I end with the boom of the recent decade, which had a particular propensity to push prices up in the Sunbelt, as Figure 1 illustrates.

Section VI summarizes and concludes. There is no obvious common source of buyer overoptimism during booms, and simple models, such as extrapolating future growth rates, are usually too weak to definitively warn against overpaying. There is however a common mistake: ignoring the impact that added supply will have on long-term price. This ordinary, understandable error can increase the volatility of housing prices and raise the costs of policies that artificially induce leveraged speculation on real estate.

In my discussions of price, the value in 2012 dollars appears in parentheses after each amount.

II. Limited Rationality and Housing Markets

Over the past 20 years, spurred on by experimental evidence and events like the Internet equity boom and bust, economics has increased embraced "behavioral" models that assume either limited cognition or downright irrationality (e.g., Kahneman 2003). One challenge facing behaviorists is the lack of a single compelling model of human error. This difficulty is a corollary to Tolstoy's line that "Happy families are all alike; every unhappy family is unhappy in its own way." There is only one way to do Bayesian forecasting correctly, but there are an uncountable number of ways to screw up.

Case, Shiller, and Thompson's (2012) surveys of home buyers during booms suggest that they hold a dizzying array of apparently inconsistent beliefs about future prices. Buyers in Boston in 2004, for example, on average report that they believe that housing prices will increase by 10.6 percent in each of the next ten years, but only by 7.6 percent in the next year. These beliefs have many plausible sources. Some buyers may be extrapolating from recent trends; others may be engaged in wishful thinking about the value of their largest asset. Glaeser (2006) emphasizes the role of entrepreneurs of error, who persuade buyers that home prices will experience dazzling future growth. The history of real estate bubbles is replete with examples of interested parties hyping local land values.

But economic models will lose all discipline if they treat investors as blank slates that irrationally absorb any foolish notion that they hear. An alternative approach is to assume that such beliefs are limited by sensible models of asset valuation. In this discussion, I borrow an idea from Hansen, Heaton, and Jagannathan (1992) and ask what range of prices is compatible with different, reasonable assumptions about human decision-making and markets. Buyers observe sellers' asking prices, receive myriad suggestions about home values, and then determine whether these suggestions are reasonable and whether it is worth buying at current prices. The range of plausible expectations creates a range of possible equilibrium prices, at least to the outside observer who is not privy to the murky workings of buyers' mental processes.

To illustrate this approach, I will outline a hierarchy of assumptions, each of which imposes more stringent predictions about the prices that can appear in a housing or land market. The least stringent assumption is the absence of arbitrage. This assumption implies only that reasonable people can't earn outsized risk-adjusted profits by following any obvious investment strategy. In the case of pricing derivative securities, this assumption yields tight predictions (e.g., Black and Scholes 1973), but even this assumption yields far weaker predictions for underlying values of assets like equities. Classical models predict that stock prices should follow a random walk (Samuelson 1965), but it is hard to assess whether values at a point in time are too low or high, and it is difficult to arbitrage over long time periods (Barberis and Shleifer 2003).

Similar difficulties limit arbitrage in housing and land markets. Lewis (2010) describes the highly profitable undertakings of some visionary investors who thought that mortgage-backed securities were overvalued during the recent boom. However, their profits required substantial insight and good luck. If the boom had lasted a few years longer, surely a possibility, they would have faced significant financing difficulties. Moreover, financial innovations gave them the ability to essentially short-sell property-related securities, which has traditionally been difficult, especially with real property itself.[2] Even if an investor is quite certain that prices will decline, there was no obvious way to short-sell property or land, either in Chicago in 1836 or Las Vegas in 2005.[3] The absence of arbitrage is also compatible with a wide range of housing prices, because arbitrage through purchase-timing is costly due to the risks inherent in future price fluctuations (Glaeser and Gyourko 2009).

The next level of market efficiency is rationality, which I take to mean that buyers' beliefs are compatible with some sensible model of real estate values. This allows the possibility of errors due to faulty inference and the more egregious mistakes that can result when the model used to forecast the future is badly misspecified (Hansen 2007). For example, incorrectly assuming that prices follow a geometric Brownian motion with drift implies extremely different price levels in different markets, based on past price patterns, even if true fundamentals are the same.[4] A market only violates rationality if the prices for land and housing are incompatible with any internally

[2] It is unclear how easy it would have been to short sell mortgage-backed securities in the 1920s (Goetzmann and Newman 2010).

[3] In the later period, it would have been possible to short sell the stocks of developers who had purchased land in the Las Vegas region, but that would have meant taking on many other risks (such as the general management of the company) as well as the normal difficulties in selling stocks short (Shleifer and Summers 1990).

[4] Assume that in reality there is no drift, and that one place has just received a recent positive shock making it identical with the second place. The first place will be thought to have a trend, while the other will not.

consistent theory that matches data readily available to market participants.

Real estate speculation, always and everywhere, reflects the conjunction of geographic fundamentals, that determine the value-in-use of land, and financial variables, that help translate a future flow of explicit or implicit rents into a current price. Two models dominate the academic discussion of real estate, and variants of them are also used by market participants. Urban and land economists, such as Ely himself, typically focus on the value-in-use of real estate, which reflects different geographic advantages. Financial economists have often been more interested in financial variables, such as interest rates, down payment requirements, and mortgage approval rates, which determine the value of a flow of future implicit rents (Poterba 1984; Himmelberg, Mayer, and Sinai 2005).

The first model follows the work on land rents of Ricardo (1822) and von Thunen (1826). I will refer to its adherents as Thunenites. This model focuses on spatial arbitrage, comparing real estate prices with prices elsewhere within the region or nation. A place should only have higher rents, and presumably higher housing and land values as well, if it offers higher wages or other amenities (Rosen 1979; Roback 1982). Within cities, the spatial arbitrage model was applied by Alonso (1964); Muth (1964); and Mills (1967), to predict that housing costs and density levels should be higher where commuting costs are lower.

The spatial arbitrage model's empirical successes have typically involved rents or land values at a point in time (e.g., Black 1999), or very long-run multi-decade changes.[5] At higher frequencies, it is hard to justify the overall level of volatility or the patterns of housing price changes (strong positive serial correlation at annual frequencies, strong mean reversion at five year frequencies), with changing fundamentals at the metropolitan area level (Glaeser et al. 2011). Yet that fact does not mean that buyers are not justifying prices by comparing them with other areas. The pattern of progression of the recent boom, where price growth gradually spread from the costs to nearby areas (Ferreira and Gyourko 2011) suggests that people may have been benchmarking prices off of geographically proximate locales.

The primary alternative model is the net present value formula offered by real estate economists with a more financial orientation. Poterba (1984) offers a classic treatment, and in these models prices equal either the net present value of future rents or the net flow of utility from living in a particular house. Since that net flow may reflect the difference in utility between the location and some reservation locale, this approach can be seen as transforming Thunenite predictions about land rents into an asset price. Typically the formula predicts a capitalization rate where $P_t = \frac{x_t}{\rho + m + \tau - \alpha}$, where x_t reflects the current state of demand (the "rent"), ρ is the discount rate, m reflects maintenance costs (assumed to be a fixed share of housing prices), τ represents the property tax rate and α represents the growth rate of x.[6] This is the real estate version of the standard Gordon (1959) growth formula, and I will refer to its adherents as Gordonians.

Gordonians are often particularly interested in financing arrangements, and the model can easily be extended to allow for mortgage payments that differ from private discount factors and for endogenous defaults. If individuals pay a mortgage rate of r over an infinite horizon, and pay a down payment equal to d times the price, and if x_t follows a geometric Brownian motion with drift α and variance σ^2, and borrowers can default at will, then the pricing formula becomes

$$(1)\quad P_t = \frac{\rho}{\rho d + r(1-d) + m + \tau} \times \left(\frac{z^z(\rho-\alpha)^z((\tau + m + r(1-d))P_t)^{1+z}}{\rho^{1+z}(1+m)^{1+z}} x_t^{-z} + \frac{x_t}{\rho - \alpha} \right),$$

where $z = \frac{\alpha - 0.5\sigma^2 + \sqrt{(\alpha - 0.5\sigma^2)^2 + 2\sigma^2\rho}}{\sigma^2}$.[7] The derivation of this formula follows Krainer,

[5] For example, 20 year changes in income correlate strongly with 20 year changes in housing values across metropolitan areas.

[6] I am ignoring more complex issues surrounding mortgage deductibility and inflation (Poterba 2004).

[7] In this formula, I have assumed that mortgage, maintenance, and tax costs are a function of the initial price of the property not of its later selling price.

LeRoy, and O (2009). To incorporate uncertainty about default, it is possible to assume that individuals can only default with probability π, and then the first term (which reflects the value of the default option) is just multiplied by π.

If there is no uncertainty, then $P_t = \frac{\rho}{\rho d + r(1-d) + m + \tau} \frac{x_t}{\rho - \alpha}$. The impact of market interest rates on prices will be less than in the classic Gordon formula, as long as market rates and private discount rates aren't equal, which seems likely given credit-constrained borrowers. Glaeser, Gottlieb, and Gyourko (forthcoming) present simulations that demonstrate that the predicted impact of interest rates on housing prices are significantly reduced when interest rates are decoupled from private discount factors. Interest rates will also have a lower impact on prices than the classic formula suggests because of elastic housing supply, and mean reversion of interest rates, which implies that buyers who face low rates when they purchase should expect to sell when rates are higher and that buyers who borrow at high rates should expect to refinance at lower rates. The empirical relationship between log prices and real interest rates is approximately -7 (1 percentage point drop in real rates implies 0.07 log points higher housing prices), which is in line with the predictions from extended Gordon models, if not with the model simply applied.

If the default option is priced into the interest rate, and if borrowers and lenders have the same discount rate and are both risk neutral, then it has no impact on price. If the default option is not priced into interest rates, perhaps because of government subsidy, then this will increase the willingness-to-pay for the home. I will use this formula to evaluate the impact that a free put option has on prices in the historical examples.

The impact of financial variables differs with the degree of optimism or overoptimism, which can be seen as an inappropriately high assessment of α. Interest rates become more powerful when expected growth rates are high (Himmelberg, Mayer, and Sinai 2005). The default option becomes significantly less valuable if buyers expect prices to perpetually increase. If buyers think that high growth is accompanied by high uncertainty, then a free default option moves prices more. If marginal buyers are wildly optimistic about future growth rates, then higher approval rates could more significantly impact price, which is one interpretation of Mian and Sufi's (2009) findings on the connection between subprime mortgages and recent price growth.

The next step toward market efficiency occurs when participants are not only rational, but have essentially unlimited cognitive powers and correctly model the long-run determinants of market supply and demand. This assumption enables them to move from crude capitalization rates or spatial equilibrium models to sophisticated general equilibrium estimation that takes into account the global supply of land, and demand for other commodities. Market participants with unlimited cognition would correctly foresee that worldwide cotton prices in 1819 would not stay high, because of the ability to grow cotton in lower cost locations throughout the planet. This assumption puts tighter bounds on beliefs, but even here false signals may cause errors.

To look at the differences in prices between cognitively limited and unlimited buyers, I assume that there is a stock of housing denoted K_t, which also equals the number of households in the community, and this depreciates so that the change in $-\delta K_t + I_t$, where I_t refers to new construction. The cost of construction is $c_o + c_1 I_t$, which creates some congestion in the construction sector. The expected value of a building equals $\int_{j=0}^{\infty} e^{-(\rho+\delta)j} R_{t+j}\, dj$, where R_{t+j} represents the rents in each period. I now introduce a downward sloping demand curve so the rent equals $x_t - vK_t$, where x_t grows continuously at a rate α.

In a cognitively unlimited world, $c_o + c_1 I_t = \frac{x_t}{\rho + \delta - \alpha} - v \int_{j=0}^{\infty} e^{-(\rho+\delta)j} K_{t+j}$, so that construction costs equal the expected value of future rents. Given an initial stock of capital, K_0, the time path of prices satisfy

$$(2)\quad P_t = \frac{x_t}{\rho + \delta - \alpha + \frac{v}{c_1(\delta + \alpha)}} + \frac{v c_0}{v + c_1(\rho+\delta)\delta} + \frac{e^{(0.5\rho - \gamma)t} v}{\delta + 0.5\rho + \gamma} \times \left(\frac{x_0}{v + c_1(\rho + \delta - \alpha)(\delta + \alpha)} - \frac{(\rho+\delta)c_0}{v + c_1(\rho+\delta)\delta} - K_0 \right),$$

where γ denotes $0.5\sqrt{(2\delta+\rho)^2+4\frac{v}{c_1}}$. Prices converge to $\frac{x_t}{\rho+\delta-\alpha+\frac{v}{c_1(\delta+\alpha)}}+\frac{vc_0}{v+c_1(\rho+\delta)\delta}$, and the long-run capitalization rate is $\frac{1}{\rho+\delta-\alpha}$. If there is no growth and c_1 is sufficiently small, then price should essentially converge to the construction costs.

If home buyers or developers who rented units were naïve Gordonians, who assumed that rents would continue to grow perpetually at a rate g (they do not attempt to forecast changes in supply), then the price will equal $x_t - vK_t$ (the current rent) divided by $\rho+\delta-g$. Builders will respond to that price so $c_o + c_1 I_t = \frac{x_t - vK_t}{\rho+\delta-g}$, as long as these beliefs hold. Substituting in for the implied capital stock means that prices will equal

$$(3)\quad P_t = \frac{x_t}{\rho+\delta-g+\frac{v}{c_1(\delta+\alpha)}} + \frac{vc_0}{v+c_1(\rho+\delta-g)\delta} + \frac{ve^{-\left(\delta+\frac{v}{c_1(\rho+\delta-g)}\right)t}}{\rho+\delta-g} \times \left(\frac{x_0}{v+c_1(\rho+\delta-g)(\delta+\alpha)} - \frac{c_0(\rho+\delta-g)}{v+c_1(\rho+\delta-g)\delta} - K_0\right).$$

If $\alpha = g = 0$, then the long-run prices and capital stock will be the same in the two cases, which is not surprising since the Gordonians eventually get things right. If $\alpha = g > 0$, then Gordonians will typically pay higher prices in the long run, because the actual growth rate in price is lower than they anticipate, but the Gordonian model surely makes more sense in the short run, before reality has a chance to disabuse buyers of their errors.

In Figure 3, I illustrate price dynamics given a naïve Gordonian and hyper-rational world, assuming that $\delta = 0.01$, $\frac{v}{c_1} = 0.01$, $\rho = 0.05$, $\alpha = 0.01$, $K_0 = 1{,}000$, $X_0 = 20$, $C_0 = 20$, and $g = 0.005$.[8] Both X_0 and C_0 are denominated in thousands of dollars. This city begins with less capital than it will have in the long run, and the gap between Gordonian and correct beliefs ultimately stems from that fact. The Gordonian takes current prices and capitalizes them, expecting a growth rate that is actually lower than the long-run growth in demand, without recognizing that new supply will dramatically lower rents.

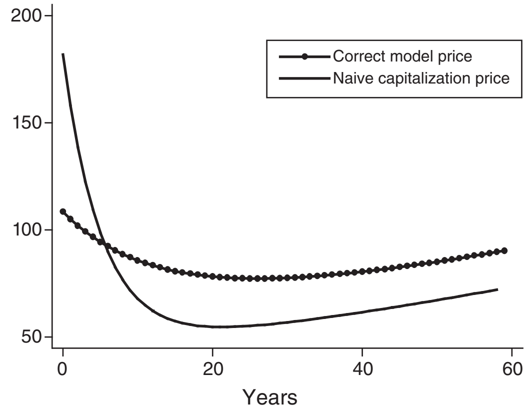

FIGURE 3

Notes: This figure simulates the price patterns as described by the model. The steeper line reflects the prices implied if buyers are naïve Gordonians who extrapolate future rent growth 0.5 percent per year. The flatter line reflects the prices implied by more rational buyers. Prices are in thousands of dollars.

High Gordonian prices then motivate an excess of supply in the short run that further depresses prices in the long run. This creates a huge boom-bust cycle in housing prices and construction. The perfect cognition case, conversely, displays far more moderation, since the impact of extra supply is correctly anticipated. Overshooting can easily occur even if Gordonians don't expect high growth rates. A failure to foresee price declines caused by increased supply is enough to generate overbuilding and radical price swings.

