Asset Bubbles and Supply Failures: Where Are the Qualified Sellers?

Bruce K. Gouldey and Clifford F. Thies

From their peak during the third quarter of 2007, to their trough during the first quarter of 2009, stock prices as measured by the S&P 500 fell 48 percent (see Figure 1). Through the third quarter of 2009, stock prices subsequently increased more than 40 percent. In contrast, housing prices, as measured by the Case-Shiller index, which fell 31 percent from their peak in the first quarter of 2006 to the first quarter of 2009, had not yet shown any sign of recovery.

In both markets, we observed the bursting of an asset bubble, but, while one market quickly began the process of recovery, the other did not. As of the writing of this article, the housing market is still characterized by large unsold inventories, rising foreclosures, and a damaged construction industry. Why did the stock market, which fell farther and faster and—with the exception of the financial services and auto industries—was not supported by the government, recover when the housing market did not?

We argue that, when a housing bubble bursts, the combination of high loan-to-value mortgages and costly foreclosures can inhibit house prices from quickly falling to their new equilibrium levels. The adjustment problem manifests itself, among other ways, in

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FIGURE 1
Stock and Housing Prices
(2002Q3 = 100)

homeowners being unable to complete the sale of their houses at current market values. For some time, the resulting supply failure distorts the supply of houses offered for sale, inventories of houses listed for sale, and the relative prices of different quality houses. Public policies have been targeted mostly at maintaining house prices by propping up demand. Those policies exacerbate the problems associated with this supply failure and can result in substantial reduction of social welfare due to misallocation of resources.

The model we develop suggests instead that public policy should focus on unwinding uneconomic contracts in order to enable house prices to fall quickly to their equilibrium levels. Such policies would enable more homeowners to sell their houses at then current market prices, restoring the normal turnover of the housing stock and housing mobility to families. Indeed, by returning a measure of liquidity such policies would, in the long term, contribute to the demand for housing.

Asset Bubbles

An asset bubble can be said to exist when the price of the asset exceeds its fundamental or intrinsic value.[1] Krainer (2003), for example, says that a housing bubble occurs when the ratio of house prices to rent trends above its long-run average. Asset bubbles are usually if not always associated with an expansion of money and credit. In the recent stock and housing bubbles, financial innovations were involved during the run-up in prices, such as risk-shifting through collateralized debt obligations and credit default swaps. Those innovations facilitated an increase in the flow of credit to the housing market, but also built up a mismatching of assets and their claims. Eventually, the stock and housing bubbles burst because of these mismatches, mortgage defaults, and the loss of confidence in asset-backed commercial paper. Brunnermeier (2009) estimates that in the year following the stock market peak in October 2007, stocks lost $8 trillion. The fall in stock prices was brutal both in terms of the extent and quickness of the loss. The fall in housing values was nowhere near as brutal. As measured by the biennial American Housing Survey, the median value of houses fell $21,500 from 2007 to 2009, for a total loss of $1.9 trillion, about one quarter of the

[1]See Malkiel (2003) for an examination of some famous bubbles.

stock market loss. But, whereas stock values began to recover in the second quarter of 2009, housing values continued to deteriorate through 2009.

Previous examinations of the phenomenon of bubbles have focused mainly on the conditions for the existence of bubbles (e.g., Tirole 1982, 1985a, 1985b; Grossman and Yanagawa 1993; Allen et al. 1993; Kunieda 2008). Abreau (2003) examines the persistence and bursting of bubbles. Barlevy (2007) provides a good review of this literature. Allen and Gale (2000) show that financial leverage, through asymmetric information and risk-shifting, not only can cause bubbles, but also can exacerbate crises following the bursting of bubbles, particularly in assets with a supply that is relatively fixed. Glaeser et al. (2008) show that less elastic housing markets have longer and larger bubbles. They measure a bubble by a rising price-to-cost ratio in 79 metropolitan areas, where their cost index involves the sum of building cost per square foot and the cost of land.

Recent changes in mortgage financing have made the U.S. housing market less elastic. Government intervention in mortgage finance (e.g., through the lowering of FHA and VA down payments first to 3 percent and then to zero and increases in guaranteed loan maximums through Fannie Mae and Freddie Mac) resulted in a higher proportion of fixed rate (versus variable rate) mortgages, higher loan-to-value ratios, and lower interest rates. International banking regulations encouraged the acquisition of government-guaranteed mortgages by treating them as nearly risk-free. Initially financial engineering seemed to better spread default risk, interest rate risk, and liquidity across a wider spectrum of investors. Instead it may have concentrated the risks involved in mortgage lending so as to replace conventional risks with systemic risk and compromised the objectivity of regulatory bodies. In addition, financial engineering degraded transparency in mortgage finance. These institutional arrangements attenuated the housing bubble by increasing demand for residential houses. Green and Wachter (2005) and Coleman et al. (2008) show that the increase in subprime mortgage originations did not cause the housing price bubble in the late 2000s, but rather was a joint product, as new entrants displaced the government-sponsored enterprises (GSEs)—that is, Fannie Mae and Freddie Mac—in the packaging and sale of mortgage loans. Coleman et al. segment the mortgage market by purchase transaction size and show that, near the beginning of 2002, the percentage increase in price in the lowest

tier started to increase at a faster rate than mid- and high-tier homes. This increase in the price in the lowest tier also was accompanied by an increase in the percentage of subprime mortgage originations and, later, by an increase in the percentage of alt-A mortgages.[2]

A significant aspect of the bubble-bursting in 2007 is that many financial markets froze. For a time even though bid and ask prices for certain financial assets were posted, no one was actually willing to trade at the posted prices. Easley and O'Hara (2010) show that markets will freeze when traders' portfolio preferences are incomplete in the presence of Knightian uncertainty.[3] When traders' preferences are incomplete and beliefs are uncertain, inertia can rule and no trades occur. The absence of trades makes unbiased valuation difficult. As indicated by time on the market, the housing market also froze. Yet, houses have real utility, and the bursting of the housing bubble should have had no impact on the house preferences of actual and potential homeowners.

