Assessing the Performance of Real Estate Auctions

by Christopher J. Mayer

Federal Reserve Bank of Boston

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Abstract

This paper investigates the performance of real estate auctions in selling real estate relative to the more traditional method of negotiated sale. Estimates from auctions in Los Angeles during the boom of the mid 1980s show a discount that ranges between 0 and 9 percent, while similar sales in Dallas during the real estate bust of the late 1980s obtained discounts in the 9 to 21 percent range. This evidence is consistent with a theory that predicts larger percentage discounts in down markets. Although these results differ from previous studies of U.S. auctions that find much larger discounts, a comparison of methodologies suggests that previous papers that use a hedonic equation suffer from a selection bias problem, pushing auction coefficients towards finding larger discounts. Another interesting finding is that publishing a reserve price does not affect the estimated auction prices. Finally, the study notes that scattered-site auctions sell at a larger discount than the more homogeneous sales of single-site condominiums and finds no evidence of price declines over the course of an auction. The paper concludes that despite the discounts, auctions are still a viable sales strategy, especially for large sellers that face high holding costs and long average sales times, and for developers of single-site condominium complexes.

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Assessing the Performance of Real Estate Auctions

Real estate auctions have been used in the United States almost exclusively for disposal of property involved in foreclosure or bankruptcy. But in the past 10 or 15 years, auctions have gained some attention as an alternative method of marketing real estate. The trend began in California in the mid 1970s, as some developers found auctions an effective way to sell a project quickly without incurring large carrying costs. In the early 1980s auctions spread to other parts of the country, following the severe regional declines in real estate prices first in the Oil Belt, and later in the Northeast.

The auction method of sale has gained still more publicity in light of the savings and loan crisis, as the federal government, through the Resolution Trust Corporation (RTC), has gained possession of a great deal of troubled real estate which it must dispose of in a "timely" fashion. In 1991, the RTC had over $180 billion in assets, including over $18 billion in real estate. Assets may increase by over $200 billion by the end of 1993 (Wall Street Journal, 10/3/91). Private banks and other agencies hold billions more in foreclosed real estate, with the solvency of many banks in doubt if they cannot dispose of these assets quickly, without taking a large loss in capital. The fact that auctions would allow the seller to dispose of large amounts of real estate in a relatively short period of time makes them very attractive to the government.[1] However, the traditional view of real estate

[1]Of the $180 billion of assets sold by the RTC, however, open outcry auctions represent only $183 million, mostly low-priced residential real estate (Wall Street Journal, 11/21/91).

auctions is that they provide a bargain to the buyer because prices are significantly below "market value."

This paper will estimate the relative returns to auctions and negotiated sales for large holders of real estate by looking at a series of auctions in Dallas and Los Angeles. Comparisons between auctions in these cities during the mid 1980s will also shed some light on the relative performance of auctions in boom and bust markets. Section I describes the growth of real estate auctions and looks at alternative views about auctions as a way to sell property quickly and at a reasonable price. The theory of optimal auctions is reviewed and applied to real estate auctions in Section II. This theory explores the role that information and the state of demand play in determining the relative performance of various sales techniques. Previous empirical results regarding auctions of various types of goods, including real estate, are also summarized.

Section III describes the data used in this study. The empirical work in Section IV uses several estimation techniques, including hedonic and resale price models, to explore how selection in the types of properties that are auctioned can affect estimates of the relative premium or discount associated with auctions. This work further explores how the auction premium varies for different types of properties and auctions, and looks for evidence of price declines during the course of an auction. Finally, these results are applied to the government's problem of selling the substantial real estate portfolios gained as a result of the savings and loan crisis.

I. The Growth of Real Estate Auctions

Real estate auctions in the United States have grown substantially over the last 15 years. By one estimate, the dollar volume of property sold at U.S. real estate auctions grew by over 260 percent between 1981 and 1989, to $26.5 billion (Martin and Battle 1991). The National Association of Realtors (NAR) began a survey in 1990, which showed that the value of auction sales increased by 65 percent in 1991 over 1990. The NAR numbers show a much lower dollar amount of sales ($6.5 billion in 1991), mostly because they do not include foreclosure auctions.[2]

The growth in real estate auctions has for the most part paralleled the downturn in local real estate markets. Unlike foreclosure auctions, however, the typical real estate auction bears many similarities to the more usual negotiated sale, except that the process is concentrated in a six-week period before the auction. Unless otherwise noted, properties come with a clear, insurable title and are open for inspection well before the sale. To bid, a buyer must present cash or a cashier's check for between 2 and 10 percent of the property's expected sales price. Sellers attempt to provide some financing and in many cases will refund the deposit if the buyer fails to qualify for financing. Most auctions have at least some properties that sell on an "absolute" basis, sometimes above a specified minimum, in an effort to