The final level in the hierarchy of market perfection is that all future shocks are foreseen. In that model, we wouldn't expect to see any of the massive fluctuations that we see in housing and

[8] The parameter $\frac{v}{c_1}$ is based on estimates from Glaeser et al. (2011), which finds estimates of c_1 ranging from \$1 to \$10 depending on the region of the country, but with the bulk of the estimates toward the lower part of that range. The value of 0.01 for v means that every extra 10,000 homes reduces the value of living in the area by \$100.

land values, since prices will perfectly anticipate future events.

I now turn to the historical examples, where I will attempt to connect events with the models just discussed and the hierarchy of errors. The approach of examining particular episodes has problems. These episodes are not representative of housing or land price fluctuations over all of American history. They are chosen because they are extreme, so the estimates of mean reversion, for example, during these periods do not indicate anything about housing markets over any broader time period. Additionally, early episodes are usually studied in places that became successful ex post, like Chicago in the 1830s, and this will mean that the boom prices may appear more reasonable with the benefit of hindsight than they actually were given the information available at the time.

III. Rural Land Speculation

In this section, I examine three episodes of rural land speculation in US history: the eighteenth century boom and bust of Robert Morris, the land boom of 1818 that preceded the panic of 1819, and the great wave of land price increases and declines between 1890 and 1933. Table 1 provides the most significant facts about these booms.

A. *Eighteenth Century Land Speculation*

In 1798, America's most famous financier, Robert Morris, was imprisoned for indebtedness. His once vast fortune had been wagered on stunningly large land holdings and he was now unable to pay his creditors. His failure would be one of the landmark events of the financial crisis of 1797.

Before Morris' bankruptcy, he occupied a storied, somewhat unique place in American history, as a merchant, financier of the revolution, signer of the Declaration of Independence, and national "Superintendent of Finance" from 1781 to 1784, when he may have been the wealthiest man in America. Morris gambled in real estate throughout his career, but his truly immense real estate speculations began in 1790, when he spent about $175,000 ($4.4 million) to buy about 1.3 million acres of New York State land, from Nathaniel Phelps, Oliver Gorham, and other Massachusetts investors.

Phelps, Gorham, and Morris were engaged in the great eighteenth century business of large scale land speculation on the American frontier, a practice of the Ohio Company, the Vandalia Company (Benjamin Franklin was an investor), the Loyal Land Company, William Penn, Lord Calvert, the Lords Proprietor of Carolina, and arguably the Virginia and Plymouth Companies themselves. Their basic business model was to acquire land from a public entity (initially the crown) at low cost and gradually sell the land to smaller investors. As the King, and later state governments, were not always the toughest bargainers—Penn received 45,000 square miles in exchange for 16,000 pounds—returns could be immense. Two major risks faced these grand speculators: governments or Native Americans might not cooperate, and the demand for frontier land might grow too slowly to cover the costs of long-term borrowing.

After the revolution, New York and Massachusetts had competing claims to western New York State, which were settled by the 1786 Treaty of Hartford, where they agreed that New York had legal jurisdiction over the territory, but Massachusetts could claim ownership of the soil as long as it could buy the territory from the Native Americans (Grubb 2009). Massachusetts sold its right to buy 6.75 million acres to Gorham and Phelps for three annual payments totaling 300,000 pounds payable in Massachusetts securities, which were trading at one-fifth their par value (Chernow 1977).[9] Phelps then secured 2.6 million of those acres—land between Lake Seneca and the Genesee River—with a payment of 2,100 pounds to the Native Americans and a promise to pay an additional 500 pounds per year.[10]

The federal assumption of Massachusetts debt in 1790 increased the market price of Massachusetts securities, and hence also increased the costs of the remaining payments owed by Gorham and Phelps. They returned the right to buy 4 million or so acres to Massachusetts, in exchange for being forgiven the 200,000 pounds that they still owed. All told

[9] The standard exchange rate is approximately $4.5 to the pound (Officer 1983), making this approximately 1.35 million dollars in nominal values, or one-fifth that amount in hard currency.

[10] That promise seems not to have been reliably kept (McKelvey 1939).

Table 1—Rural Land Values

Where was the boom?	What happened to land prices?	What was the uncertainty?	What was the credit market like?	Were the prices reasonable?	Why did it end?
Western New York in the 1790s	Gorham and Phelps acquire 2.6 million acres for less than $125,000: less than 5 cents/acre (~$1.30).	Political risks: rival states, Native American ownership.	Personal borrowing and mortgages, access to European lenders. Generally rising interest rates.	Hamilton's valuation was 30 cents/acre (~$7.50) in the early 1790s, and by 1796 Congress considered a $2/acre (~$35) minimum price reasonable.	Morris overextended himself. Effective discount rates too high to buy and hold. Panic of 1797.
	Morris buys over 1 million acres for 30,000 pounds: ~13.5 cents/acre (~$3.30). Resells land for Pulteney associates for 75,000 pounds: ~26 cents/acre (~$6.40).	Transportation costs and the related migration possibilities.	Securitization in Holland.	Blodget value is $2.20/acre (~$43) in 1804.	
	Buys 4 million acres from MA for less than 15 cents/acre (~$3.70) and resells to Holland Land Company for close to 30 cents/acre (~$5.22).			Value in 1850 is $29/acre (~$854) (Linder/2)—9 percent return.	
Frontier Land 1815–1819: Huntsville	1817: Madison County Public Land is $2 (~$35) per acre (twice national unimproved norm) 1818: Madison Land is $7.40 ($134) per acre.	Cotton prices, cotton yields, transportation costs.	25 percent down payment to the government. Six percent interest rates.	The richest land was yielding were 800–1,000 pounds per acre.	Cotton prices fall by 50 percent, as global supply increases. Bank of the United States tightens credit and the panic of 1819.
			Four years to pay off the remaining debt.	Prices were over 30 cents/pound ($5) in 1817–1818. Costs were about 15 cents per pound ($2.70) in 1819.	After the panic land price falls dramatically—1850 Alabama price is 17 cents ($5) per acre.
US Farmland 1880–1933: Iowa	$96 ($2,330) per acre (for buildings and land) in 1910.	Wheat prices, wheat yields, transportation costs.	5 percent interest and 50 percent down payment was common.	Wheat yields averaged 18 bushels per acre. Prices are 99 cents ($24)/bushel in Chicago; and operating costs are 40 percent of revenues. Prices are 76 cents ($18)/bushel in Iowa.	Wheat yields increases stopped for 20 years. Wheat prices in 1933 were 43 percent of their values in 1916. Global wheat supply increased.
	$138 per acre for buildings and land in 1916 ($2,900). $68 per acre in 1933 (~$1,200).		Growth rate in real wheat prices is 3.3 percent since 1895.	Growth rate in real wheat prices is 33 percent since 1895. Growth in yields is 1.4 percent.	Great Depression.
			Growth rate in real wheat yields in Iowa is 1.4 percent. Transportation costs also declining significantly.	Capitalization rate of 16 is compatible with reasonable growth and interest rates.	Capitalization rate had fallen from 16 to 12.5, which is compatible with an increase in discount-growth rates of 1.75 percent.

they had acquired 2.6 million acres, for less than $125,000 or under five cents (~$1.30) an acre, not counting surveying and other costs. Gorham and Phelps then sold Morris over 1 million acres out of 2.6 million for four payments totaling 30,000 pounds plus interest, or about 13.5 cents (~$3.30) per acre.

Morris resold the land in 1791 to the English Pulteney Associates for 75,000 pounds, or $343,800 (about $8.4 million), making a substantial profit. He plowed his earnings, and additional loans from the Pulteney Associates back into New York land, spending another 100,000 pounds to purchase the remaining 4 million acres of the original Phelps-Gorham land (Wilkinson 1953). At the Treaty of Big Tree, Morris paid another $100,000 to actually buy the land from its Native American inhabitants.

The total purchase price of 4 million acres was well below 15 cents an acre (~$3.70), and Morris was again able to resell his land profitably to the Dutch Holland Land Company. In four separate transactions, he sold 3.25 million acres for close to $1 million, suggesting that land prices had risen to about 30 cents (or about $5.22). The Dutch investors did buy and hold and were less successful, but a recent investigation of the Holland Land Company's finances finds that they too earned reasonable returns over the long-term (Frehen, Rouwenhorst, and Goetzmann forthcoming).

Morris continued his massive land purchases in other states, but faced increasingly difficult credit conditions. The yield on British consols, a classic measure of the long-run interest rate, rose from 3.3 percent in 1793 to 5.9 percent in 1797 (Silberling 1919).[11] The period of credit tightening culminated in the Bank of England's suspension of specie payment in February 1797. As borrowing became more difficult, Morris formed the North American Land Company, in 1795 with James Greenleaf and John Nicholson, evidently in the unrealized hope of finding equity financing.

Morris' ability to meet his debts deteriorated, and he increasingly mortgaged his property. Amidst the confusion of his financial affairs, it is hard to determine what an actual market price of land would have been in 1797, but the number of buyers were limited in that chaotic year. Eventually, he was unable to meet his obligations and become bankrupt. Still, Morris and his partners would surely have prospered if not for "their failure to raise sufficient capital to allow them to be patient investors" (Frehen, Rouwenhorst, and Goetzmann forthcoming).

Morris' land purchases were not at absurd "bubble" level prices, but rather at prices that were quite low both relative to future prices and relative to prices elsewhere in the United States. In the early 1790s, Alexander Hamilton thought that 30 cents (~$7.50) per acre was a fair price for government frontier land, and by 1796, congress considered a $2 (~$35) minimum sale price to be reasonable (Treat 1910). The Blodget (1806) estimate of the value of unimproved land in 1804 is $2.20 per acre, or $43 per acre in modern currency. By 1850, New York State land was valued at $29 per acre ($854), implying that the 60 year nominal return for Morris would have been 9 percent per year (Lindert 1988), well above the normal 6 percent maximum mortgage lending rate (Homer and Sylla 1991).

There is also a Thunenite justification for Morris' purchases because frontier land prices were quite low relative to land elsewhere in the United States. Ellis (1946) reports that land values in established regions typically ranged from $14 to $18 per acre (3 to 4 pounds) ($293–397), and prices could rise as high as $125 ($2,600) per acre for the best wheat-bearing soil. The difficulties of moving goods over land made frontier land less valuable, but it was surely not unreasonable to believe ongoing transportation improvements would cause western New York properties to eventually be almost as valuable as land in the East.

While boom prices were compatible with reasonable real estate models, so were the prices during the bust. Grubb's (2009) price series suggest a decline of approximately 20 percent in value after 1797, which is readily reconcilable with a 2 percentage point increase in long-run expected returns from 8 percent to 10 percent.[12]

Credit market tightening helps explain Morris' decline, but increases in easy credit do not seem

[11] Assuredly, these rate increases indicated some premium for large scale political risk as a result of the Napoleonic conflict, but they still indicate an increasingly difficult borrowing environment for Morris and his partners, who would certainly have also fared poorly in the case of a political catastrophe impacting England.

[12] That increase is in line with the previously discussed increase in British consol rates.

to have fueled his earlier buying. Morris found much of his financing abroad, and rates were rising in England over this period.[13] Financial innovation in the Netherlands did play a role in the land sales of the 1790s, but Morris began his purchases before he could have known about these new financial structures. It seems more likely that Morris believed that he would sell his later purchases, like his earlier ones, to more standard groups of non-American investors.

Yet as Frehen, Rouwenhorst, and Goetzmann (forthcoming) note, there is a credit puzzle hidden in the Morris story. The people who invested in Morris, and in the Holland Land Company, did not have the same upside potential that the equity owners did. Yet they lent money at relatively standard interest rates, suggesting that like recent purchasers of mortgage-backed securities, they may have underestimated the risks inherent in real estate speculation.

B. *The 1815–1819 Convulsion*

During the boom before the Panic of 1819, Rothbard (2007, p. 13) writes that "speculation in urban and rural lands and real estate, using bank credit, was a common phenomenon which sharply raised property values." As Treat (1910, p. 157) notes "It was in Alabama, of course, that the land speculation, under the credit system, had reached its height." The epicenter of the boom, Huntsville, combined excellent cotton-growing soil with access to the Tennessee River, which brings access to the Ohio river, the Mississippi river and ultimately, the Gulf of Mexico. Transportation was the key to making frontier land valuable, and water was the key to transportation.

Rohrbough (1968) reports that 5,610 acres of public land in Madison County, Alabama (which contains Huntsville) were sold in 1817 for $11,220 ($194,000), and 973,000 acres were sold in 1818 for $7.2 million ($130 million). A 270 percent increase in price during a single year is impressive. Chappell (1949, p. 472) notes that "at the first sales at Huntsville, Alabama Territory, in February, 1818, the lands in the first four ranges sold at prices ranging from $20 to $78 per acre," which seems extraordinary given that land prices elsewhere on the American frontier were closer to $1 per acre. The initial seller of land was the federal government, which "facilitated large-scale speculation in public lands by opening up for sale large tracts in the Southwest and Northwest, and granting liberal credit terms to purchasers" (Rothbard 2007, p. 12). Greer (1948, p. 229) writes that "[p]ublic lands were sold by the federal government on an installment payment basis, and speculators mingled with homesteaders in the rush to buy."[14]

In 1819, the boom busted, the country went into recession and Alabama land values plummeted. Treat (1910) reports that land buyers owed $21 million to the federal government in 1820, and $12 million of that amount was due from Alabama itself. The government responded to these debts with various relief measures and it reduced the credit available for buying public land (Rothbard 2007).

These boom prices were not as unreasonable as they might first appear. Howe (2007, p. 128) writes that "while backcountry South Carolina yielded 300 pounds of cotton per acre, the Alabama blackbelt could yield 800 or even a thousand pounds per acre." In 1817 and 1818, cotton prices were over 30 cents ($5) per pound in many markets, according to Cole (1938).[15] Moreover, English cotton imports had increased by 78 percent from 1815 to 1818, despite high prices, suggesting that industrialization was creating an enormous boost in cotton demand (Mitchell 1988).

According to Watkins (1908) one-twelfth of the cotton was the standard price for ginning. Conrad and Meyer (1958) estimate the annual cost of slave labor at $20 per year after 1840, which given a productivity level of 1,000 pounds per slave, suggests a cost of 2 cents per pound. Abernethy (1922) gives a similar cost for slaves in the 1820s in Alabama, although his cost

[13] Curott and Watts (2011) note that realized real rates declined in 1795 because of a spike in nominal wholesale prices. I remain convinced that the nominal series is somewhat more reasonable to use, because of the unexpected nature of these prices changes, and the specie-backed nature of currency in that decade.

[14] Bidding on public land seems to have involved a fair amount of collusion, both among groups of bidders and with public officials (Chappell 1949). Rohrbough (1968, p. 126) describes how "interested individuals organized into joint stock companies or partnerships," and then "land was purchased for the company at the minimum price; and the tracts thus acquired were immediately resold at auction."

[15] http://www.vanderbilt.edu/econ/cipr/cole-historical-data.html (Cole 1938).

appears to be less inclusive, so I will double that value and use instead 4 cents per pound. He also gives 10 cents a pound as the minimum price for profitability during this time period. Conrad and Meyer suggest that transportation and marketing costs were about 0.7 cents per pound, again for a later period. Given the deflation between 1820 and 1850, this would be about 1.2 cents per pound in 1820. If that cost figure was quadrupled to account for higher transport prices, then total costs would be 15 cents per pound. This figure is also supported by the fact that Alabama was still producing cotton in the mid-1820s when prices had fallen to less than 15 cents per pound, where they would stay until the Civil War.

If cotton sells for 30 cents per pound and costs 15 cents per pound to produce, then this would imply annual profits of $120 per acre, which could readily support a $75 per acre price, or possibly even a $750 per acre price. Even with reasonable expectations about interest rates, mean reversion and depreciation of the land, $75 per acre seems like a good deal in 1818.

From 1815 to 1818, demand growth outstripped the growth in supply, but after that year supply triumphed, cotton prices fell and land prices followed. Cole (1938) reports that first quality cotton went for 32 cents a pound in January 1818, 25 cents a pound in January 1819, and 16 cents per pound in January 1820. If production costs were 15 cents per pound, the profit associated with an acre of land had dropped by over 90 percent. The prices appeared to have been pushed down by increases in supply from the United States and elsewhere. Between 1818 and 1819, US exports to the United Kingdom increased by 50 percent (Mitchell 1988).