In the next section, we argue that the combination of binding mortgage constraints and costly foreclosure distort the housing market upon the bursting of a housing bubble by inhibiting the fall of house prices to the levels necessary to clear the market. This distortion occurs because of a contraction in the number of qualified sellers. Homeowners cannot complete the sale because the current market value of their house is "underwater" or less than the balance on their mortgage and it would be costly to the homeowner to cover the deficiency.

Leamer (2007) observes that housing follows a volume cycle, not a price cycle. That is, home prices are always sticky downward when demand declines. Instead of selling at depressed prices, homeowners choose not to make an elective move when prices in the short term are below intrinsic values, anticipating that prices will eventually return to their long-run equilibrium levels. This is a well-known example of time flexibility as a real option (e.g., see Brealey et al. 2006). However, when a housing bubble bursts, homeowners often face a different scenario. In this case, a falling price might still be

[2]Alt-A mortgages are conventional mortgages that are otherwise conforming but are not fully documented.

[3]Knightian uncertainty describes a situation where the probability distribution of outcomes cannot be determined. Traders have incomplete portfolio preferences when they cannot rank order some portfolios.

greater than the new equilibrium price, but less than both the price paid for the house and the outstanding mortgage loan balance.

Below we develop a model describing first the generation of a housing bubble and then the bursting of the bubble. With regard to the bursting of the bubble, we utilize an agent model.[4] Our primary conclusion is that the combination of high loan-to-value mortgages and costly foreclosure have constrained the number of qualified sellers, causing the housing market to freeze, distorting relative prices, and inhibiting housing prices from quickly falling to market-clearing levels. Our analysis suggests that public policy should focus not on increasing housing demand but rather on removing constraints on the supply of houses being offered for sale so as to allow prices to quickly reach their equilibrium levels.

Formation of a Housing Bubble

For the present purpose, houses are not usefully characterized as commodities; rather, the facts that houses are discrete, durable, and differentiated goods must be taken into account. A house's price, accordingly, depends on its desirability relative to that of other houses. A particular house's desirability is affected by such factors as location, size, age, construction quality, lot, and finishes. In a perfect market all houses with the same desirability should sell at the same price and all houses with greater desirability should sell at a higher price than houses with lesser desirability. Otherwise, potential buyers of lesser desirable houses instead would purchase houses that are both more desirable and cheaper. Arbitrage would eliminate this anomaly in a perfect market. Furthermore, the long-term equilibrium price for houses of any level of desirability would be the sum of the building-ready site cost, structure replacement cost, and cost of capital. In a perfect housing market with a potentially infinite supply of houses of each desirability level that could be built, the supply curve of more desirable houses would be horizontal and lie parallel to and entirely above the supply curves for less desirable houses.

Now suppose there is a finite supply of houses of each desirability cluster that can be built at the original replacement costs. Also suppose that when this finite number of houses has been built and sold,

[4]The mathematical derivation is provided in an appendix that is available from the authors.

new houses of the same desirability will cost more to build or require a more expensive building lot. At this break point there will be a price discontinuity in the supply curve and the long-term equilibrium price will shift upward. This situation is typical, for example, in a new housing development with multiple development phases and multiple housing models in each phase. Prices often are raised from the end of one phase to the beginning of the next phase.

We are now ready to describe sufficient conditions for a housing bubble. Assume that the market for housing services involves owner-occupied houses of each desirability level and rental units, that there is a very large number of renters who will potentially want to purchase houses, and that the supply of rental units is perfectly elastic. These assumptions enable us to focus on the dynamics in the owner-occupied segment of the market for housing services. A stylized progression of home ownership is that new family units will first rent, then purchase a lower desirable (i.e., starter) home, and perhaps later move up to a more desirable home if and when they can afford higher priced housing. New construction and deaths of existing homeowners make more desirable homes available to family units owning lesser desirable houses who are ready to move up. This upgrading frees up lesser desirable houses for renters who are ready to purchase. Alternatively elderly homeowners may desire to downsize and purchase less desirable houses or rent again. Divorces can also affect the demand for and supply of housing in each category.