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[2]Here it is important to note the difference between the real estate auctions described in this paper and the foreclosure auctions advertised in the auction section of many newspapers. Foreclosures are much riskier and provide the buyer with substantially less information than conventional real estate sales, and thus are often not attractive to the usual purchaser of residential real estate. The typical foreclosure serves the legal purpose of allowing the holder of a lien, such as a bank or a municipality collecting back taxes, to take legal control of a property whose owner is in default of some legal obligation. Consequently, the lien holder will purchase the property 80 to 90 percent of the time, and then market the property using more conventional means.

show potential buyers that the seller is anxious to sell the properties.[3] Other auctions, including many run by government agencies, are conducted as reserve sales, meaning that the seller reserves the right to reject the highest bid.

Major banks, developers, and government agencies have sold many thousands of properties across the Southwest in the last eight years, and still more properties remain in their portfolios. Many other banks and developers have resisted using auctions to sell off their real estate owned, waiting instead for better times and higher prices. In holding their properties, sellers face substantial holding costs that can easily add up to between 1 and 2 percent per month for unoccupied units. These carrying costs include interest, taxes, physical depreciation, insurance, and continuing marketing costs.[4] (One auctioneer cited an internal estimate by the RTC that a property loses 48 percent of its value if it remains unsold for two years.)

Some critics claim that the increase in real estate auctions is due to the willingness of shortsighted sellers to accept low prices for their property in order to make a quick sale. In a recent article in the Real Estate Finance Journal (1991), Martin Ginsburg, a New York developer, argues that "basic economics" ensures that auctions will perform poorly in a soft market, because they flood the market with more properties than it can easily absorb. While conceding that auctions might be attractive if they sold properties for small discounts, he predicts that "Unfortunately. . .15 percent

[3]"Absolute" auctions are sales in which the seller agrees not to bid at the auction and to accept the highest bid, regardless of price.

[4]A review of appraisal reports from some government properties suggests that the costs of physical depreciation can be quite large for many types of unoccupied property. Vandalism and deterioration can quickly and substantially reduce a property's value.

to 20 percent discounts are the exception."[5] In addition, Ginsburg and other critics claim that auctions of large projects "taint" a property's image and increase risk for a seller.[6]

II. Previous Research

The theory of optimal auctions is an area that economists have studied heavily in recent years, offering many strong conclusions about the relative merits of different types of auctions.[7] The initial motivation of much of the literature was Vickrey's (1961) famous revenue equivalence result, in which he found that under certain conditions, including risk-neutral bidders, unaffiliated bids, and symmetrical buyer's valuations, four major auction types (English, first price, second price, and Dutch) all provide the seller with the same expected revenue.[8] Others have shown that under these same conditions, the optimal auction is equivalent to an English auction with a

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[5]Many buyers also believe that they are getting bargain prices at auctions. After a recent auction in New York, The New York Times quoted a successful buyer who claimed that she could ". . .make money if we turned it around right now. . . ."

[6]The typical auction contract requires the seller to pay for all marketing expenses in addition to a commission of 5 to 10 percent that is contingent on a property selling at the auction. The fixed expenses are paid up front, regardless of the success of the auction, and for large auctions will add up to about 1 or 2 percent of the final sales price.

[7]This section highlights theory and empirical results that will be tested in subsequent sections of the paper. For a more complete survey of the auction literature, see Milgrom (1989) and McAffee and McMillan (1987).

[8]Unaffiliated bids refer to the assumption that a potential buyer does not get information from another bid that would affect his or her valuation for the auctioned good. That does not hold for common value items like real estate or used cars, where the valuation of other potential buyers may change a bidder's estimate of the resale value, and consequently the bid.

reserve price.[9] This section explores the theory and previous evidence as to whether or not the reserve price should be published. Later evidence will show that publishing the reserve price has no significant effect on the final sales price. In addition, this section will consider an area that has received much less attention; that is, how auctions compare to other sales techniques such as privately negotiated sales. Subsequent sections will estimate the auction discount or premium (relative to a negotiated sale) and compare how auctions perform in boom and bust markets.

Theory shows that under most circumstances the optimal auction will include a reserve, which is usually greater than the seller's own valuation of the property. Intuitively, a reserve can force bidders to raise their bids in order to compete with the seller. The reserve is binding only if it is above the bid of the buyer with the second-highest valuation. The risk in setting a reserve is that the buyer with the highest valuation may not purchase a property, despite valuing it more than the seller. But the problem of choosing a reserve is equivalent to a monopolist setting a price. A monopolist who raises price above marginal cost loses some sales, but makes up for the lower volume with higher profits.