The Alabama boom and bust illustrates a phenomenon that will reappear throughout these real estate episodes: an underappreciation of the long-run power of elastic supply to push prices downward. At current cotton prices, land prices in 1818 Alabama were justifiable. But since land was so freely available, in the United States and elsewhere, a smart investor might have reasoned that prices would eventually fall so that land prices in Alabama would resemble land prices of similarly productive places throughout the world. That logic would have made the land buyer of 1818 far warier about paying so much for even prime Alabama land.

To gauge reasonable beliefs about prices as of 1819, I have run simple time series regressions on cotton prices over the 1801–1840 period. I have used average prices from Cole (1938) for January in four key markets: Charleston, New Orleans, New York, and Philadelphia.[16] A land speculator with access to this data, as of 1819, who based long-term prices on the average past price, would have estimated an average cotton price of 22 cents per pound in 1820. This price was below the 32 cents high, but still high relative to the prices that actually materialized. At 7 cents per pound profit, yields of 800 pounds per acre could still justify the prices being paid at the peak. A more sophisticated buyer, estimating a regression with a time trend, would have found a statistically significant upward trend of 0.6 cents per year, which if extrapolated would make the 1818 prices look cheap indeed.[17] Buyers would need to have a much better model than just forecasting cotton prices with past time series to anticipate the drop in prices.

The boom doesn't appear to be related to lower interest rates. Homer and Sylla (1991) show that New England municipal bond yields were flat. While federal yields decline by 2 percentage points between 1815 and 1817, they are then flat during the rest of the boom. The availability of private credit assuredly declined substantially after the 1819 Panic, but for most land buyers the elimination of public credit in 1820 was the more important issue, and that followed the bust.

The most important credit policy during the boom was the 1800 Land Act, which enabled purchasers of public land to put up one-twentieth of the price immediately, and then bring the payment up to one-fourth within forty days. The remainder was to be paid in annual installments, beginning two years after the purchase date. The nominal interest rate was 6 percent, but there were added discounts for early payment,

[16] In 1802, I utilize the February rather than the January price for Charleston, because the January price is given in Shillings and at standard exchange rates this differs sufficiently much from the prices that prevail for the next six months that it seemed safer to use the slightly later price. In 1801, I inflate the 1802 price for Charleston by difference in shilling prices listed in Cole (1938). We are missing 1814 and 1815 prices for New Orleans, and have averaged over the three remaining markets.

[17] An even more sophisticated buyer, who estimated a time series regression with mean reversion and a growth rate, would also have expected high returns from prime cotton land bought at $75 per acre.

so the effective discount rate was higher.[18] The policy had been essentially constant since 1800 (Grubb 2009), but the existence of these policies may still have helped prices rise.

In this instance, there are two ways in which credit policies may have increased housing prices: bridging the gap between private discount rates and market rates and granting an underpriced default option. Both may have been significant in this case, but since mortgage durations were so short, the first effect is likely to be modest if private discount factors were less than 15 percent. At that discount rate, the value of being able to delay payments for four years would cause the effective price of the property to drop by 16.25 percent, meaning that prices should be only 19 percent higher than they would be with full credit.

An underpriced default option may have done more to boost prices. For illustrative purposes, assume that the buyers thought that the long-run uncertainty about cotton conditions was going to be resolved before 1821, when the first payment was due, and that land would be worth either $50 per acre or $2 per acre, each with equal probability. A risk neutral buyer with a 6 percent interest rate would then have been willing to pay $21 for the land if he had to put everything down up front (if he wasn't planning on planting anything for the first two years) and $82 (or $20.5 up front), if he was just putting 25 percent down. This is an extreme example, but the default option could easily have increased values substantially. The dramatic uncertainty about Alabama's future would have made any free put option offered by the government far more valuable.

The boom was not initiated by any change in credit policies for public land, but instead fueled by optimism about uncertain economic fundamentals, such as declining transport costs and English demand for American cotton. Alabama's land prices were not obviously rational in 1818, but they weren't obviously irrational either. The $7 average price, which would have been $4.60 in 1860, also looks reasonable relative to the $9 per acre prices that were prevalent in that later year (Lindert 1988). Buyers at higher prices lost money, but they wouldn't have if cotton prices had stayed high. The world was changing rapidly

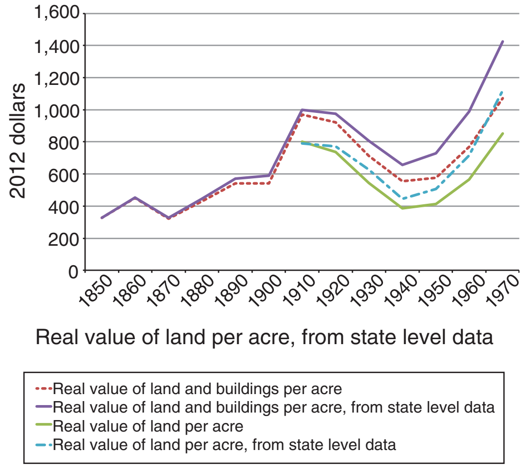

FIGURE 4. REAL LAND VALUES PER ACRE IN THE UNITED STATES, 1850–1970

Source: Farm Real Estate Historical Series Data: 1850–1970, from the US Department of Agriculture, June 1973.

and industrial producers needed raw cotton. The buyers just don't seem to anticipate that supply would eventually outstrip demand. Ex post, the Alabama speculators look foolish, but ex ante, there was enough uncertainty to justify the buying; prices would have been reasonable as long as cotton prices stayed high, and that was hardly such a crazy thought.

C. *The 1900–1940 Land Cycle*

We now turn to a more modern period, during which there exists widespread data on agricultural land values. Figure 4 illustrates, in 2012 dollars, the basic pattern of real values, where I have included four different series. The first two series begin in 1850, and reflect the value per acre for both buildings and land. The second two series begin in 1910, when building valuations become available that enable us to look at pure land value (even after 1910, the building series requires inter-censal interpolation).[19] The figure shows time patterns both for the entire United States and for the 35 states for which there is data in 1850, which may somewhat diminish the

[18] Since the government tended to forgive its debtors, this lowered the effective rate.

[19] Building values are only available for years in which there is an agricultural census. For the years between censuses, I have assumed that building prices move with a linear time trend.

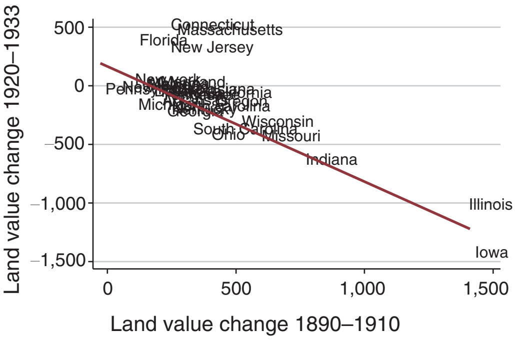

Figure 5. Mean Reversion in Land Values, 1890–1933

Source: Farm Real Estate Historical Series Data: 1850–1970, from the US Department of Agriculture, June 1973.

tendency of the changing composition of acreage to shift land values (Lindert 1988).[20]

From 1850 through 1900, land values are slowly rising. From 1900 to 1935, prices soar and then decline, hitting bottom in the 1930s. After 1945, prices again rise steadily. I focus on the great price undulation between 1900 and 1940. The nature of the convulsion is illustrated in Figure 5, which shows the relationship between the growth in the logarithm of the real value of farm land per acre between 1890 and 1910 and the decline in the logarithm of farm land value per acre between 1920 and 1933.[21] The figure follows a remarkably straight line (slope of −0.95), with only four visible outliers: Massachusetts, Connecticut, New Jersey, and Florida.[22] For every dollar increase between 1890 and 1910, prices dropped by 96 cents between 1920 and 1933. The R^2 of the underlying regression is 0.7, meaning that the relationship is even tighter than the mean reversion seen during the great convulsion of the past decade.

Looking at this regression alone, this looks like a great land bubble that peaked in the early teens and then gradually disappeared: a farm property phenomenon, almost as spectacular as the housing boom that we have just experienced. Across the United States as a whole, farm debt per acre increased five-fold between 1910 and 1920, and as in the post-2007 period, the price collapse led to financial failures. Alston, Grove, and Wheelock (1994) discuss the wave of bank failures that went through rural America after 1920; those failures occurred disproportionately in states that experienced greater increases in land values between 1912 and 1920.

Yet just like the buyers in Alabama in 1818, the buyers of 1915 don't look irrational given the potential profits from their farms. Just as in earlier Alabama, major technological changes (and changes in rail regulation) were altering the geography of agricultural productivity across the United States. As the figure shows that the biggest gains and losses were in Iowa, I will focus my analysis on farm profitability in that state and focus especially on wheat-growing. One doesn't necessarily think of the sturdy farmers of Iowa as being high-flying speculators, but these agrarians were at the center of the land boom of 1910.

Iowa wheat yields averaged 18 bushels per acre between 1905 and 1915, and a bushel of wheat was priced at about $1 ($24) on the Chicago exchange.[23] Over the same 1895 to 1910 period, wheat yields had been rising in the state by 1.4 percent per year. The growth in wheat yields did not occur nationwide, but was particularly present in the Middle West, where new wheat varieties were boosting wheat productivity (Olmstead and Rhode 2002). Over the longer period since 1868 when data becomes available, yields in Iowa rose by more than 1 percent per year.

Chicago wheat prices had been rising for 16 years. Figure 6 shows the great undulation in wheat prices during the late nineteenth century. From 1876 to 1894, prices steadily declined, as increases in supply outstripped demand. Then the trend reversed itself and prices would continue to rise until 1917. During this period domestic demand, and increasingly accessible international markets, rose even more steadily than supply. Real Chicago wheat prices had increased by 3.3 percent per year annually since 1895.[24]

[20] I am of course not eliminating changing land composition entirely, because there is a substantial shift in the location of agriculture within those 35 states.

[21] A similar but somewhat weaker pattern appears if I regress 1910–1933 changes on 1890–1910 changes.

[22] In the three northeastern states, farms were close to metropolitan areas and this presumably kept prices up. Florida peaked later than other states, because of its mid-1920s land boom. Moreover, it continued to decline steadily throughout the 1930s, while other states began to recover. By 1940, it no longer seemed unusual.

[23] Data from the NBER historical price series data.

[24] Across states, there is a 0.44 correlation between growth in prices and growth in wheat yields between the ten year average around 1890 and the ten year average around 1910.

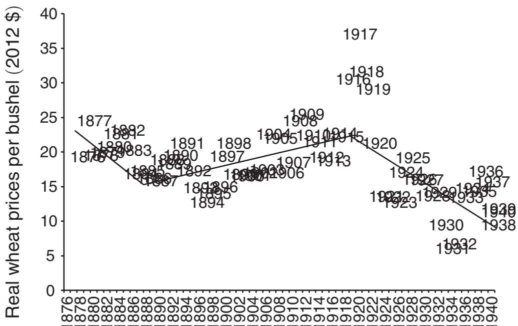

Figure 6. Wheat Prices over Time

Source: USDA Economic Research Services http://www.ers.usda.gov/data-products/wheat-data.aspx#25377.

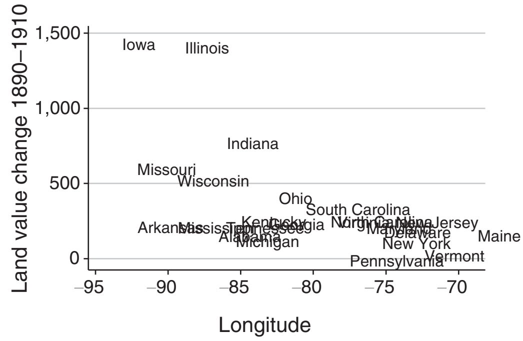

Figure 7. Land Value Changes, 1890–1910 and Longitude

Source: Farm Real Estate Historical Series Data: 1850–1970, from the US Department of Agriculture, June 1973.

Harley (1978) discusses an average Iowa price of wheat of 76 cents (\$18) in 1910 during the same time period, which suggests that transport costs ran at 24 cents (\$5.80) per bushel, but transportation costs were declining significantly (Bawden and Schmitz 1973). The ability of railroads to price discriminate against Midwestern farmers had diminished due to regulatory changes and transportation technology was also improving. Real revenue per ton mile across all US railroads had declined by 20 percent since 1895, making for an annual rate of decline of 1.5 percent.[25] The decline in transport costs helps explain the pattern of the boom. Figure 7 shows the −0.55 correlation coefficient between longitude and price growth among states east of −99 degrees longitude.[26]

Over the 1910–1920 period, US Department of Agriculture data shows that the ratio of net income to total revenues on farms ranged from 0.56 in 1913 to 0.66 in 1917, with a mean of 0.6 (costs include property taxes).[27] If 18 bushels of wheat are sold at 76 cents (\$18) a bushel, and 40 percent of that amount is subtracted for costs, then the total return on an acre of wheat land would be \$8.20 (\$199). Iowa's land price of \$96 (\$2,330) per acre (for buildings and land) in 1910 implies a discount factor of 8.5 percent which seems quite reasonable, given standard mortgage rates of 6 percent (Homer and Sylla 1991). If the owner's value of time, and any other costs, caused the net return to drop by 20 percent, then the implied discount factor is 6.8 percent, which seems somewhat low, at least for farmers that expected the world to continue without change.

Yet the world of 1910 was anything but static, and the trends make that \$96 price seem even better. To appraise the impact that expected growth might have on the value of land, I assume that land yields $(P_t - T_t)Y_t(1 - C_P)$, where P_t is price, C_P is production costs, Y_t is yield and T_t represents transport costs. If prices are growing at a continuous rate g_P, yields are growing at a continuous rate g_Y, transport costs are declining at a continuous rate g_T, and if the individual discounts future revenues at a rate of ρ, then the net present value of the land is $(1 - C_P)Y_t\left(\frac{P_t}{\rho - g_Y - g_P} - \frac{T_t}{\rho - g_Y + g_T}\right)$.[28] Taking wheat yields to be 18, $1 - C_P$ to be 0.6, P_t to be \$1, T_t to be 25 cents, and ρ to be 0.10, and, if the growth rate in prices and yields are assumed to be 1 percent, and the rate of decline in transport costs is also assumed to be 1 percent, then the value of the land equals \$108, slightly above prices in 1910 and 1911. These growth rates were not unreasonable in 1910—they were below recent trends— and a 10 percent discount rate also seems high, although it is meant to

[25] http://www.nber.org/databases/macrohistory/rectdata/03/a03003b.dat.

[26] The figure excludes Texas, New Mexico, California, and Oregon from our sample through that restriction.

[27] I include revenues to nonresident owners and interest on real property as income.

[28] This formula excludes property taxes and maintenance, because those costs are built into farm operating costs.

partially compensate for not fully counting the cost of the owner's time in managing the farm.

In the short run, those projections didn't look bad. Transport costs continue to fall, declining about 4 percent per year in real terms between 1910 and 1920. Prices continued to grow substantially until 1917, at an annual rate of over 10 percent. Only wheat yields sagged, falling by 2 percent per year over the teens, but that partially reflects the increasing number of marginal acres harvested over the decade.

Iowa land prices continued to rise in real terms until 1916, when they hit $138 per acre (again for buildings and land) which is equivalent to $120 in 1910. But given that national wheat prices had increased by 34 percent in real terms since 1910, this price growth is understandable. Figure 6 shows that wheat prices switched from growth to decline in 1917, when they hit their twentieth century peak.[29] International supply recovered after the war and American production stayed high. Over the 1920s, the growth in world wheat production appeared to be seriously outpacing the growth in world wheat demand (Malenbaum 1953). Again, buyers seem not to have anticipated the impact that elastic supply would have on price.

The positive trend in wheat yields stalled until World War II. While farmers in 1910 could reasonably believe that technology would continue perpetually increasing the productivity of their farms, the farmers of 1933 could also reasonably believe that the age of productivity advances were over. To assess prices in 1933, I use the same formula as before, assuming the same discount factor, parameters for yield, and costs. In 1932, rail revenues per ton mile were the same in real terms as 1910, but I will assume transport costs to have fallen to 18 cents.[30] I will also assume that buyers now believe that there is no prospective growth in yields, prices or transport costs. At the wheat price of 38 cents per bushel, the formula predicts a price of $22 per acre, which is actually far less than the nominal price of $89 in 1932 or even $68 ($1,200) per acre (the lowest value) in 1933. If the long-run price was thought to be closer to 80 cents per bushel, which would be the norm later in the decade, the implied price is $67.