When the quantity demanded exceeds available supply of houses of a particular level of desirability, more of that kind of house will be built. Because there is a large number of renters, the potential demand for owner-occupied houses is also very large. Without any possible short-selling in the housing market,[5] as long as the arrival rate of new renters exceeds the death rate of house owners, there is the potential for a housing bubble (Tirole 1982). If builders could accurately predict the demand for houses of a particular level of desirability, they would build exactly the right number of houses to satisfy demand and no bubble would be created. Because building

[5]Short-selling involves selling a borrowed asset with the intention to replace the borrowed asset by repurchasing it at a later date. This should not be confused with a "short sale" of a house whereby a mortgage holder forgives a portion of the outstanding mortgage loan in order to facilitate the sale of the mortgaged property at a price lower than the outstanding debt.

houses is expensive, builders have incentives to build only to expected demand so as not to create excess supply that will incur carrying costs and/or lose value when a bubble bursts. However if exogenous forces (e.g., government programs that incentivize wider home ownership) unexpectedly drive more renters to become house buyers, perhaps incentivizing speculation that further artificially increases demand, builders can be surprised by the number of houses demanded and may begin to build in advance of confirmed demand in anticipation of a higher arrival rate of new buyers.[6]

Suppose no more houses of a particular level of desirability can be built at the lower cost. Then the next house to be built will be at the higher cost (i.e., where the long-term equilibrium price will increase). If there is a great demand for houses of this and nearby levels of desirability, prices of all existing houses with these levels of desirability will rise to near their new higher long-term equilibrium prices. House prices then will exceed their initial long-run equilibrium prices. By recursion, the argument can be repeated when two houses, three houses, etc. can be built before the long-run equilibrium price rises. Thus, every house of a particular level of desirability will cost more than the previous sale and a bubble will get underway. In a normal housing market, house sale listing prices are usually greater than or equal to the actual sales price. However, one piece of evidence of a bubble is that there are often multiple bids on a house, starting a bidding war and resulting in sales prices exceeding listing prices.

Bursting of a Housing Bubble

Bursting of a housing bubble occurs when all house prices are falling simultaneously due to unanticipated economic and/or demographic factors. This simultaneous drop in housing demand across desirability levels creates a temporary imbalance between supply and demand. If there were no foreclosure costs in housing markets, prices would fall back in an orderly fashion toward (and to clear an inventory glut perhaps somewhat beyond) the long-run equilibrium price, and the equilibrium pricing relationship among houses of

[6]Because of this artificial demand increase for home ownership, rental housing unexpectedly will become available and rental prices should fall, thereby inducing greater numbers of households to be formed (e.g., adult children moving out of their parents' houses into their own rental units).

different desirability would be maintained. Prices of more desirable houses always would exceed the prices of less desirable houses. Because there would be no penalties for mortgage loan default, lenders would build appropriate risk premiums into mortgage loan rates, use those premiums to fund loss reserves, and take losses against the reserves when borrowers with underwater mortgages default. Homeowners would incur no other default costs, lenders would foreclose,[7] and houses would sell for the then current market prices.

Now consider a housing market with costly foreclosure so that homeowners in default on their mortgage loans seek to avoid losing their homes and creditors also have incentives to avoid the foreclosure process.[8] Foreclosure costs, some of which are listed in Table 1, include both direct expenses and indirect economic costs for both deficient mortgagees and the mortgage holders.

When a homeowner can no longer afford to make his mortgage payments, he has several possible courses of action. We will list these alternative actions in decreasing order of cost to the homeowner. First, if there is sufficient equity in the property, the homeowner could refinance the mortgage at a lower interest rate to reduce the payments. If refinancing is not a viable option, he could choose to sell the home and pay off the mortgage balance in full. However, in a bursting housing bubble the mortgage could be underwater. In this case the homeowner possibly could liquidate other assets to cover the shortfall. None of these actions would result in default and the homeowner's credit worthiness would not be damaged, but the homeowner could incur direct costs. However, once the homeowner has exhausted his liquid assets, there is potential damage to the homeowner's credit worthiness.

[7]Alternatively, and not uncommonly under normal conditions, borrowers could give back the title in lieu of foreclosure.

[8]While bankruptcy (and foreclosure) laws can vary across states (e.g., the treatment of homesteading), a stylized view of the treatment of houses and mortgages in Chapter 7 bankruptcy is that mortgage debt is its own class or a subset of a class of secured debt. In event of default, creditors in this class would satisfy their claims by selling the collateral after a lifting of the stay. Hence, with recognition of process differences, we treat bankruptcy as a special case of foreclosure. While the legal process is different, the end result regarding the disposition of the home to satisfy the outstanding mortgage balance is essentially the same. In similar manner, Chapter 13 bankruptcy has many similar characteristics to a loan modification process to avoid foreclosure.

TABLE 1
Foreclosure Costs

	Direct Costs	Indirect Costs
Borrowers	Legal	Reduced access to credit
	Moving	Stigma
Lenders	Legal	Asset carry
	Transfer taxes	Monitoring
	Real estate taxes	
	Repairs	
	Real estate sale commission	
	Building maintenance	
	Potential further capital loss	

Either in advance or following the missing of mortgage loan payments, the homeowner could notify the lender of his inability to make the contractual payments. At that point the homeowner would be conceding control of the asset to the lender and would begin to incur both direct and indirect economic costs. The lender could take one of the following actions: modify the loan to temporarily reduce the loan payments, refinance the mortgage at a lower interest rate with a loan-to-value ratio greater than one, forgive a portion of the loan principal, accept the deed in lieu of foreclosure, or begin foreclosure proceedings once the homeowner defaults. The first four of these actions are meant to forestall foreclosure and avoid the incurrence of the direct and indirect economic costs listed in Table 1. Forgiveness of loan principal can be employed either to keep the homeowner in his home or, more frequently, in a short sale to facilitate the transfer to a more viable buyer.