While debt levels increased over the teens, credit markets appear to have played only a modest role in the price increase and decrease. Nominal bond yields were rising over the period (Homer and Sylla 1991) although expected real bond yields may have fallen somewhat because of changing inflationary expectations. Loans were limited to 50 percent of property values and interest rates averaged 5 percent (Preston 1922). The 50 percent down payment requirement, which was required by state law, also limited the potential value of any non-priced default option. Given the historical standard deviation of log price changes of 0.18, interest rates of 5 percent, a down payment of 50 percent, and expected price growth of 0.015 log points annually (one-half the actual rate from 1880–1910), depreciation and tax rates of 1 percent, the value of a free default option only increases the value of the land by 6 percent, which is shown in Table 2. A free default option would increase land values by only 8.9 percent if expected land price growth dropped to zero. Easy credit seems to have little role in the land boom of the teens.

The farm convulsion between 1880 and 1933 was an extreme event, but wheat price changes were also dramatic. Reasonable projections of increases in wheat prices, yields and lower transportation costs could readily justify the high land values seen during the boom years. Those projections were wrong, and one can argue that farmers should have anticipated the fall in prices that would eventually result from abundant supply. Still, it would be a far-sighted farmer indeed who wouldn't have been optimistic given over a decade's worth of positive price movements.

IV. The Urban Price Waves

In 1899, Adna Weber began his majesterial study of cities with the words "the most remarkable social phenomenon of the present century is the concentration of population in cities," (Weber 1899, p. 1) Cities grew because they were productive, and the cities that grew were nodes on a great transportation network that spread across America during the nineteenth

[29] We have used the USDA average wheat price average in 1908, and the Chicago price before then. To make them compatible, we regressed USDA average wheat prices on Chicago prices after 1908 and used the regression to adjust the Chicago prices during the earlier period.

[30] This would reflect 23 years of 1.5 percent price declines. Higher costs make prices lower.

TABLE 2—VALUE OF FREE DEFAULT OPTIONS

Boom/bust	Annual log trend (boom)	SD log price changes	Mortgage rate percentage	Down payment percentage	Implied default premium (0.5 × rate)	Implied default premium (no growth)
Rural land 1880–1933, peak = 1914	0.029 (−0.0017)	0.18	5	50	6.0	8.9
Chicago, 1830–1841, peak = 1836	1.05	1.2	10	50	41	65
New York, 1832–1840, peak = 1837	0.095 (0.05)	0.5	7	50	26	32
Los Angeles, 1880–1889, peak = 1888	0.31 (0.05)	0.4	10	30	10.20	29
Chicago, 1873–1931, peak = 1928	0.06 (0.013)	0.14	6	50	1.00	4.00
New York, 1920–1933, peak = 1929	0.045 (0.07)	0.25	6	10	32	46
California, 1984–1994, peak = 1989	0.047 (0.005)	0.065	5	5	3	11
USA, 1996–2012, peak = 2006	0.045 (0.001)	0.066	5	1	6	17

Notes: Down payment effects are calculated assuming 1 percent property tax and 1 percent depreciation. Standard deviations are based on column 2. Growth rates are either zero or one-half the previously realized growth rates in column 1.

century (Bleakley and Lin 2012). Every one of the 20 largest cities in the United States in 1900 was on a major waterway, from the oldest, typically where a river hits the ocean, to the newest, Minneapolis, on the northernmost navigable point on the Mississippi River, reflecting the enormous cost advantages of waterborne transport during the early nineteenth century. In 1816, it cost as much to ship goods 30 miles over land as it did to ship them across the Atlantic Ocean (Taylor 1951).

Today, we routinely see high prices paid for urban residential real estate, but residential land was fairly abundant in all eighteenth century American cities and most early nineteenth century cities as well. The 1722 Bonner map of Boston shows plenty of open space within 1.5 miles of the Long Wharf. Blodget (1806) reports that in 1785, the price of improved land near the centers of either New York or Philadelphia was $50 per acre (over $1,000 today). By contrast, moving hogsheads was significantly harder work, which made it natural to put commercial operations along King Street near the wharf. The high cost of moving goods meant that areas close to waterways were particularly valuable as commercial space, which is the backdrop for the great Chicago land convulsion of the 1830s. The most salient facts about these urban price waves are given in Table 3.

A. *The Chicago Boom:1830–1841*

The great Chicago boom and bust of the 1830s has been seen as the epitome of a classic real estate bubble (Shiller 2008). Prices for land on the edge of America rose from essentially nothing to New York levels in six years. Hoyt (1933) remains the indispensable resource for nineteenth century Chicago real estate. While much of his early data is interpolated, there is no obviously better source for land values during the city's formative period. I will focus on his data on land values in the Chicago loop, where according to Hoyt's estimates, prices per acre in 2012 dollars were about $800 in 1830, $320,700 per acre in 1836 and $38,000 per acre in 1841. In the aftermath of the bust, the Bank of Illinois first foreclosed on sizable real estate holdings and then declared bankruptcy in 1842.

Figure 8 illustrates the mean reversion of prices across city blocks in Chicago over this time period. The figure shows the relationship between land value increases, in 2012 dollars, between 1830 and 1836 and land value

Table 3—Urban Land Values

Where was the boom?	What happened to land prices?	What was the uncertainty?	What was the credit market like?	Were the prices reasonable?	Why did it end?
Chicago Loop Real Estate: 1830–1841	Price per acre in 1830 is $32 ($800).	Transportation technology (canal improvements), the western movement of the US population, and the possibility of becoming a major city.	10 percent interest/50 percent down payment was common.	If Chicago had a 50 percent chance of becoming like NYC or Cincinnati, most prices were reasonable.	Panic of 1837. Bank lending collapses. Bank of Illinois goes bankrupt.
	Price per acre in 1836 is $13,000 ($327,000: tops out over $1 million).		Growth rates are not estimable in this context.	Andreas (1884) gives one data point with a capitalization rate of 12.5.	Illinois stops internal improvements, such as canals.
	Price per acre in 1841 is $1,400 ($38,000), but by 1856, prices are well above 1836 levels.		An unpriced default option (state bank) could have increased prices by 50 percent.	Ex post annual returns were 9 percent.	
Los Angeles in the 1880s	Real median price per square foot in nonurban land rises from 1.8 cents per square foot in 1882 to 2.8 cents in 1885, to 6.9 cents in 1886, to 9.3 cents in 1887, and to 18 cents in 1888, then falling to 12 cents in 1889.	Increased competition between railroad companies reduced transport costs.	10 percent interest rates; down payments as low as 30 percent.	A house that cost $4,000 in land and construction could net $420 per year, a decent ratio assuming 2.5 percent growth.	Prices declined after 1888, but Southern California continued to grow, and eventually prices recovered. No financial collapse.
	In the urban core, price per front foot was $1,333 (~$32,000) in 1887 By 1888, the largest recorded transaction price was $1,700–$2,000 (~$41,000–$49,000) per front foot.	The western movement of the US and the chance of becoming a major city.	No public default option, but sellers provided financing and probably built the option's value into the sale price.	Top commercial real estate in Los Angeles is $1,333 per front foot, as opposed to $3,000 ($73,000) in Cleveland and $6,000 (~$146,000) in Chicago.	Buyers of outlying urban lots did not see prices recover.
New York City (*Nicholas/Scherbina*): 1920–1933	Price per square foot in 1920 is $2.70 ($31).	Demand for central city space—agglomeration economies—and aggregate fundamentals.	6 percent interest rates and 50 percent down payments were common.	Building and land costs of $25 (~$328) per rentable square foot in the 1920s produce $1.75 (~$23) in net revenues, compatible with 6 percent interest rates	Prices start falling with excess supply. Wall Street crash—economic depression.
	Price per square foot in 1929 is $93, and then falls to $51 in 1933.	Construction technology and supply.	Builders were able to securitize mortgages (Goetzman and Newman).	New York prices are higher than elsewhere, but output per worker is 72 percent higher.	Suburbanization

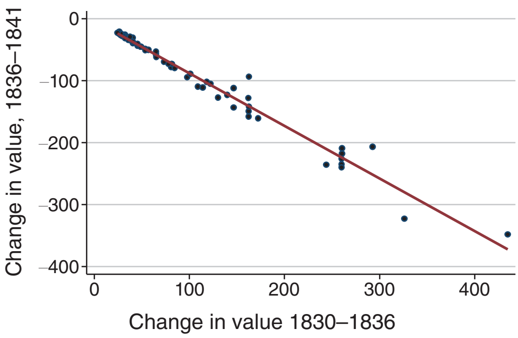

Figure 8. Mean Reversion in the Chicago Boom of 1830–1836 and 1836–1841

Source: Data from Hoyt (1933).

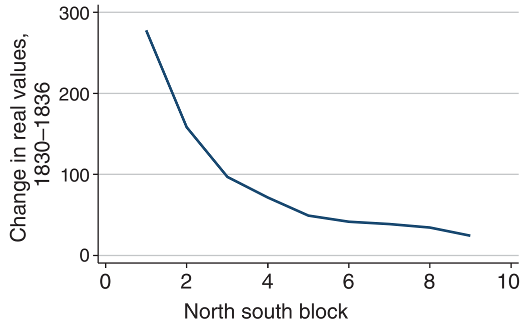

Figure 9. Distance from the Chicago River and the Price Boom

Source: Data from Hoyt (1933).

decreases between 1836 and 1841. The slope is almost exactly -1, which is not surprising since prices are essentially zero in both 1830 and 1841. Since many of Hoyt's figures are interpolations, the figure should be taken more as a sketch of the event than as a precise description.

The Chicago real estate convulsion was not some isolated asset market event, reflecting a temporary mania for rare flora or exotic securities. The Chicago boom was vitally connected with the deep currents of America's economic development. The Erie Canal, which had opened in 1825 gave Chicago access to the East Coast, meaning that "even by 1831 it was found that goods could be brought from New York to St. Louis by way of Chicago one-third cheaper than by New Orleans" (Hoyt 1933, p. 17). In 1835, the state of Illinois had committed itself to digging the Illinois and Michigan Canal which promised to eventually (it would take until 1848) give Chicago access to the Mississippi River System. With these two canals, Chicago would sit at the epicenter of America's transportation network.

The 20 years before 1830 had seen an explosive period of population growth for other cities occupying critical spots on America's waterways. Most spectacularly of all, Cincinnati, on the banks of the Ohio river, had grown from 2,540 people in 1810 to almost 25,000 people 20 years later. Rochester and Buffalo had each more than tripled in size during the 1820s, thanks largely to the promise of the Erie Canal.

The importance of access to water is illustrated by the pattern of the boom. Figure 9 shows the relationship between price growth between 1830 and 1836 and proximity to the Chicago river. I estimate that the distance gradient from the river in 1836 in Chicago is about three times steeper than the price gradients for distance from City Hall estimated by Atack and Margo (1998) for New York.[31]

Were the 1836 prices in line with sensible expectations? A Gordonian would compare Chicago prices with the expected value of future rent flows for commercial enterprises in the area. Andreas (1884, p. 142) quotes the July 9, *Chicago American*: "a store on Lake Street, which sold for $8,000, rents for $1,000." Hoyt (1933) finds this capitalization rate low, given risk and the possibility that interest rates may have been over 10 percent, but given reasonable growth expectations, it looks like a good return to me. While this solitary data point makes buying look sensible, most land buyers were purchasing properties with no initial income whatsoever.

For areas with no current cash flow, the Thunenite approach, which focuses on comparisons with other cities, seems more sensible. This approach asks whether prices seem reasonable by looking at current prices in successful cities and assigning a probability that the city will also succeed. Atack and Margo (1998) provide land prices for New York City in 1835, and the average price per square foot in their sample is

[31] They also report stronger distance gradients in Chicago than in New York.

76 cents ($20). In the highest price areas, land appears to sell for $2.50 ($65) a square foot.

I have also assembled my own data on property sales from New York City during the 1830s, from the sales announcements in the *Spectator*. The median price for unimproved land per square foot between 1832 and 1836 is 64 cents (~$17), which is slightly less than the Atack and Margo figure. This price rises to $1.10 (~$27) per square foot in 1836 and 1837. Four out of 122 sales, in 1836 and 1837, of undeveloped land parcels between 2,000 and 10,000 square feet, are over $5 (~$122) per square foot, and only one-sixth of such sales are over $2.50 ($61) per square foot. These data corroborate Atack and Margo and suggest that $2.50 per square foot represents a reasonable upper limit on land values, but it remains possible that a few particularly well placed parcels could be more valuable.

Cincinnati, the "Queen of the West," might have been a more feasible comparison for Chicago than New York. Greve (1904) is the best source I have on Cincinnati land values during the period. He lists a number of land sales at different years, and gives the impression that these are somewhat representative of desirable commercial land in the city center. He discusses prices between $120 and $300 per front foot ($1–$2 per square foot, or $26–$51 today) in downtown Cincinnati in the 1830s and provides land rents that seem to justify those prices. It surprised me that Cincinnati land values were so close to prime New York values, and leads me to wonder whether Greve may have reported properties at the very high top of the land value distribution.

The Hoyt data, in dollars per front foot (typical depths are 160 feet), indicate that Dearborn Avenue and the River hit $267 ($6,597) per front foot, or $1.66 ($41) per square foot. The other river front blocks are typically $160 ($3,953) per front foot or $1 ($25) per square foot. The average across the entire loop sample is $19 ($469) per front foot. That average price is less than one-sixth of the land values listed in New York City or in Cincinnati, but the peak prices in Chicago on Dearborn are only slightly less than the New York or Cincinnati peaks.

I assume that the buyers of 1835 believe that with probability π, Chicago will resemble Cincinnati or a mini-New York in 15 years, and with probability $1 - \pi$ the land will be worthless. If we assume that buyers discount the future at a rate ρ and that the value of Cincinnati or New York style land will grow at a rate, g, then a risk neutral buyer would evaluate Chicago property, that paid no rents, at a value of $\pi e^{-(\rho-g)15}$. Using 10 percent as a discount factor and assuming a growth rate of 5 percent (the realized nominal annual growth rate for New York City between 1835 and 1870 in the Atack and Margo 2006, data), then the discount factor is approximately $\pi/2$ relative to New York or Cincinnati values. The discount reflects both the possibility that Chicago will fail and the time delay before success.

Walters (2010) suggests that only one-third of the Illinois towns founded in the 1830s made it to maturity, although none of those towns, at the time, were thought to have nearly the same possibilities as Chicago.[32] If I assume that $\pi = 1/2$, then if success means hitting 80 cents per square foot, which seems plausible given New York and Cincinnati values, then the 19 cents per acre seems reasonable. If land should go for one-fourth New York values, then land values should not exceed 0.75 cents. The bulk of riverfront property appears slightly too expensive relative to that standard, and Dearborn Street property seems much too expensive, but it is surely a mistake to overweight the importance of a single parcel.[33] The trophy property buyers may have been unreasonably optimistic, but, of course, they did end up being right.

Many authors—Hoyt among them—discuss the role of easy money after 1835. The state government appears to have intended to boost real estate through aggressive lending practices. The critical facts are that the State Bank of Illinois was forbidden by statute from lending out more than one-half of the appraised value for any property or from lending mortgages over five years (Public and General Status of the State of Illinois 1839, p. 96).[34] The State Bank was the

[32] Walters provides an entertaining discourse into land speculation in smaller upstart Illinois towns between 1835–1837. While town promoters certainly over-hyped their properties, the uncertainty was large enough to justify significant confusion. The difference in value per acre between frontier agricultural land and the center of an even modestly successful town could be enormous.

[33] Dearborn Street property seems much too expensive, but surely it is inappropriate to put too much weight on a single transaction.

[34] In New York, during the same time period, it was alleged that lenders would grant real estate buyers loans as

large local lender, and these terms presumably reflect the terms given by other banks as well.

Since the Bank of Illinois was a creature of state policy, and since the legislature pushed the bank to support real estate, it is certainly possible that the Bank was not charging appropriate interest rates given the probability of default. In Table 2, I evaluate the impact that a non-priced default option would have on willingness-to-pay, assuming that the standard deviation of log prices is 1.2, the down payment rate is 50 percent, and the interest rate is 10 percent. I present results both for the case of no price growth and for the case of 50 percent growth (one-half the realized annual growth rate). In the case of no growth, the default option increases the willingness to pay for land by 65 percent. In the case of 50 percent growth, the default option increases the willingness to pay by 41 percent. The premium for intermediate growth rates lies between those two extremes, suggesting that a free default option could have had significant value, despite the high down payment level.[35]

The optimists were vindicated in the long run. Even the buyers of the most expensive tract in the Loop in 1836, on Dearborn Avenue near the Chicago River, experienced 3.6 percent real property value appreciation over the next 20 years. But ex post justification is dangerous. Chicago is studied precisely because it ended up as a success.

In 1837, there was widespread panic. Temin (1968) blames credit tightening coming from England. Rousseau (2000) emphasizes governmental interbank transfers across. On May 29, 1837, the Illinois banks suspended payments. As the banks careened toward bankruptcy, Illinois' internal improvements, like the canals which were supposed to be financed by the banks, stopped.

Hoyt reports that in 1841 land near the river on Michigan Avenue was down to $5 a front foot, or less than $1,500 an acre, less than one-thirtieth of its price four years earlier. He estimates that the prime land on Dearborn was worth less than one-fifth of its 1837 peak. These prices are so low that they seem like far greater folly than the higher prices paid four years earlier. Yet if the discount rate had gone up from 10 percent, to 15 or 20 percent, and if the probability of Chicago becoming a major city had fallen dramatically, then even the bottom doesn't look so strange. At a 20 percent interest rate, with no free default option, then land that will be worth $100,000 in 20 years time but provides no intervening benefits is only worth $2,600 an acre.

B. *Los Angeles in the 1880s*

I now turn to Los Angeles in the 1800s, the "Chicago of the West," which experienced a substantial run-up in values during the 1880s and a subsequent reversal. To assess the rise, I use land value data from reported sales in the *Los Angeles Times* from 1882 to 1889. As Figure 10 shows, the median price per square foot, in 2012 dollars, increases from 1.8 cents in 1882 to 2.8 cents in 1885. In 1886, the real price per square foot rises to 6.9 cents, and then 9.3 cents in 1887 and 18 cents in 1888, before the price returns to 12 cents in 1889. The 90th percentile price in 1888 is 70 cents per square foot. Figure 10 also shows the time path of annual dummy variables from a regression of log of real price on log of land area and dummies for the major ranchos in the area; that line shows log prices increasing by 1.5 between 1885 and 1888.

These sales represent nonurban land that is relatively far from the urban core, where prices were much higher. On January 9, 1887, the *Los Angeles Times* gives the price per front foot of $1,333 (~$32,000), and prices would still increase. On May 6, 1888, the *Times* reported that the single most valuable piece of property in the city ran for $2,500 (~$61,000) per front foot, but that the largest recorded transaction price was $1,700 (~$41,000) per front foot. Somewhat contradictorily, three days earlier the *Times* had said that the maximum price paid was $2,000 (~$49,000) per front foot.

Perhaps even more impressively, commercial lots far from the urban core could also go for $100 (~$2,400) or more per front foot. After the boom more than 60 percent of these would-be cities disappeared (Dumke 1944). Los Angeles buyers who bought during the boom and held would earn substantial real returns. The buyers in these outlying areas were less fortunate.

if they were a business, on commercial credit terms. If this occurred in Chicago, it would mean higher leverage ratios and shorter debt durations.

[35] Alternatively, I could use the calculation discussed above, and assume that if Chicago does not succeed, the buyer will default. In that case, a free default option can increase the willingness to pay as much as 100 percent.

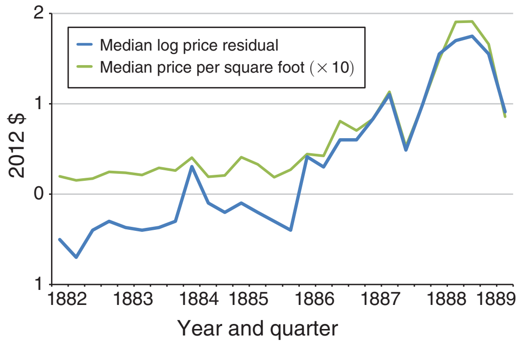

FIGURE 10. PRICES IN LOS ANGELES

Source: Sales data from the *Los Angeles Times*, compiled by the author.

The Los Angeles boom was precipitated by the entry of the Sante Fe railroad into the Los Angeles market, breaking the monopoly previously held by the Southern Pacific and leading to a rate war. The price of transport for people and goods dropped dramatically, and the population of Los Angeles increased from 6 to 50 thousand between 1885 and 1890. Migrants saw benefits in the Southern California climate, the agricultural value of its land and the economic opportunity, created partially by real estate speculation.

Within Los Angeles, there was considerable demand for rented residential and commercial space and there exists some information about rents. The *Los Angeles Times* in 1887 and 1888 regularly inveighed against the high rents charged by landlords, which appear to have started at $20 per month for a modest bungalow away from the city center and could rise to $30 to $40 per month for homes closer to the central city. The *Times* gives $5 per month per room as a standard figure.

In 1887, the *Times* lists the price for a high end sized residential lot of 7,500 square feet in Los Angeles at $2,500 ($61,000). The price of a cheap lot is given at $400–$500 ($9,700–$12,000).[36] Building costs, again according to the *Times* on January 1, 1887, ranged from $172–$250 ($4,200–$6,000) per room, so a seven room house would cost $1,750 ($43,000). A Chicago builder in the *Times* who noted that Los Angeles construction costs were higher than those in Chicago cites a cost of $2,500 ($61,000). I will use the latter figure and assume that the owner must pay 1.5 percent of the construction costs annually to forestall deprecation.

A seven room house might cost $4,000 ($97,000) in land and construction costs, assuming a $1,500 ($36,000) lot figure, which is triple the cheap lot price of 1887 but less than the most expensive lots.[37] State property taxes were approximately 0.6 percent in the 1880s (Ely and Finley 1888); the City Charter capped city property tax rates at 1 percent, so I assume a 1.5 percent total tax rate. I assume a discount rate of 10 percent and a growth rate of 2.5 percent, which is far less than the actual Los Angeles experience. This implies that rents would have to be $420 ($10,200), which is exactly what the monthly rents of $35 ($850) (seven rooms at $5 ($121) per room) would equal.

On June 11, 1888, the *Times* went through a similar calculation for an owner who had built a $15,000 structure, with stores and lodging room, and spent $50 monthly on land rent. Since "he will rent it for the first five years at $700 a month—after that without doubt at a higher rate," the costs are amply returned. At a capitalization rate of 12.5, $50 per month land rent ($600 per year) would justify a $7,500 value for the underlying land.[38]

Los Angeles prices could also be justified using a Thunenite perspective. On January 9, 1887, the *Los Angeles Times* ran an article titled "A Comparison: Real estate prices here and in other cities." The primary conclusion drawn from the data was that "these figures should convince anyone that considering the great natural advantages enjoyed by this city, prices of realty are not so inflated a condition as is sometimes supposed by the less sanguine among us." This is exactly the logic suggested by the Rosen-Roback approach to metropolitan area pricing.

[36] Scholars of the Los Angeles boom (Dumke 1944) suggest that real estate peaked in that city in the late summer of 1887, although our series suggests that prices continued to rise in 1888.

[37] Such lots seem unlikely to be used for lower end rental properties.

[38] I am, unfortunately, not in possession of any form of rental data that would enable me to gauge whether the higher prices paid by businesses were sensible from a Gordonian perspective. Perhaps the only evidence that it did was that many of the most expensive properties, such as the land that went for $1,700 per foot cited by the Los Angeles, were owned by businesses that used them and would presumably not have acquired them if the associated revenues did not cover the costs.

They note that while the price for top commercial real estate in Los Angeles is $1,333 (over $30,000) per front foot, the price per front foot is $3,000 (~$73,000) in Cleveland and $6,000 (~$146,000) in Chicago. Low end business land was similarly cheaper in Los Angeles than in Cleveland or Chicago. Residential properties in Los Angeles cost 40 percent of prices in Cleveland or Chicago and were comparable to the other cities in the sample. In other articles the *Times* repeatedly compared Los Angeles with San Francisco and pronounced its own city cheap.

Los Angeles hardly possessed the economic dynamism of those Midwestern cities in 1887 and the comparison does seem optimistic. Nonetheless, the city had grown so rapidly and it did seem poised to become the region's major hub. Moreover, as the *Times* repeatedly noted, Los Angeles did have a nice climate. Buyers could and did look at prices in other cities and they appear to have inferred that Los Angeles' prices were reasonable.

A similar process occurred in the outlying boom towns around Los Angeles. The Gordonian approach is hard to use for lots in outlying towns, where just as in Chicago in 1836, prices were really based on hopes of a far flung future. The promoters of those towns instead used a Thunenite approach, explicitly comparing their prices with those in Los Angeles and suggesting that the inconvenience of distance was well worth the reduction in price. The problem with that logic is that Los Angeles did have access to a truly scarce resource: proximity to the two major rail lines. No other town had any comparable monopoly power. There was abundant land to house millions within the region, but millions would not materialize for many decades. Marshallian buyers would have observed the abundance of land and concluded that supply would eventually push land prices down.

What role did finance play in the boom? Interest rates were typically 7 percent and there seems to be little change in credit conditions during the preceding years. The New York Commercial Paper rates rose in 1887. Banks were generally conservative, although it appears to have been possible to provide only a 30 percent down payment. Table 2 evaluates the value of free default options given the variation in log prices of our land data over the period assuming a 10 percent interest rate and illustrates that even a free default option should have increased prices at 10 percent with no growth or 30 percent at higher growth rates. Yet there is little evidence that banks were giving away such free options.

Sellers themselves often offered financing on liberal terms, and that suggests the listed prices overstate the true cost of property. Sellers presumably weren't offering a free default option, but were instead charging more to reflect the risk. The true price was therefore substantially less than the listed price because the buyer was also giving the seller the option to default.

Prices declined after 1888, but Southern California continued to grow. Since aggressive financing was provided by sellers not banks, there was no financial crisis during the bust. Los Angeles did have a large boom-bust cycle and people who bought during the boom did lose money. Yet the prices paid seem compatible with both Gordonian and Thunenite assumptions. They were also quite justified given subsequent events, at least in the city itself. The biggest losses were sustained by investors in outlying boom-towns, who don't seem to have focused on the virtually limitless supply of space in greater Los Angeles, at least relative to the demand during the nineteenth century.

C. *Building Up: New York City and Chicago from 1890–1933*

In 1885, William LeBaron Jenney built the Home Insurance Building in Chicago, one of the seminal buildings in the development of the skyscraper: a tall building with a load-bearing steel or cast-iron skeleton. Skyscraper technology, which made it vastly cheaper to build up, substituted the elevator for the streetcar as a means of transportation. It also radically increased the value of urban land, at least temporarily.

Theoretically, skyscrapers can either increase or decrease the value of land. To see this, assume that demand for office space satisfies $Rental\ Price = XK^{-v}$ where X is a constant, K reflects the quantity of space rented and v is a parameter. The world is static and the stock price of capital will equal $XK^{-v}/(1-\rho)$, where ρ is the discount rate.[39] The total amount of

[39] I have adopted a log-linear demand curve to simplify the algebra.

land in the area is normalized to one, so $K = H$, where H denotes the average height in the area. If developers buy land and then pay for building cost equal to cH^{σ} times land area, where c and σ are parameters and $\sigma > 1$, then the equilibrium price of land is $(\sigma - 1)c^{\frac{v-1}{v+\sigma-1}}\left(\frac{X}{\sigma(1-\rho)}\right)^{\frac{\sigma}{v+\sigma-1}}$, which equals revenues minus construction costs given optimal building,[40] Clark and Kingston (1930) present a comprehensive guide to the costs of skyscraper construction in 1929. Their typical average cost runs from \$9.2–\$12.6 (\$124–\$174) per square foot for the physical costs of construction. Using their data on the cost-height relationship suggests that $\sigma = 1.2$, for buildings above eight stories.[41] This suggests that the equilibrium price of space should be less than \$15.10 per square foot.[42]

The impact of improvements in either technology is unclear, because reducing costs will generate more supply and lower prices. If skyscraper technology represents a reduction in the parameter σ, then land values will rise if and only if $(1 - v)\log(H) > \frac{1}{\sigma - 1}$. If skyscraper technology is a reduction in costs "c" then this will increase land values if and only if demand is inelastic, i.e., $1 > v$. Even if a reduction in c leads to an increase in land values, a decline in the technological parameter σ may not, because that parameter both increases the supply of space and reduces the gap between marginal cost and average cost, which determines the value of land. The parameter σ seems more closely related to skyscraper technology because it directly determines the extent to which average costs increase with height.

Over the period 1873–1933, both New York and Chicago experienced a radical boom and bust in land and property values. Figure 11 illustrates these cycles using data from Hoyt (1933) and Nicholas and Scherbina (2011). Hoyt's data includes only four years from this period and is meant to capture land values. Nicholas and Scherbina (2011) have data on the sales of properties given a particular year. In both cases, I regress the log of price on a vector of characteristics and year dummies and I plot the year dummies.[43] The year 1894 is normalized to zero, since that is the earliest year in the Hoyt data.

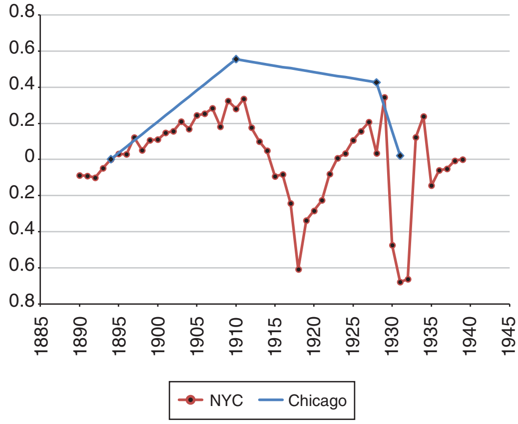

FIGURE 11. LOG COEFFICIENT REGRESSION RESULTS: NEW YORK CITY AND CHICAGO

Sources: New York data from Nicholas and Scherbina (2011). Chicago data from Hoyt (1933).

The 1920s were not some land value bubble without precedent—prices had actually peaked before World War I. Chicago prices shoot up from 1894 to 1910 and then decline mildly from 1910 to 1928 and radically from 1928 to 1933. Given the New York price series, it seems likely that Chicago also experienced a drop in values during the teens and a recovery during the 1920s.

Changes in building technology had enabled a vast increase in the supply of office space in core downturn areas. The amount of cubic space in Chicago's business district increased from 344 million in 1893 to 581 million in 1923 to

[40] Equilibrium height equals $\left(\frac{X}{c\sigma(1-\rho)}\right)^{\frac{1}{v+\sigma-1}}$ and the price of space equals $\left(\frac{X}{1-\rho}\right)^{\frac{\sigma-l}{v+\sigma-1}}(c\sigma)^{\frac{v}{v+\sigma-1}}$.

[41] This estimate comes from regressing that logarithm of building cost per square foot on the logarithm of building height. Price per square foot actually declines from 8 to 14 stories, but after that the estimated coefficient is 0.19 and the standard error is 0.14. There are only seven data points, as they only list costs for eight total heights.

[42] It also suggests that the share of land in total cost should not exceed 20 percent, but land shares in 1929 were often over 50 percent, implying either that the model is wrong, or that land prices were due to drop, as they did.

[43] In the case of Chicago, the controls include the logarithm of parcel depth and location fixed effects, but these controls are irrelevant since the sample is completely balanced. In the case of New York, I control for fixed location dummies, the logarithm of square footage of the property, and building height.

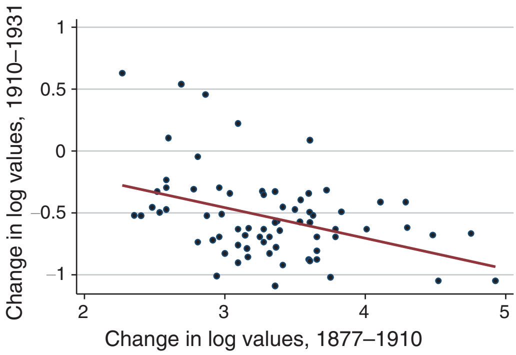

Figure 12. Mean Reversion in Chicago, 1877–1931

Source: Data from Hoyt (1933).