The main factor that determines whether the homeowner or the lender controls the decision of how to handle a potential mortgage default is the market price of homes of that desirability level.[9] The combination of the market price with mortgage debt and costly foreclosure can result in pricing distortion in the housing market after the

[9]Other factors include a homeowner's cash flow, liquid assets, refinance interest rates and availability, and the homeowner's expectation of the results of a loan modification request.

bursting of a housing bubble. A homeowner has an option to sell his house, which we call the sale option. However, he will not exercise this option unless the sum of the sale price and his other wealth exceeds the sum of the outstanding mortgage balance and transaction costs. If the homeowner is in default on his mortgage and he cannot exercise the sale option, then both he and the lender will incur foreclosure costs.

In this case of costly foreclosure, the equilibrium relationship that lesser desirable houses list and sell for lower prices than more desirable houses need no longer hold and relative prices can become distorted. This is because houses where the mortgage constraint is not violated (i.e., where the sum of the house price plus the owner's wealth equals or exceeds the outstanding mortgage balance) are free to sell at current market prices, whereas houses with identical desirability but with negative homeowner's equity cannot be sold without incurring costly default and foreclosure. Once a mortgage holder/lender forecloses on a property in mortgage default, often in a declining housing market, he will sell the property below its market value to quickly get the fixed asset off his books to avoid future carrying costs.[10]

Because listing prices are usually higher than transaction prices except in a bubble, when a bubble bursts, it is not unusual to see listing prices driven by the outstanding mortgage loan balance instead of by the market. These houses will not sell and various anomalies will be observed: large inventories of houses listed for sale, more desirable houses listed at lower prices than less desirable houses, and price listing compression between houses of different levels of desirability.

To see that the equilibrium pricing relationship need not hold when a housing bubble bursts in a market with costly foreclosure, consider the following example. Suppose there are 20 houses, 10 each of lower (i.e., type-1) and higher (i.e., type-2) desirability where the long-term equilibrium prices are $200,000 and $250,000, respectively, for type-1 and type-2 houses. Suppose mortgage terms require

[10]To delay or avoid an asset write-down, if a lender believes the price drop to be short lived, he may outbid other potential buyers up to a price not greater than the outstanding mortgage balance. However, if prices are expected to continue to decline for the foreseeable future, the lender will attempt to sell the asset at market price to avoid incurring carry costs. See Timiraos (2010) for evidence.

10 percent equity for type-1 houses, 20 percent for type-2 houses with purchase prices under $300,000, and 30 percent for type-2 houses with purchase prices of at least $300,000. For simplicity and without loss of generality, assume that all mortgages require payment of only interest and assume that all houses were purchased in the first phase—that is, before the long-term equilibrium price increased. Assume without loss of generality that houses were originally purchased in the following order so that the pricing equilibrium requirement is satisfied. First the lowest priced type-1 house was purchased, then the lowest price type-2 house, then the next lowest price type-1 house, then the next lowest price type-2 house, etc. This assumed sale order preserves the equilibrium pricing relationship between type-1 and type-2 houses in the initial purchase transactions; each type-2 house is purchased for $50,000 more than the previous purchase of a type-1 house (see Table 2). As the houses are initially sold, prices for equivalent houses increase over their long-term equilibrium levels consistent with a price bubble.

Now suppose the owners of these houses were unable to make their promised mortgage loan payments and fell into default. If the owners were unable to sell their houses and had no other assets, their lenders would foreclose. Home prices would start to fall and the bubble would burst. However, current mortgage loan balances impede the orderly bursting of the bubble because house owners would be unwilling to sell their homes for less than their outstanding mortgage balances. Figure 2 shows the minimum prices at which owners of both type-1 and type-2 houses would be willing to sell, assuming interest-only payment mortgages. As evident in Figure 2, the equilibrium pricing relationship no longer holds as the bubble bursts; minimum prices of type-1 houses are not necessarily uniformly less than prices of type-2 houses.

For example in Table 2, because the first type-1 house was purchased for $200,000 and financed with a 90 percent loan-to-value (LTV) mortgage, the strike price of the owner's sale option is $180,000. The first type-2 house was purchased for $250,000 and financed with an 80 percent LTV mortgage. Because the strike price of its owner's sale option is $200,000, which is greater than the strike price of $180,000 for the first type-1 house, the equilibrium pricing relationship is not violated. However, the purchase price of the last type-1 house sold with a 90 percent LTV mortgage has a sale option with a strike price of $261,000, which is greater than the sale option