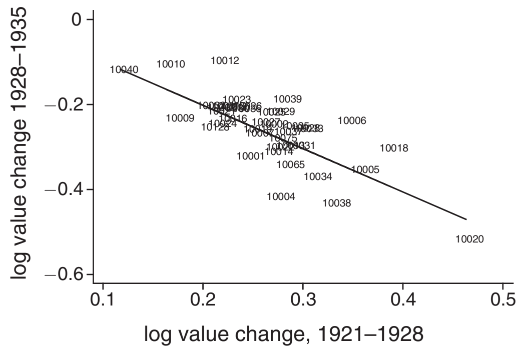

Figure 13. Mean Reversion across Zip Codes
(*mean residuals from hedonic regression*)

Source: Data from Nicholas and Scherbina (2011).

743 million in 1933 (Hoyt 1933, Table XL). Supply seems to have reduced prices after 1910. The New York prices are flat until the teens, and then decline (primarily because of inflation) during the late teens before rising again during the early 1920s and then dropping dramatically after 1929. Wheaton, Baranski, and Templeton (2006) show that commercial real estate prices in Manhattan declined from 1899 to 1919 and then returned in 1929 to 1899 levels before crashing again.

Figures 12 and 13 show mean reversion for these two samples. In Figure 12, I show the relationship between log land value growth in Chicago from 1877 to 1910 and the subsequent decline. The coefficient is −0.25 and the R^2 is 0.16. Figure 13 shows the growth in log price residuals for New York using the same regression used in Figure 11 but without year or zip code dummies, averaged at the zip code level from 1920–1922, 1927–1929, and 1934–1936. Again, there is substantial mean reversion.

I will focus on the great boom of New York during the 1920s basing my discussion on the data collected by Nicholas and Scherbina (2011). Their hedonic price index shows a 34 percent increase in nominal values between 1920 and 1929 and a 56 percent real price increase.[44] Inferring actual per square foot prices from their data is somewhat difficult, because while they have lot dimensions and height, those facts don't translate immediately into usable square footage, because lots may not be fully used, and more importantly, there will be significant non-rentable space in any tenement or commercial building.

Making no correction for nonused ground space, and simply multiplying the lot dimensions by height yields a price series in which the median price per square foot increases from \$2.70 per square foot in 1920 (\$31 in 2012 dollars) to \$4 (\$54) per square foot in 1929. Clark and Kingston (1930) provide ratios of rentable space to total possible space, for buildings of various heights, based on actual building constructions in New York during the late twenties. Their estimate is that the ratio of net rentable space to stories times ground area ranges from over 0.75 (at eight stories) to under 30 percent for taller buildings, reflecting the setback requirements in the 1916 Zoning Act. The Old Tenement Law of 1879 mandated air shafts and restricted the coverage of lots to under 65 percent, and even those buildings had to allocate some space for stairwells.[45] I will use the figure of 60 percent of lot size times the number of stories. This figure is in line with current estimates of the relationship between gross and net square footage, allowing for some unused ground space. With this correction, the square footage prices in their series should be multiplied by 1.66, yielding a value of \$6.60 in 1929.

[44] I have averaged over the four quarters reported in Table A1 of their paper.

[45] The laws concerning new law tenements are somewhat more complicated, but the new law seems to have allowed roughly the same amount of rentable space (DeForest and Veiller 1903).

Even scaled upward, the Nicholas and Scherbina (2011) figures are lower than many of the more usual figures seen in the 1920s, which reflects the enormous heterogeneity in housing quality and location value within New York. If I restrict their sample to buildings labeled dwellings, rather than tenements, the median price per square foot, where area equals height times lot size times 0.6, reaches $12 and the mean is double that amount.[46] The 90th percentile of the value per foot distribution in 1929 for dwellings $24 per square foot.

Can these higher prices be reconciled with rational buyer beliefs? I begin with a tenement purchaser intending to rent out rooms and then turn to skyscraper builders.

Between 1920 and 1929, Nicholas and Scherbina report 368 sales of tenements with exactly five stories and between 2,400 and 2,600 square feet of ground space (25 times 100). These represent the dimensions of a classic dumbbell tenement, with fourteen rooms on each floor. The median nominal price for these structures over the decade as a whole is $27,000 ($354,000). Between 1926 and 1929, the median price rises to $30,000 ($393,000). If buildout uses 60 percent of lot size, this represents a price of $4 ($52) per square foot, or approximately $428 ($5,600) per room (dumbbell tenements typically have 14 rooms per floor), where rooms contain slightly less than 110 square feet. The 75th percentile buyer paid 34 percent more than the median during the latter half of the decade.

The Stein Commission extensively studied tenement rents during the early part of the 1920s and discusses room rents from $12 to $15 ($155–$194) per month, which would represent at the low end, $1.33 ($17) per square foot per year. Fisher (1951) reports that operating expenses for office buildings run at 50 percent of revenues. If this ratio held for tenements as well, then this would imply $0.67 ($8.50) per foot per year both for expenses and net income. I will assume that operating expenses are sufficient to forestall depreciation. I will also assume a 2.4 percent tax rate (Report of the New York State Commission for the revision of tax laws 1922).

If the purchase price per foot is $4, then rents of 67 cents would represent an annual return of 14.35 percent, and if the price is 34 percent more, returns would be 10.1 percent. Even if these numbers are slightly incorrect, the standard tenement purchaser of the late 1920s could expect to receive a relatively good return on investment, assuming that prices didn't fall dramatically.

The 1920s was a great era of skyscraper building (Barr 2010), and some of these builders certainly did poorly after 1929. But would reasonable expectations make their investments appear sensible. I will assume construction cost of $12 per square foot ($161 in 2012 dollars). Clark and Kingston (1930) describe land prices per square foot of $200 (~$2,700), which is about the price that John J. Rascob paid for the two acres that sit beneath the Empire State Building, and that once housed the old Waldorf-Astoria. Nicholas and Scherbina find almost no larger properties (with over 4,000 square feet), with values above $2 million per acre in their sample, but their data contains little of the highest end real estate. The top price of land by foot frontage in Hoyt's data for 1928 is $55,000, or $343 (~$4,300) per square foot. Clark and Kingston (1930) calculate the ratio of rentable square feet to land area is 15 for a 50 story building. If land costs $200 per square foot, land costs per square foot of rentable space are $13.30 (~$178).[47]

Securitization had increased substantially in the 1920s (Goetzmann and Newman 2010), and as a result, real estate companies could get financing at 6 percent. Fisher (1951) gives us data on income and operating costs for office buildings across 56 cities during the 1920s. His data shows that costs per rentable square foot average $1.09 ($15) and rents average $2.17 ($29). Clark and Kingston's operating costs are somewhat lower, and they give revenues of over $3.50 ($47) per square feet for Manhattan skyscrapers, which would suggest net revenues of $1.75 ($23) per square foot if the ratio of costs to revenues were close to the national norm.[48] Their $3.50 result

[46] Extremely high values per square foot presumably reflects the value placed on the underlying land, which may have been part of land assembled to create a larger parcel and a considerably taller building.

[47] The critical factor is that there are only about 0.3 square feet of rentable space on each floor for each square foot of land, both because the property doesn't use the entire lot and because of nonrentable space, like elevators.

[48] This relatively high rent also includes the significant rental income from ground floor retail; their pure office rents top out of $3.34 ($45) on average. They suggest somewhat lower operating costs, including taxes and depreciation, or about $1.45 ($19) per square foot.

is supported by a July 14, 1929, *New York Times* article that surveys rents in Manhattan and suggests a range that begins at $2.50 in Midtown and $3.50 (~$34–$47) in Downtown. Top rents appear to have been as high as $6.50 per square foot, or even $8 (~$88–$108). The revenues even at $3.50 per square foot can readily cover physical construction costs.

In a pure Gordonian framework with no growth, net revenues of $1.75, together with an interest rate of 6 percent and a tax rate of 2.4 percent, should imply a willingness to pay of $20.83. This is slightly below total construction and land costs of $25.33 (~$328). But with a 2 percent expected growth rate, the willingness to pay should be over $27. Annual prices were growing at 4.5 percent during the 1920s, so these beliefs were compatible with recent experience. Given reasonable assumptions about capitalization rates, building up even with very expensive land would have seemed reasonable in 1927 and 1928.

What would the Thunenite have to say about prices or rents in New York City in the 1920s? The cost of living gap between New York City and the nation does not seem to have widened over the 1920s. The 1930 US Statistical Abstract shows that between 1920 and 1929, the cost of living declined by 12 percent in New York and 14.5 percent in the country as whole. Average weekly manufacturing wages in the United States as a whole were $24.60 ($324) in 1925 and $30.70 ($404) in New York City. Yet despite that gap, rental costs in New York City in 1923 appear to have averaged $315 (~$4,200) for families earning between $1,500 and $2,000 ($20,000–$27,000) annually (Stein Report), while Historical Statistics gives a higher value of spending on housing for the United States as a whole in 1929 (prices were constant between those two years). It is impossible to correct properly for quality, so it is quite likely that prices were higher in New York, but there is no evidence suggesting that people were paying higher rents than New York's higher wages would justify.

The 1929 Census of Manufacturers suggests that value added averaged $3,600 (~$48,000) per worker across the United States as a whole, and $6,200 (~$83,000) in Manhattan. While there are many problems with just using that gap (differences in capital investment, differences in worker quality, etc.), it seems reasonable to think that firms renting in the city were also paying rental costs that were compatible with the enormous productivity of the island. Both the Gordonian and the Thunenite approaches could justify the prices paid during the 1920s, even if they failed to predict the subsequent price decline.

The one approach that would have managed to predict the future more accurately is Marshallian. At 50 stories a building, there was essentially an infinite supply of upward space in New York and Chicago in the 1920s. The Loop contains 1.58 square miles. If 50 story buildings covered just half of that area, this could supply 65 million square feet of office space, nearly ten times Chicago's supply in 1933. The marginal cost of building up is still higher than the average, but only by a few dollars, and this would mean that in an uncontrolled market, prices per acre would have to be far below 1928 prices. By 1930, an economic downturn made the oversupply of space apparent. Far from receiving high rents in perpetuity, many buildings sunk to the very margins of profitability. Prices, again understandably, plummeted and building ceased.

What impact did easy credit have on the boom? Private borrowers faced mortgage conditions that remained essentially constant throughout the period. Interest rates stayed around 6 percent and down payments were typically 50 percent with banks and 40 percent when borrowing from savings and loans, which typically charged an extra percentage point in interest (Historical Statistics of the United States, Millennium Edition). The gap in interest rates between banks and Savings and Loans, which offered lower down payments and longer duration mortgages, suggests that lenders were well aware of default risk. Nonetheless, if buyers facing 6 percent rates and 50 percent down payments were given a free default option, this would increase the willingness to pay for the house modestly, assuming a standard deviation of log prices changes of 0.14, which represents the real experience of Chicago prices over the 1871–1933 period.

It is more likely that an underpriced default option played more of a role in encouraging the speculative activities of builders. While some mega-buildings of the 1920s, including the Chrysler and Empire State Buildings were largely self-financed, Goetzmann and Newman (2010) detail the impressive increase in the securitization business for property-backed securities. These securities were bought by ordinary investors, in search of a 6 percent return, and those investors may well have underappreciated the value of the default option that they were giving the building's promoters.

I lack hard data on the equity-shares in these investments, which would be the equivalent of the down payment. As an illustrative calculation, I assume that the equity share was only 10 percent. In that case, given a standard deviation of 0.25 and an expected growth rate of zero, the default option would have added 46 percent to the willingness to pay. If the growth rate was expected to be 2.25 percent, the extra willingness to pay is 32 percent. While we do not yet have the data that would enable us to assess the down payment levels, let alone the degree to which default risk was actually priced into the cost of capital, it seems possible that securitization helped boost prices paid by developers significantly during the 1920s.

After 1929, prices plummeted during a great global meltdown. Yet even if the Great Depression had not occurred, it is hard to see how peak 1920s prices would have been sustainable. Before 1961, there were no effective height limits on building up, only setback requirements, and the amount of space that could have been added is considerable. If Clark and Kingston (1930) are right, and construction technology has few diseconomies of scale, then prices would have eventually been squeezed down near construction costs, at least for skyscrapers, which would ultimately causes the price of land to also fall.

V. Metropolitan Real Estate Convulsions

Sprawl has occurred whenever transportation innovations have enabled people to travel further at less cost. In the early nineteenth century, Manhattan moved uptown as Abraham Brower's horse-drawn omnibuses made it possible for people to share the costs of equine power. In the middle and late parts of the same century, elevated railroads and streetcars enabled still further decentralization of population into the upper reaches of Manhattan and the streetcar suburbs of Boston (Warner 1962). In the twentieth century, the automobile generated an enormous decentralization of people (Baum-Snow 2007) and employment (Glaeser and Kahn 2004). Declining transport costs, also enabled the move to the Sunbelt consumer cities (Glaeser, Kolko, and Saiz 2001) away from older urban centers that had access to inland waterways and the older rail network.[49]

The housing convulsions in the late twentieth century are metropolitan rather than purely urban. While the price growth of the last boom was higher in the city centers (Glaeser, Gottlieb, and Tobio 2012), the largest building booms were often at the urban edge. In this section, I discuss three episodes since World War II, all of which spread across the wide territory in enlarged metropolitan regions. Table 4 summarizes the conditions during these booms, but I begin with a bubble that didn't happen.

A. *The Bubble that Didn't Happen: Housing Prices Immediately After World War II*

The period between 1945 and 1970 would seem to be an ideal setting for a housing bubble. The economy was resurgent after World War II and the Great Depression. Household formation soared during the baby boom. Most strikingly, there was a revolution in mortgage finance, making it far easier to almost anyone to get a long-term, relatively low rate mortgage.

Before the Great Depression, down payment requirements averaged 50 percent, sometimes by law, although savings and loans sometimes decreased down payments to 40 percent. Bank loans had terms under five years, and even Savings and Loans average only slightly more than a decade. Interest rates were typically 6 percent. The Federal Housing Administration was formed in 1934 to insure mortgages and hopefully increase employment in the construction sector, insuring mortgages requiring only 20 percent down. By 1939, FHA mortgages reached 18 percent of the mortgage market (Quigley 2006), yet prices were still far below 1929 levels.

In the 1940s and 1950s, federal programs, including the FHA, the Veteran's administration, and the Federal National Mortgage Association (Fannie Mae), enabled a massive increase in credit availability. By 1955, FHA and VA insured mortgages had average maturities over

[49] The move to the Sunbelt was also abetted by improvement in health (Bleakley 2007) and pro-business policies (Holmes 1998).

Table 4—Metropolitan Land Values

Where was the boom?	What happened to housing prices?	What was the uncertainty?	What was the credit market like?	Were the prices reasonable?	Why did it end?
US-wide post-World War II: 1950–1970	Prices increased less than construction costs.	Postwar economic boom, increased credit availability.	After 1934, the Federal Housing Administration (FHA) required only a 20 percent down payment. The FHA and Veteran's Administration increased credit availability after 1944.	Supply kept pace with demand In the 1950s, the US permitted 11.84 million housing units, which was roughly the same amount the US permitted from 1920 to 1945.	In California, prices started to rise dramatically in the 1970s.
California: 1970s and 1980s	In 1970, housing values in California were 26 percent higher than the US. In 1990, housing values were 140 percent higher.	Decrease in new supply due to increased land use regulation.	20 percent and less down payments.	Price to rent ratios range from 25–38 in expensive metro areas in 1990. Reasonable parameters, and expected growth of 2.5 percent generates a predicted ratio of 31.	Supply increased in California, and by 1990, inventory was no longer scarce. Assessment of future growth fell.
	Los Angeles real prices (FHFA Index) rose 156 percent, between 1975 and 1990, and then fell by 37 percent between 1990 and 1996.	Reduction in property taxes due to Proposition 13.	Real interest rates undulated in the late 1970s and early 1980s and then rose steadily through 1980.	Unique California attributes bedevil comparisons with metro areas elsewhere.	Recession hit the US.
The Great Housing Convulsion: 1996–2012	Across the US as a whole, real prices increased by 53 percent between 1996 and 2006, and fell 28 percent between 2006 and 2011.	Few dramatic episodes of economic uncertainty during this boom. Land shortage claims in Las Vegas.	Interest rates were low, loan approval rates were high, and required down-payments were under 5 percent. But changes seem modest.	Price-rent ratios hit 38 in higher cost areas. Reasonable parameter values and expected growth rates generate 2.5 percent user costs, which predicts a ratio of 40.	Slowing price growth may have led to a reassessment of future price growth.

20 years and down payment requirements averaged under 20 percent.[50]

Yet during the entire 1950–1970 prices remained astonishingly flat across America's metropolitan areas. Figure 14 shows prices in 1950 and 1970 in 2012 dollars. The bottom line on the graph is the 45 degree line. Almost everywhere experienced a significant increase in prices. But those prices were perfectly in line with the general increase in

[50] Fetter (2010) looks at the impact of these programs on homeownership and fertility choice by comparing individuals whose birthdays put them right before or right after the dates that led to being drafted to fight in the Korean War. He finds significant effects on both outcomes.

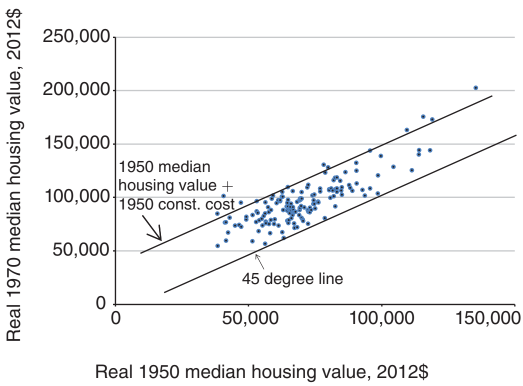

Figure 14. 1970 Price versus 1950 Price Plus Increase in Construction Cost for 1,500 Square Feet

Source: Price data from the US census and cost data from R. S. Means.

construction costs in America during that time period.

Glaeser, Gyourko, and Saks (2005) report that the R. S. Means survey of construction costs showed that the real price per foot of construction increased from $49.70 per square foot in 1950 to $63.60 per square foot in 1970. The second higher line in the figure multiplies that $13.90 cost per square foot increase times 1,500 square feet (a reasonable house size) and adds that amount to the 1950 price. Almost everywhere, prices in 1970 were below 1950 prices plus this construction cost related price increase. Even after the most stupendous change in America's mortgage history, and a postwar economic boom, housing prices had gone up less than construction costs would warrant.

The natural explanation for the missing boom in prices after World War II is that there was an enormous increase in housing supply over the same time period. During the 1950s, America permitted 11.84 million housing units, which is roughly the same as America permitted during the 26 years from 1920 to 1945. The construction was disproportionately on the urban fringe (Jackson 1979) and disproportionately in the Sunbelt.

The post-World War II era demonstrated exactly what textbook economics predicts should happen when robust demand meets relatively elastic supply. Quantities rose and prices stayed relatively flat. The relatively elastic supply owed much to the rise of automobile-based living on the urban fringe, which can be seen as either a shift in housing supply or a change in supply elasticity. For example, in an open-city formulation of the Alonso-Muth-Mills model, with supply costs that increase with density, lower transportation costs will increase supply but not change supply elasticity. Yet it is possible that the automobile made supply more elastic as well. On the urban fringe, lower cost, low density housing can be built in massive quantities, essentially using a constant returns-to-scale technology.

Accompanying the shift toward car-based suburbia were technological improvements in building. One view of William Levitt and his two postwar Levittowns is that he brought Fordist ideas about mass production to housing and significantly increased efficiency (Gans 1969). The fact that real construction costs rose substantially over this period does seem to question this technological improvement claim, but it is quite possible that the Means data substantially overstates cost increases because quality of new homes improved. The R. S. Means survey does claim to hold unit quality constant, but given how radically the quality of the US housing stock rose after World War II, it seems unlikely that they managed to correct for quality perfectly.[51]

The missing postwar price boom is not a conventional economics problem, but it does present a challenge to those who seek to explain bubbles as the outcomes of a stable process where readily observable exogenous variables translate into the presence of a bubble. The 1950s had easier credit for homeowners than the 1920s and economic conditions were at least as good. Any model that suggests that there is a stable relationship between either of those variables and price bubbles has difficulties with this epoch.

B. *California in the 1970s and 1980s*

For the first half of the postwar period, California housing prices didn't seem all that different from prices elsewhere in the United States. Between 1950 and 1970, the logarithm

[51] If this view is correct, then the rising prices between 1950 and 1970 are explained not by increasing construction costs but by increasing unit quality.

of self-reported housing values grew only 0.002 log points faster annually in Californian metropolitan areas than in other American metropolitan areas. The California effect even becomes negative if you control for January Temperature, which is positively associated with price growth during this period (Glaeser and Tobio 2008).

By contrast, between 1970 and 1990, price growth was 0.03 log points higher annually in California than elsewhere, an extremely significant difference, both statistically and economically. In 1970, self-reported housing values across California's metropolitan areas were on average 26 percent higher than self-reported housing values elsewhere in the United States. By 1990, self-reported housing values in California were 140 percent higher than elsewhere in the United States.

The shift in California prices certainly doesn't seem rooted in changes in credit markets: real mortgage rates were rising over much of this time period, and local economic conditions don't seem to have driven the price rise. The average metropolitan area in California saw its incomes rise by 0.0022 log points annually faster than metropolitan areas elsewhere in the country. Even if all of this change was rising productivity, rather than shifting human capital composition, this should lead to only a 0.044 log point increase in California prices relative to the rest of the nation if the income growth represents a permanent level shift in productivity. Even if the growth rate was expected to continue (it did not), then California's prices should have risen by an extra 3.5 percent, assuming a real interest rate of 4 percent, no other price appreciation, a property tax rate of 1 percent and depreciation of 1.5 percent.[52] Moreover, income in California's metropolitan areas was not rising faster than in other warmer places during this time period, and yet its prices grew far more quickly.

Another explanation for the rising values of California land after 1970 is that as America became richer, people were willing to pay more for the best climates in the country (Graves 1980). Yet California's climate hadn't changed, and a secular process of increasing valuation of nicer places shouldn't have created such a sizable shift. That slow process should have been anticipated.

California did experience a major reduction in property taxes due to Proposition 13, and Rosen (1979) finds a significant impact of that change on prices in northern California. The effective tax rate prior to the reform averaged 2.5 percent (Sonstelie, Brunner, and Ardon 2000) and by 1990, the effective tax rate was 0.58 percent (Ferreira 2010). Using the same parameter values as before, this shift in property taxes should generate a price increase of 23 percent, which suggests that the effect could have been considerable. Some of this rise should have been offset by the impact of other tax increases which rose to mitigate the impact of declining property tax revenue.

There was another major shift in California's housing markets in the 1970s: new supply fell significantly. In the 1940s, California's housing stock grew by 53 percent and the stock grew again by 52 percent during the 1950s. In the early 1960s, California was responsible for over a fifth of the total number of permits in the United States. But permitting dropped off significantly after 1965, and the housing stock grew by 32 percent in the 1970s and 21 percent in the 1980s. Growth had particularly dropped in the state's most economically productive places. Between 1950 and 1970, Los Angeles County added 1.1 million housing units and its housing stock grew by 76 percent. Between 1970 and 1990, Los Angeles' housing stock grew by 620,000 housing units and its housing stock grew by 24 percent. Between 1975, when the FHFA Index coverage begins and 1989 at the peak of the boom, Los Angeles's real housing prices rose by 156 percent or a continuous annual rate of 6.7 percent.

Albert Saiz's (2010) work on the determinants of housing supply reminds us that difficult geography, such as hills and water, limits supply. California's coastal cities face both forms of geographic challenge, but there was no change in the geography of California after 1970, and these future limits to supply should have been anticipated. The regulatory shocks to construction were far less predictable.

Before the mid-1960s, California looked relatively similar to much of Sunbelt America in its approach to land use regulation. Growth was typically desired, and the limits to building were few, as the permits data suggests. Starting in the

[52] The depreciation rate of 1.5 percent reflects a 2.5 percent depreciation rate on the structure (Harding, Rosenthal, and Sirmans 2007) and the assumption that structure only accounts for 60 percent of value.

early 1960s, activists, such as the Save the Bay movement, used environmental arguments to justify barriers to new building. In the Friends of Mammoth case, in 1973, the California Supreme Court shifted the rules of development by requiring all major private developments to go through an environmental impact review process, which has meant that California's rules create more impact reviews annually than do the rules of the federal government. There were of course myriad local regulations as well, such as 60 acre minimum lot sizes which exist even in counties close to the heart of the San Francisco metropolitan area.

Limits on supply would have driven up prices in any case, as would Proposition 13, but buyers seem to have been particularly optimistic about future price growth. According to Case, Shiller, and Thompson, (2012) surveys of homebuyers, in 1988, 95 percent of San Francisco buyers in their sample and 93 percent of buyers in Orange County agreed with the statement that "It's a good time to buy because prices are likely to increase." On average, respondents in Los Angeles said that they expected to grow by 14.3 percent in "each year" "over next ten years" (Case, Shiller, and Thompson 2012). Moreover, 63.3 percent said that buying a home in Los Angeles involved little or no risk.

These answers certainly suggest that buyers may have used a naïve Gordonian model, and price-rent ratios in California based on the 1990 census are compatible with such beliefs.[53] Across the ten most expensive California metropolitan areas in our sample, these price rent ratios range from 25 (San Diego) to 38 (San Francisco).

Assuming a depreciation rate of 1.15 percent,[54] a property tax rate of 0.58 percent and a real interest rate of 4 percent yields a predicted price-to-rent ratio of 17.5. If the expected growth rate is 2.5 percent, the predicted capitalization rate rises to 31. Among those metropolitan areas in the sample with a price-rent ratio over 25, price growth between 1970 and 1990 averaged 0.023 log points more per year than those metropolitan areas with a price rent ratio below 25. The price-rent ratio for the lower group was 18 on average, and hit 29 for the higher group. Facing the same discount rate, the purchasers in the higher growth area would have to expect 2.5 percent faster growth per year, which is just about what their recent experience had been.

These prices are compatible with a Thunenite approach as well, for given the idiosyncratic tastes of Los Angeles buyers, geographic comparisons provide little guidance. Coastal California does have relatively unique natural advantages, within the United States at least, and a particular culture. It is no easier to say how much people should value these amenities than to say how much art buyers should value a Rembrandt. Moreover, since 80 percent of Los Angelenos agreed that "unless I buy a home now, I won't be able to afford one later" in the Case-Shiller survey, they really did seem to want to live in Los Angeles.

The events after 1989 were typical for the ends of booms. Supply had gradually been increasing in California. From 1985–1989, California averaged 262,000 permits per year, which is 80 percent higher than the average during the early 1980s. By 1990, buyers no longer found scarce inventory and prices began to fall again. Prices took a long time to reach bottom, but finally in 1996, real prices in Los Angeles hit 62 percent of the peak level. The new prices were also justifiable in a naïve Gordon model, because if little real growth is expected, these lower prices seem sensible. The lower prices are also compatible with buyers' applying a spatial arbitrage model. Prices elsewhere had fallen, and California had experienced a reasonably tough economic downturn.

The California boom and bust is the precursor to the great convulsion of the last ten years. The earlier event featured real shocks to housing supply and a somewhat limited ability to provide abundant housing elastically, especially in a short time period. Across metropolitan areas during this period, there was a tight connection between inelastic housing supply and the extent of price appreciation. The prices during both the

[53] There are significant problems with using the ratios of housing values to rents in an area to capture what is meant by capitalization rates. The housing stock that is rented and owned is different along observable and unobservable dimensions (Glaeser and Gyourko 2009). Homeownership involves sweat equity that is not fully priced.

[54] I have reduced the depreciation rate to reflect the lower share of structures in total value in 1990 California. Glaeser, Gyourko, and Saks (2005) report that the price to construction cost ratio is 2.17 for the 90th percentile metropolitan area in the United States in 1990, and almost all of California's major metropolitan areas are above that mark.

boom and the bust were compatible with reasonable valuation models. Those models just weren't right.

C. *The Great Housing Convulsion between 1996 and 2012*

The basic contours of the period from 1996 to 2012 are well known. Across the United States as a whole, there was a 53 percent real increase in housing prices between 1996 and 2006, which was followed by a 28 percent decrease in real values between 2006 and 2011. The boom was not felt everywhere equally, and as Figure 1 shows, price growth occurred disproportionately in the warmest quarter of America's metropolitan areas. Moreover, there was enormous mean reversion across areas, as shown in Figure 2. If a place experienced 10 percent more price growth between 2001 and 2006, that place on average saw prices drop by 9 percent relative to 2001 prices.

Price to rent ratios provide a tool for looking at the event. Using 40th percentile rents for each metropolitan area, provided by the Department of Housing and Urban Development, and calculating housing prices by using the base level in the 2000 census and the FHFA price index, Figure 15 shows price-rent ratios across the United States. The middle line shows the median price to rent ratios. The top line shows the 90th percentile of price to rent ratios and the bottom line shows the 10th percentile of price to rent ratios. The price-rent ratio for the median city increased from 16 in 2001 to 18 in 2006; the price-rent ratio for the 90th percentile city increase from 20 in 2000 to 36 in 2006.

While the previous booms were associated with dramatic episodes of economic uncertainty, it is hard to find any comparable force in the recent boom. The economy was not growing particularly swiftly, nor was it obvious that there were any tectonic shifts in the geography of American enterprise. Some denser, older cities like New York and Boston were doing particularly well, but that can do little to explain the boom in Las Vegas and inland California. The move to the Sunbelt was continuing during this time period, but much of that appears to have been driven by unrestricted supply of new housing (Glaeser and Tobio 2008), which should not have boosted prices. Land buyers may have thought that the supply of new land

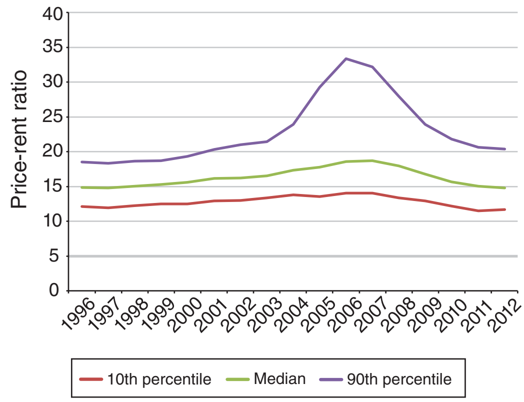

FIGURE 15. HOUSING PRICE-RENT RATIOS FOR 266 MSAs, 1996–2012

Sources: Price data from the Federal Housing Finance Agency (FHFA) http://www.fhfa.gov/Default.aspx?Page=87; Rent data from HUD's Fair Market Rents http://www.huduser.org/portal/datasets/fmr.html.

surrounding Las Vegas was likely to contract (Nathanson and Zwick 2012), but reasonable projections still suggest that there was more than enough desert space for America to build enormous amounts of housing. The entire country could fit in Texas with more than one acre per household.

The most common explanation for the boom was that easy credit is the culprit. In previous work (Glaeser, Gottlieb, and Gyourko forthcoming), I have argued that credit market conditions cannot explain the boom if buyers are rational. The changes in interest rates were too small to justify such price swings, especially given elastic housing supply and rational buyers should expect interest rates to mean revert following historical norms. Scholars also stress easier approval rates and lower levels of down payment (Mian and Sufi 2009), but it is hard to assess the magnitude of these effects since it is impossible to control adequately for the changing characteristics of mortgage applicants.

While the price boom does not seem to be explained by changing credit conditions, interest rates were low enough to justify prices given the standard Gordonian model, especially given reasonable growth rates. Himmelberg, Mayer, and Sinai (2005) report a 2.5 percent real interest rate in 2004, and Glaeser, Gottlieb, and Gyourko (forthcoming) similarly find real rates close to 2 percent over the time period. If growth rates follow historical norms, incorporating a risk premium for buyers, property taxes and depreciation still leaves the user cost at under 4 percent for many metropolitan areas and under 2.5 percent in some areas in Coastal California (Himmelberg, Mayer, and Sinai 2005). This calculation suggests that a Gordonian approach could readily justify price-to-rent ratios of 40 in these areas, which is roughly what occurred during the boom.