TABLE 2
Disequilibrium Pricing Example

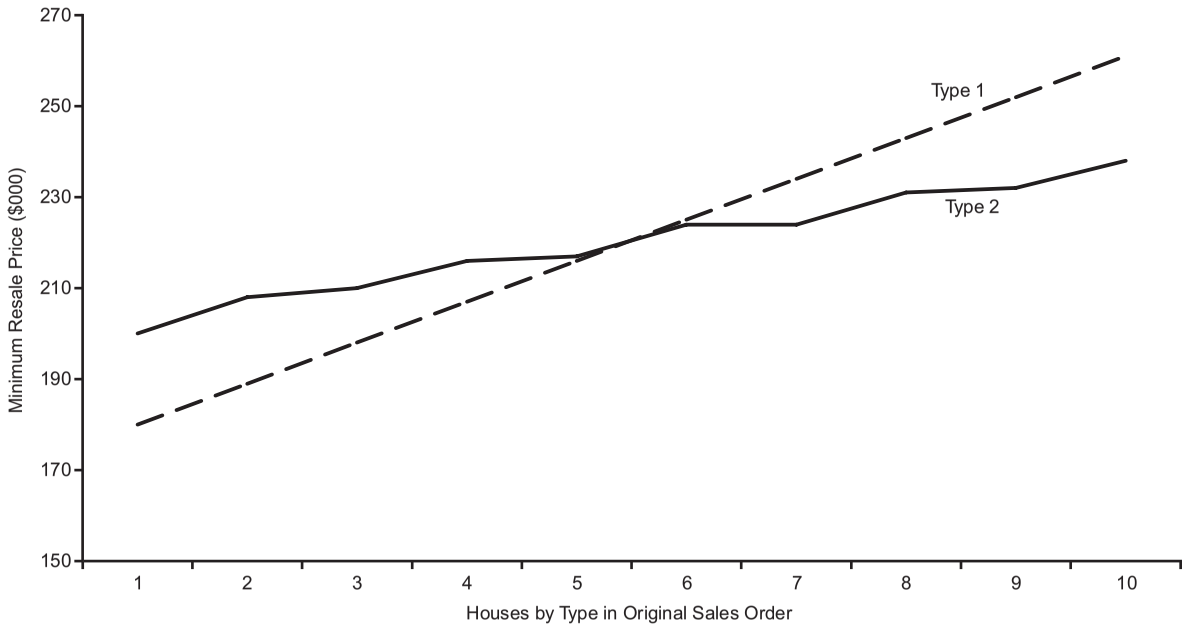
House Type	Purchase Price ($000)	Purchase Order	Mortgage Debt as % of Purchase Price	Minimum Resale Price = Current Mortgage Debt ($000)	Homeowner's Equity ($000)
1	200	1	90	180	20
1	210	3	90	189	21
1	220	5	90	198	22
1	230	7	90	207	23
1	240	9	90	216	24
1	250	11	90	225	25
1	260	13	90	234	26
1	270	15	90	243	27
1	280	17	90	252	28
1	290	19	90	261	29
2	250	2	80	200	50
2	260	4	80	208	52
2	270	6	80	216	54
2	280	8	80	224	56
2	290	10	80	232	58
2	300	12	70	210	90
2	310	14	70	217	93
2	320	16	70	224	96
2	330	18	70	231	99
2	340	20	70	238	102

strike prices of any of the type-2 houses—a violation of the equilibrium pricing relationship.

Mortgage loan balances in an environment with costly foreclosure impede the orderly unwinding of a bubble. A house that would otherwise be offered by the owner, in or out of default on the mortgage loan, at whatever price the market would bear would not be offered for sale because of the mortgage balance if the mortgage is "upside down"—that is, the sale option would not be exercised. Moreover, because of the time and cost of the foreclosure process, prices will not return as quickly to the long-run equilibrium.

The higher is the mortgage balance as a percentage of the house value, the less likely is the sale option to be exercised as a bubble unwinds and the more price distortion will appear in the housing

FIGURE 2
Disequilibrium Pricing Example



NOTE: This chart shows that as a bubble unwinds, less desirable (Type 1) houses can sell at lower prices than more desirable (Type 2) houses because of binding mortgage loan constraints.

market. Homeowners with negative equity who would otherwise be disposed to sell their houses for any reason (e.g., to move closer to a job, to move into a more desirable home, or to avoid foreclosure when they can no longer afford their mortgage loan payments) cannot exercise the sale option and the housing market can seize. Thus, available housing supply is restricted as houses are either not listed for sale because their owners are underwater on their mortgage loans or the houses are listed for sale but not sold because market prices are below both the sales option strike price and the listing price. Not until foreclosure occurs will these houses be sold at or below then current market prices.

Empirical Support

A number of stylized facts support the implications of our agent model. It is well known that housing prices and real interest rates are negatively correlated (Hubbard and Mayer 2009). From a relative maximum of 6.5 percent in May 2000, the Federal Reserve drove the Fed funds rate down to 1.0 percent in June 2003. By June 2005, when the rate again peaked at 5.25 percent, the monetary base had increased by more than 34 percent, making credit cheap and triggering asset bubbles in both equities and housing. Between June 2003 and June 2005, 30-year fixed mortgage rates varied between 5.23 percent and 6.29 percent with between 0.5 and 0.7 points. From 2003Q2 until housing prices peaked in the U.S. in 2006Q1, conventional mortgage housing purchase prices increased by 52 percent. By 2009Q1 following the housing bubble burst, the average house purchase price had declined back to its 2003Q1 level. New residential single-family house sales plummeted from 1.28 million in 2005 to 485,000 in 2008.

Following the bursting of the asset bubbles, housing prices have not adjusted as quickly to their long-term equilibrium price levels as have stock prices, which are not impeded by the same type of financing constraints. As shown in Figure 1, from the third quarter of 2002 to the third quarter of 2007, the S&P 500 rose 87 percent. Housing prices, as measured by the Case-Shiller National Seasonally Adjusted Purchase Index (CSI), peaked six quarters earlier up 52 percent from the third quarter of 2002. The asset bubbles burst following these peaks for both stocks and house prices. By the first quarter of 2009, the S&P 500 plummeted to 2 percent below its third quarter of

2002 level but quickly rebounded over the next year to more than 40 percent higher than that level. On the other hand, by the first quarter of 2009, CSI had plummeted to its level from six years previously and has remained within a range of 4 percentage points since then.