Case, Shiller, and Thompson (2012) report buyer expectations that were far more optimistic than historic norms would justify. For example, in 2005 the average Orange County buyer said that he expected 15.2 percent price increases in each of the next ten years. Such beliefs seem utterly implausible, but even if buyers expect 5 percent perpetual growth, they would essentially be willing to pay an almost limitless amount for a new house. Nathanson and Zwick (2012) address belief heterogeneity, and argue that beliefs for the marginal buyer should determine prices. In standard housing markets, the marginal buyer may be far less optimistic than the average buyer, but in markets for land, where large land purchases are prevalent like Las Vegas, a few overly-optimistic purchasers may end up dominating land sales.

This argument might explain the apparent anomalies of Las Vegas and Phoenix during the boom. During the 1980s boom, places with elastic housing supply experienced relatively little growth—the median price growth was 5 percent in such metropolitan areas (Glaeser, Gyourko, and Saiz 2008). There was still a strong negative connection between elasticity and price growth during the recent boom, but a number of more elastic metropolitan areas, such as Phoenix, still experienced fast price growth and reflected skyrocketing land values.

Just as a Gordonian approach could explain the boom, a Thunenite approach can also help explain the Las Vegas phenomenon. It seems plausible that some Las Vegas buyers in 2003 noted that prices seemed extremely low, relative to California, and reasoned that conditions weren't all that different. This reasoning may explain their increased willingness to pay, and the geographic spread of the boom. Ferreira and Gyourko (2011) find that the boom spread spatially, moving from the inelastic areas of the coast to proximate locales inland.

A free, or underpriced, default option might also add considerably to the willingness to pay. During this period, the mortgage insurance practices of federally-subsidized mortgage giants Freddie Mac and Fannie Mae provide the most natural explanation for why borrowers might have received an underpriced default option. In Table 2, I illustrate the impact of that default option on willingness-to-pay in an extreme case. I assume that mortgage, depreciation and property taxes total 5 percent, and that the standard deviation of log prices was 0.066 (following historical norms). If house prices are expected to have no trend, then the default premium adds 16.9 percent to the price of the housing. If housing prices are expected to rise at 2.25 percent (one-half the national average), then prices should increase by 5.5 percent if borrowers are given a free default option. The impact of the default option on housing prices will not be large whenever borrowers are optimistic about future price growth.

There were few obvious changes in economic fundamentals that set off the bust. The economy continued to grow strongly throughout most of 2007, but the Case-Shiller index reached its peak in April 2006. Nor is it obvious that credit markets conditions were tightening (Glaeser, Gottlieb, and Gyourko forthcoming). Perhaps the most plausible explanation is that slowing price growth led to a reassessment of future price growth, which is often given as an explanation for the end of a speculative boom (Kindelberger 1978).

D. *Calculating Social Costs*

One policy question is whether the boom led to substantial social losses from overbuilding. I now calculate the difference in social welfare after a boom (denoted as time T), comparing an optimal investment strategy between time zero and time T, with the actual investment strategy that did occur. I assume a representative agent, with quasi-linear preferences over "capital" and income. The agent buys the capital from its owners at market price P_T and also receives profits. I let $V(K_T)$ denote the lifetime utility from consuming this capital. Welfare is therefore $Income + Profits - P_T K_T + V(K_T)$. The profits received from the developer equal

$P_T K_T + F_{t\to T} - \int_{t=0}^{T} e^{r(T-t)}(C(I_t) + P_{L,t}L_t)dt$, where $F_{t\to T}$ denotes the current value of earnings from building between time zero and time T, $C(I_t)$ is the physical cost of building the structure and $P_{L,t}L_t$ is the land cost. The agent also receives the earnings from land sales which equal $\int_{t=0}^{T} e^{r(T-t)}P_{L,t}L_t\,dt$. I assume that the flow of earnings from t to T equals r times the cost of construction, so that welfare equals $Y + (K_T) - \int_{t=0}^{T}(C(I_t) - (e^{r(T-t)} - 1)P_{L,t}L_t)\,dt$.

The gap in welfare between this actual building strategy and any alternate is

$$(4)\quad V(K_T) - V(K_T^{Alt}) - \int_{t=0}^{T}\Big(C(I_t) - C(I_t^{Alt}) + (e^{r(T-t)} - 1) \times \big(P_{L,t}^{Alt}\,L{:}_t^{Alt} - P_{L,t}\,L_t\big)\Big)\,dt.$$

I ignore the social welfare changes associated with interest on the land component of the construction costs, which should be small if the building episode is short in duration. The function $V(\cdot)$ is concave, and its derivative equals the price of capital at time T. Using a second order Taylor series expansion and assuming a demand elasticity for housing of one (see Ellwood and Polinsky 1979; or Saiz 2003), implies that $V(K_T) - V(K_T^{Alt})$, can be approximated with $P_T(1 + \frac{K_T - K_T^{Alt}}{2K_T})(K_T - K_T^{Alt})$, where the adjustment $\frac{K_T - K_T^{Alt}}{2K_T}$ addresses the concavity of the welfare function.

If C_{Av} and C_{Av}^{Alt} denote the alternative per unit average construction costs, and let I_{Total} and I_{Total}^{Alt} denote the total amount of investment under the two scenarios, then the total social welfare difference is approximately equal to

$$(5)\quad P_T\left(1 + \frac{K_T - K_T^{Alt}}{2K_T}\right)(K_T - K_T^{Alt}) - \int_{t=0}^{T}\Big(C_t(I_t - I_t^{Alt}) + (C_t - C_t^{Alt})I_t^{Alt}\Big)\,dt.$$

There are three terms in the expression. The first term reflects the benefits of added capital. The second term multiplies the change in investment times the realized average cost of production. The third term is the increase in the average cost of production, created by the boom multiplied by the old investment level. I will ignore the adjustment $\frac{K_T - K_T^{Alt}}{2K_T}$ in my calculations.

One of the more troubling aspects of this approximation is that capital is hardly homogenous within a city, and new capital may be located in areas where prices are far lower than area average. The new units, however, will typically be of higher quality than the existing units which have depreciated, and that will cause a bias in the other direction.

To implement this scenario across American metropolitan areas during the last boom, we assume that in the absence of a boom, the investment in each year would have equaled the annual increase in the housing stock during the 1990s, multiplied by the ratio between national population growth in the 2000s and divided by population growth in the 1990s times ten. This formula essentially assumes that the growth in housing would have continued in the same way in each metropolitan area, except that all metropolitan areas slowed down by the same amount to reflect the slightly lower national rate of population growth. I use national population growth, rather than growth in households, to adjust for the fact that household formation is somewhat more likely to have been impacted by the recession itself.[55] To calculate the added capital stock due to the boom, I add estimated construction between 2004 and 2006 (inclusive) and divide by three times the predicted annual growth rate.

Annual construction is estimated by taking the number of building permits in the previous year multiplied by the ratio of national housing completed in that year to national permits in the previous year. Completed housing is not available at the metropolitan area level, so this correction is meant to capture the fact that not every unit is completed. This failure to complete became more severe at the very end of the boom,

[55] It is of course also true that the population growth has presumably slowed as well because of the recession, but the impact on population seems to have been less severe.

so it is most relevant for 2006, when the national completion rate falls to 92 percent.

The calculation of price is not itself completely straightforward, as self-reported census housing values in 2010 may seriously overestimate current housing prices in many metropolitan areas. Overestimation is common in self-reported housing valuations (Goodman and Ittner 1992), but it is particularly severe in places that have just experienced a housing bust. To address this issue, I use an alternative measure of price: the year 2000 self-reported housing value times 0.94 (to reflect standard overreporting) times the price appreciation in the metropolitan area implied by the Federal Housing Finance Agency's repeat sales index. This measure does miss any upgrading of quality in the area.

To calculate costs, I use the R. S. Means cost for a luxury 2,000 square foot home for each metropolitan area in each year and the cost for an average 2,500 foot home. I also added $25,000 to reflect the cost of added infrastructure including schools, roads, water, and sewage provision, which is based on an estimate for Austin, Texas (Fodor and Associates 2011) and in line with an earlier broader estimate based on more locations, once I also include some adjustment for school costs (Najafi et al. 2007).

The final step is to estimate the difference in cost associated with extra development. Glaeser et al. (2011) estimate that development costs per unit rise by 74 cents to $10 per units. Many of these cost estimates may not be real social costs, but may reflect instead increases in land prices or permitting difficulties. For this reason, I use a cost estimate from the bottom of our range of $1 per unit. However, I multiply this amount by the ratio of housing units in the area in 2000 to average housing units across our sample. This division reflects the fact that increasing the number of units by 10,000 in a year will have a much more modest impact on costs in Atlanta than in Green Bay, Wisconsin. All of these assumptions are debatable and other researchers may well come to disagree about my choice of parameters. My goal is to provide an illustrative calculation, rather than any sort of definitive figure.

Table 5 shows the results. The top panel shows results given luxury home costs (for a smaller home); the bottom panel shows results for a larger home. The first column shows the amount of overbuilding between 2001 and 2006 as a share of the total housing stock in 2010. Bakersfield, California and Las Vegas, Nevada, are estimated at the upper tail of this overbuilding, with 4 and 5 percent of their building stock in 2010 respectively reflecting "overbuilding" during the boom. This construction is not without value. The next column multiplies the number of extra homes times 2010 prices and again divides by the total number of houses in 2010. Across all of Las Vegas, there is estimated to be a $5,424 benefit (per home) from the added building costs.

The third column shows the costs of the extra housing, again on a per unit basis. The costs in Las Vegas are estimated to be $5,839, only $420 more per unit if I use luxury costs. When I use average costs, the costs in Las Vegas are actually below current prices. The proximity between current prices and construction costs (even adding in infrastructure) is the fact that limits the estimates of social losses from overbuilding.

The fourth column estimates the added construction costs that resulted from congestion in the building sector. In Las Vegas, this figure is over $500, which reflects the combination of a high baseline level of housing supply, and a significant increase in construction relative to the long-term trend. In the other metropolitan areas, the estimates are typically much smaller.

The total figures are relatively modest, with largest losses per household under $1,200, assuming luxury construction costs, and under $300 per household assuming average construction costs.[56] If taken literally, these results suggest that the overbuilding during the boom had relatively modest social costs relative to the financial distress that occurred during the bust.

One reason why these calculations may understate the true social costs of overbuilding is that even with the two corrections, I am overestimating the market value of real estate in Las Vegas as a whole. A second possibility, that seems even more serious, is that I am using a metropolitan area average price, and much of the new housing has been built in areas with relatively low price levels. I am far from confident that overbuilding had such moderate social losses. Further research, looking below

[56] The largest social loss given average costs is in Ann Arbor, but the loss there comes from underbuilding during the boom relative to historic trends.

TABLE 5—SOCIAL COSTS OF THE HOUSING BOOM

	Extra building (2004–2006)/ housing stock in 2010 (1)	Benefit from the extra building (2004–2006)/ housing stock in 2010 (2)	Extra building costs due to extra building (2004–2006)/ housing stock in 2010 (3)	Extra supply costs due to extra building (2004–2006)/ housing stock in 2010 (4)	Benefits-costs/ housing stock in 2010 (5)
Bottom 10 MSAs (calculated using luxury costs)					
Bakersfield, CA MSA	0.05	6,108.14	7,015.02	217.24	−1,124.11
Las Vegas, NV-AZ MSA	0.04	5,424.95	5,838.80	556.58	−970.43
Toledo, OH MSA	0.02	1,568.83	2,260.61	25.74	−717.52
Memphis, TN-AR-MS MSA	0.02	2,003.39	2,590.60	87.47	−674.69
San Antonio, TX MSA	0.04	4,282.42	4,770.27	183.93	−671.79
Kansas City, MO-KS MSA	0.02	2,855.07	3,436.80	79.62	−661.35
Oklahoma City, OK MSA	0.03	2,834.52	3,287.87	77.65	−531.00
Detroit-Livonia-Dearborn, MI (MSAD)	0.01	878.30	1,328.32	20.06	−470.08
Houston-Galveston-Brazoria, TX CMSA	0.05	6,381.28	6,584.80	222.94	−426.45
Omaha, NE-IA MSA	0.02	2,561.95	2,877.84	84.87	−400.75
Bottom 10 MSAs (calculated using average costs)					
Ann Arbor, MI PMSA	−0.04	−5,790.19	−4,552.11	−224.25	−1,013.83
Toledo, OH MSA	0.02	1,568.83	1,837.24	25.74	−294.15
Detroit-Livonia-Dearborn, MI (MSAD)	0.01	878.30	1,074.51	20.06	−216.27
Memphis, TN-AR-MS MSA	0.02	2,003.39	2,125.14	87.47	−209.23
Wichita, KS MSA	0.01	1,200.83	1,236.97	42.94	−79.08
Fort Wayne, IN MSA	0.00	287.09	321.44	12.19	−46.55
Dayton-Springfield, OH MSA	0.01	732.37	755.02	12.84	−35.49
Pittsburgh, PA MSA	0.01	568.14	587.32	4.91	−24.09
Youngstown-Warren, OH MSA	0.00	59.68	69.21	0.93	−10.46
Kansas City, MO-KS MSA	0.02	2,855.07	2,781.60	79.62	−6.15

Notes: Using adjusted housing prices. Sample is MSAs with populations over 500,000.

at sub-metropolitan data, is critical. Yet these results do suggest that the financial downside of the housing bust is still likely to be orders of magnitude more significant than any real costs of overbuilding.

Despite Field's (1992) fine analysis of the recession period, most previous real estate events are likely to have even smaller real costs from overbuilding. Even after the California boom of the 1980s, prices remained comfortably above construction costs, so it is unlikely that there were real losses in that case. The estimates of price decline provided by Nicholas and Scherbina (2011) suggest even after the bust, prices in Manhattan in 1933 were generally close to or above the physical cost of construction during the earlier time period. As opposed to Las Vegas in 2004, the land that was built upon was not generally vacant at the time of construction, and the full opportunity cost must include both the construction costs and the lost value of the destroyed capital and I have not attempted to evaluate that cost. The booms in early Los Angeles and Chicago were certainly not associated with overbuilding. Even if these places ended up being less successful than they eventually were, more capital was still surely appropriate. Significant social losses, if they occurred, would have to come from paying too much in construction costs because of speeding construction too quickly.

VI. Conclusion

The housing convulsion that occurred between 1996 and 2010 has many precedents in US history. Americans have been speculating heavily on real estate for centuries, and vast fortunes have regularly been won and lost. Many things are similar between the most recent boom and previous events. Rising prices are most strongly associated with optimistic expectations, and credit market conditions more typically played a supporting role. The optimistic expectations have been justifiable based on recent experience and a simple capitalization formula (the Gordonian approach) and by Thunenite comparisons with land prices or rents in other areas.

In the most recent boom, paying high prices required an optimistic assessment of future price growth. Expecting a better future was also critical to the rural land boom on the New York frontier in the 1790s, in Iowa in 1910, and in the urban booms of Chicago in the 1830s and Los Angeles in the 1880s and 1980s. In other cases, such as the Alabama land boom of 1819 and tenements in New York during the 1920s, prices were reasonable even if rents would stay constant.

Booms end when these optimistic projections fail to materialize, at least in the short run, but in many cases, the shocks seem like they should have been predictable to a forecaster with a Marshallian appreciation for the power of long-run elastic supply. A sufficiently well-informed buyer in Alabama in 1819 should have been able to expect that worldwide cotton supply would push prices down, just like a skyscraper builder in 1920s Manhattan should have been able to predict that abundant office space should decrease apartment rents dramatically. In the recent boom, sufficiently well-informed buyers in Las Vegas presumably should have recognized that America's incredible abundance of desert space would ultimately limit the long-run value of homes on the urban fringe of that metropolis.

The difficulties in forecasting the impact of supply are both understandable and hard to arbitrage. They are understandable, because the cognitive requirements needed to forecast the impact of global supply conditions on local property values are large. To an economist with the benefit of hindsight, the drop in cotton prices after 1819 may seem highly predictable, but why should that have been true among cotton farmers on America's frontier?

The ubiquitous nature of housing convulsions remind us that seemingly safe real estate investments can leave a gaping hole in bank balance sheets when things go sour. The tendency of markets to crash teaches that underpriced default options can lead to large social losses, especially because of financial meltdowns. This fact implies that there may be advantages if bank regulators recognize the regular tendency of real estate values to mean revert after booms.

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