As of September 2009, First American CoreLogic estimated the average inventory of unsold homes to be 5.5 million units, a supply of more than 11 months. This inventory consisted of a visible supply of unsold houses of 3.8 million units and a 1.7 million unit pending supply, comprised of residential real estate owned by banks and pending foreclosures (CoreLogic 2009). However, the actual inventory of unsold houses is understated by an unknown number of homeowners who would like to sell but cannot because they are underwater on their mortgage loans.

It is well known that default rates are highly correlated with mortgages' initial loan-to-value ratio (see Deng et al. 2000). While the relative frequency of first mortgage loans with an initial LTV ratio greater than 90 percent generally decreased from 2000 to 2006, the use of piggyback second and third mortgages ballooned. The combined LTV ratio of purchase transaction mortgage loans increased from about 80 to 88 percent during this period (Coleman et al. 2008). At the end of the first quarter of 2010, 11.2 million, or 24 percent, of all residential properties with mortgages were in negative equity positions. Moreover, 38 percent of borrowers with junior liens, such as closed end second liens or home equity lines of credit, had negative home equity compared to19 percent of borrowers that did not have a junior lien. In addition the foreclosure rate for borrowers with junior liens was 4 percent, compared to 2 percent for borrowers without junior liens (Core Logic 2010).

Distressed sales now comprise a significant portion of total house sales.[11] Prior to the bursting of the housing bubble, distressed sales were less than 3 percent of total sales with short sales making up a negligible amount of distressed sales and real estate owned (REO) sales making up the bulk. Relative to total sales, distressed sales peaked in early 2009 at nearly 35 percent and remained between 22 and 30 percent throughout 2010. Mortgage holders have increasingly accepted short sale purchase contracts that allow underwater homeowners to sell their houses directly with neither borrower nor lender

[11]Distressed sales are comprised of short sales by homeowners and real estate owned sales by mortgage holders.

incurring direct foreclosure costs. CoreLogic reports that short sales have grown steadily reaching more than a quarter of all distressed sales at the end of 2010.

The observed negative relationship between bank foreclosures and housing prices also supports our agent model which predicts that costly foreclosure combined with high LTV mortgages restrict the number of qualified sellers, thereby inhibiting housing prices from adjusting quickly to their long-run equilibrium levels (e.g., in contrast to liquid financial assets) following the bursting of a bubble. On the other hand, once foreclosure occurs, the lender immediately offers the house at the perceived market price (or lower, to realize a quick sale and avoid expected carrying costs) and writes down the loan to market value (taking a capital loss). Hence, as the rate of foreclosures accelerates, so should the decline in sold house prices. In fact, this is exactly what has been observed. Timiraos (2010) reports that house prices declined rapidly in 2008 as foreclosed properties were dumped. A combination of federal programs to stimulate demand and modify mortgages in default and low mortgage rates reduced the number of foreclosures in the first half of 2009. These programs temporarily stemmed the house price drop as the share of distressed sales fell to 25 percent of home sales by November 2009, before increasing to 30 percent in July 2010, when prices again deteriorated.

Cross-sectional data lend further support to the implications of our model. Using Federal Housing Finance Agency (www.fhfa.gov/Default.aspx?Page=87) and HousingTracker (www.deptofnumbers.com/asking-prices/) data, we ranked 54 metropolitan areas on their percentage increases in sales prices from 2000 through 2007 and divided them into thirds. The top third of these metropolitan areas saw median increases in sales prices of 115 percent versus 68 percent for the middle third and 29 percent for the bottom third. The bursting of the housing bubble did not affect all areas equally or simultaneously. Figure 3 shows that the areas with the biggest bubbles experienced the greatest declines in listing prices after the bubble burst. Evidence of supply failures can be seen in the inventory levels.[12] Figure 4 shows that the areas that experienced the smallest

[12]Ideally we would break out REO sales listings from voluntary sales listings because our model predicts that voluntary sales will be withheld as prices drop while REO sales increase. Unfortunately data limitations do not permit this breakdown.

FIGURE 3
Listing Prices by Metro Area

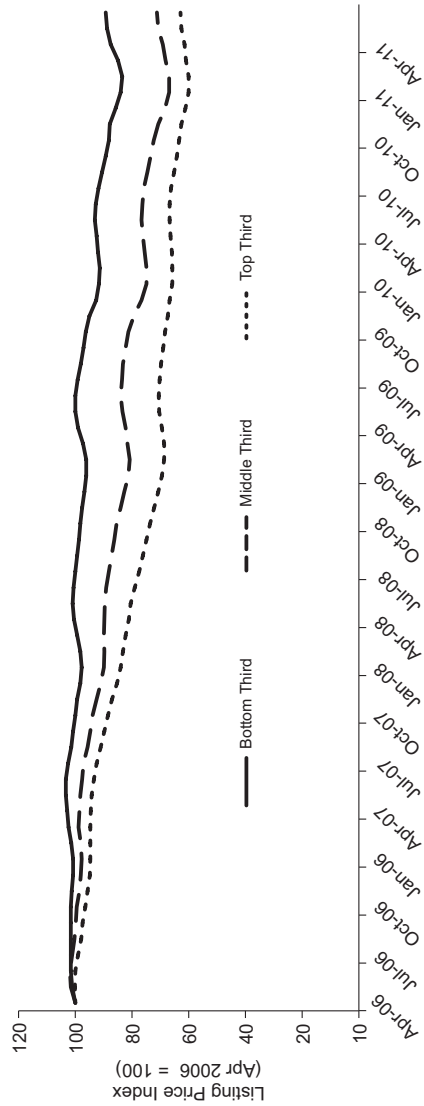
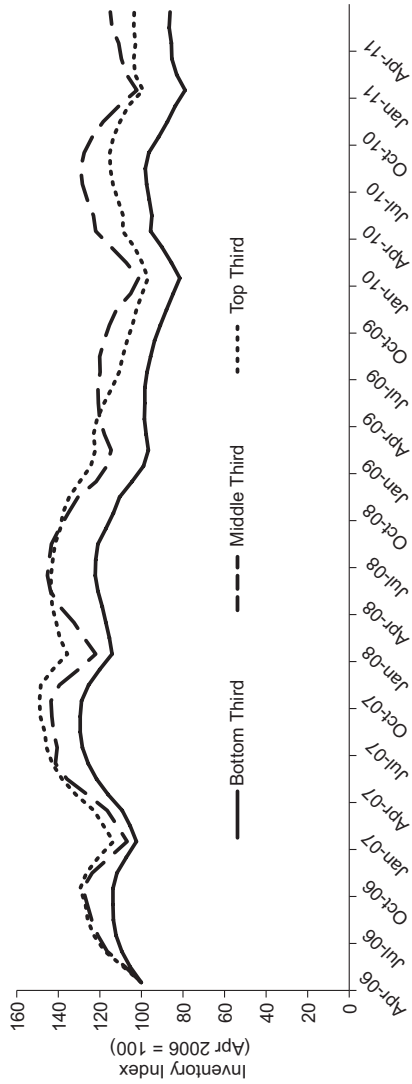


FIGURE 4
INVENTORY BY METRO AREA



bubbles (i.e., the bottom third) have the lowest inventory of houses for sale. Homeowners in these areas have fewer distressed sales listings and fewer homeowners are willing to voluntarily sell their homes as prices have dropped. Areas in the middle and top thirds also have experienced declining inventory levels following the bursting of the bubble, just not as significantly, as these areas have seen higher levels of foreclosure activity.[13]

Another implication of our model is that there should be greater dispersion in listing prices following the bursting of a bubble—that is, listing prices at and far above the equilibrium market price should be observed. Homeowners who are most underwater but need or want to sell are going to list above the market price. The areas that experienced the greatest price increases during the bubble should have the greatest price dispersion during the bubble's collapse. In fact, Figure 5 shows that variability in listing prices increased in all three groups following the bursting of the bubble and that the markets in the top third for price increases during the bubble have substantially higher dispersion in listing prices than the other markets.

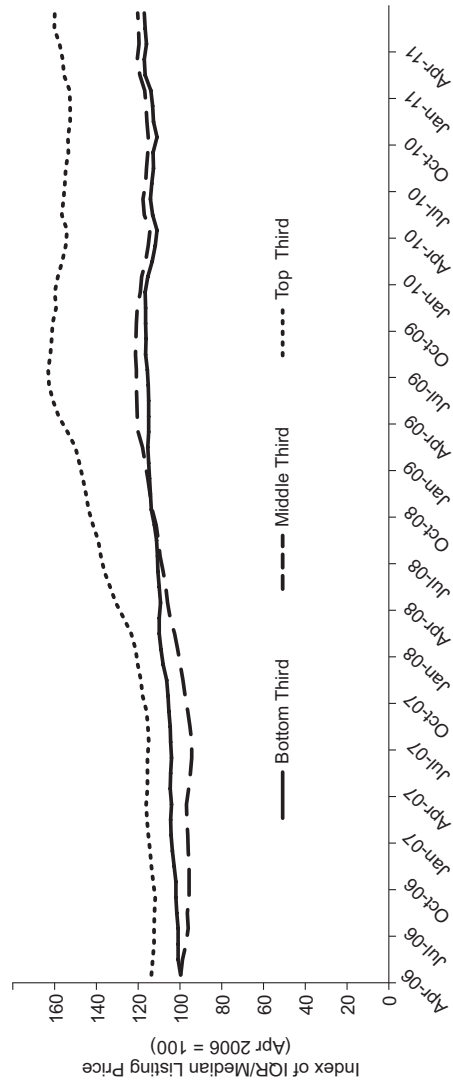
In sum, while we cannot directly test our model, we have a variety of direct and indirect evidence that supports its implications. In the next section we discuss the policy implications of our agent model.

Policy Implications

Herein we have developed an agent model to explain house price bubbles and how the combination of mortgage financing and costly foreclosure delay house prices from falling to their long-run equilibrium levels. These impediments to house prices quickly adjusting to economic conditions and exogenous shocks decrease the supply of houses offered for sale, increase the inventory of unsold listed houses, and distort relative prices. Offering (i.e., listing) prices for less desirable houses can exceed those for more desirable houses when house sellers are constrained by their outstanding mortgage

[13]Core Logic reports 11 states with foreclosure rates above the U.S. average (http://cr4re.com/charts/charts.html?Delinquency#category=Delinquency andchart=MBAStatesLoansinForeclosureQ1.JPG). Nine of the metro areas in the top third are in these states (including five in the states with the three highest foreclosure rates) versus five metro areas each from the middle and bottom thirds (with three and one, respectively, in the top three foreclosure states).

FIGURE 5
LISTING PRICE VARIABILITY BY METRO AREA



balances from selling their houses at market prices. Houses that are underwater on their mortgage loans cannot be sold without lenders' willingness to take credit losses. As a result homeowners who are locked into their homes and relatively illiquid assets in normal times become even less liquid. A higher mortgage balance relative to the home's value increases illiquidity and market distortions.

To halt the drop in house prices, the federal government has introduced programs designed to increase demand for houses. Through the Mortgage Debt Relief Act of 2007, from December 20, 2007, to November 2009, first-time home buyers were eligible for a tax credit of $8,000. The Mortgage Debt Relief Act of 2009 subsequently extended this first-time home buyer credit through April 2010, added a credit of $6,500 for existing homeowners to purchase replacement homes, and increased the income limitation from $75,000 to $125,000 for single taxpayers and from $150,000 to $225,000 for joint filers.

The Mortgage Debt Relief Act of 2007 also alleviated mortgage financing impediments to house prices falling to their long-run equilibrium level by reducing or eliminating foreclosure costs. Specifically for the calendar years 2007 through 2009 (and subsequently extended through 2012 by the Emergency Economic Stabilization Act of 2008), taxpayers can exclude income from the discharge of up to $2 million of debt on their principal residence. Except for debts discharged through bankruptcy or when the debtor is insolvent, certain farm debts, and non-recourse loans, any debt forgiveness is treated as taxable income in the year of the debt's discharge by a lender. The Mortgage Debt Relief Act of 2007 excluded from taxable income both debt reduced through mortgage restructuring and mortgage debt forgiven in connection with a foreclosure. In addition in October 2009, the Department of Treasury and Department of Housing and Urban Development, together with the FHFA, Fannie Mae, and Freddie Mac, announced the Making Home Affordable Program to subsidize lenders' losses in mortgage modifications and low-interest rate mortgages for first-time buyers. However, this program has had limited success because it does not address modifications of second mortgages, which often were used in piggyback fashion to purchase houses (Merle 2010).

In addition to public programs that directly subsidize mortgage lenders, borrowers in default, and homebuyers, the federal government has spent massive amounts through TARP and direct purchases

by the Federal Reserve of mortgage-backed securities (MBS) issued by Fannie Mae and Freddie Mac to supply liquidity to the mortgage market. These programs increase demand for overpriced houses (i.e., at higher than long-run equilibrium prices) by subsidizing homebuyers through lower mortgage interest rates.[14]

It is interesting that these various government intervention policies have contradictory goals. Tax credits for purchasing houses have the effect of accelerating future home purchases, but at higher prices. They impede and delay prices from falling to their long-term equilibrium levels. Meanwhile, programs that exclude discharged mortgage debt from homeowners' taxable income and programs that encourage lenders to forgive mortgage loan balances remove constraints that inhibit house prices from falling to their long-term equilibrium levels. These mixed signals sent by the federal government's policy response contribute to Knightian uncertainty and impede the search for a new equilibrium. Acceleration or postponement of transactions to take advantage of current or future legislation, respectively, likewise impedes the adjustment process by pulling forward from future demand or by subduing current demand.

Impeding prices from quickly adjusting to their equilibrium levels imposes a deadweight loss on society and misallocates resources toward less productive uses. For example, when house prices exceed fair market values, more houses become vacant and the number of renters is artificially inflated, thereby driving up rental prices. Unaffordable housing prices and high rents result in fewer new households being formed. In the United States only 509,000 new households were formed on average from 2008 through 2010, versus an annual average of 1.3 million from 2002 through 2007, the housing bubble years (U.S. Census Bureau, Current Population Survey, Table HH-1).

On average about 800,000 fewer households have been created annually since the bursting of the housing bubble. If all of these nonexistent households had spent the average $4,000 that movers into existing single-family houses spend incrementally (Siniavskaia 2008), annual consumer spending would have been $3 billion higher.

Lower household formation is just one small negative unintended consequence of public policies since the bursting of the

[14]We thank an anonymous referee for reminding us of these programs that dwarf in magnitude the other aforementioned programs.

housing bubble. These public programs also promote moral hazard. There is anecdotal evidence of misuse in the form of upside-down homeowners, with sufficient cash flow and liquidity to pay their mortgage loans, defaulting and then repurchasing their own homes at foreclosure sales at prices below their previous mortgage balances. In addition to the misallocation of resources from misguided public programs that subsidize mortgage lenders' losses, the losses to social welfare from future inflation due to the enormous expansion of the Federal Reserve's balance sheet from purchasing MBS from the GSEs may end up dwarfing all other costs.

Conclusion

The cost of a dysfunctional housing market imposes a deadweight societal loss, questions the efficacy of both the policies and institutional arrangements that fostered the housing bubble, and impedes the resolution of underwater mortgages. Our agent model suggests that to be effective policies should address this deadweight loss through the supply side by reducing foreclosure costs to both mortgage lenders and borrowers, thereby allowing prices to quickly settle at their long-run equilibrium levels. For example, to reduce foreclosures and decrease mortgage-caused housing market distortions, Hubbard and Mayer (2008, 2009) propose that the federal government rewrite all mortgages into 30-year fixed rate mortgages at the 10-year Treasury bond rate plus 160 basis points and split with mortgage lenders the write-down of principal on underwater mortgages. The solution to the doldrums in the housing market is not to artificially stimulate demand, but rather to remove impediments to market prices reaching their equilibrium levels, thereby freeing up more homeowners to become qualified sellers.

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