This still leaves the question of whether the seller should publish the chosen reserve price. In auctions of most types of goods, including sales of real estate in Australia, New Zealand, and other parts of the world, sellers take great care to keep the reserve price secret. That differs from the practice in many U.S. auctions, where the reserve is announced as a minimum price. When the minimum price is published, sellers must accept the highest

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[9]See McAfee and McMillan (1987) for a survey of the optimal auction literature.

price above that minimum and are prohibited from bidding. A few auctions are even absolute sales, with the property going to the highest bidder regardless of price.

If a reserve contains non-public information about a property, theory suggests that a seller should, in most cases, release the information. Milgrom and Weber (1982b) show that a policy of releasing all information, good or bad, will raise a seller's revenue relative to policies that publish only "good" information or do not publish any information at all. The exception occurs when the information is a complement to private knowledge in the hands of the most informed buyer. In this case, releasing the reserve will only increase the private information of a single bidder, raising that bidder's profits at the expense of the seller. Using a sample of oil tract sales, Hendricks and Porter (1988) show that informed bidders--those who own neighboring tracts--have positive returns to bidding and uninformed buyers have a zero expected surplus.

Other papers suggest that the possible presence of the "winner's curse" explains why few sellers choose to release reserve prices.[10] According to this view, a published reserve will give information about the seller's valuation for the good, making overbidding (as in the winner's curse) less likely. Kagel and Levin (1986) conduct experiments of mock auctions with volunteers and find strong evidence of the winner's curse in larger groups (six or seven players), despite the fact that the players have participated in several previous auctions.[11] When the players have better information, they

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[10]See Kagel and Levin (1986) and Vandell and Riddough (1992).

[11]Kagel and Levin find less significant evidence of the winner's curse in smaller groups (three or four players) and in groups of "super-experienced" bidders.

bid more accurately and the seller loses revenue. Studies of various real-world markets give a mixed view as to the prevalence of the winner's curse. Papers that look at oil drilling and highway repair contracts find little evidence, but that result is contradicted by studies of savings and loans and of drainage lease sales.[12] Investigations of real estate auctions in the United States generally find no evidence of the winner's curse.[13] However, Lusht (1990) finds that Australian auctions do sell property at a premium of as much as 6.5 percent. That could explain why Australia relies upon auctions with unpublished reserves and uses them in "boom" markets when the winner's curse is more likely to appear.

Much of the above discussion on information and reserves relies on the assumption of a fixed number of bidders who costlessly gather information and choose a bid. Publicly setting a low reserve serves as a commitment by the owner to sell a property at a "reasonable" price. That may be especially important in real estate, where many sellers may have inflated views of a property's value, or are willing to hold out a long time for a buyer with a high valuation. A commitment to sell may convince additional buyers to spend time or money in investigating a property and attending the auction. Bidders also realize that with a published minimum the seller cannot engage in ex post negotiations with the high bidder in order to raise the price. One auctioneer claimed that absolute auctions attract a significantly larger audience and get prices that are 10 percent higher than auctions with an unpublished reserve.

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[12]See Hendricks and Porter (1988) for oil tracts, Theil (1988) for highway contracts, Meade, Moseidjord and Sorensen (1984) for drainage leases, and Gilberto and Varaiya (1989) for savings and loans.

[13]Results from this paper, as well as from Gau, Quan, and Sternberg (1990) and Wright (1989), show no evidence that auctions are associated with significant excess returns relative to alternative sales techniques.

This paper will also look for evidence of price declines over the course of an auction. Using evidence from wine and art auctions, Ashenfelter (1989) has shown that over the course of an auction significant price declines occur, even for identical cases of wine. He attributes these declines to a combination of risk aversion and quantity constraints among buyers. Ashenfelter and Genesove (1992) find evidence of price declines in two New Jersey condominium auctions by looking at sales that fell through after the auction and comparing the subsequent resale price with the original auction price. Gau, Quan, and Sternberg (1990) and Vanderporten (1990) look at individual real estate auctions using a hedonic methodology and conclude that properties in later parts of the auction sell at significant discounts.

Although many papers look at auctions and at search markets, little attention has been given to markets in which both of these techniques exist simultaneously.[14] This is so despite the fact that these markets may provide valuable insights into the advantages or disadvantages inherent in the choice of sales technique. Adams, Kluger, and Wyatt (1992) attempt to compare these two techniques by modeling negotiated sales as a slow Dutch auction. They show that if buyers arrive at an exogenous rate with independently identically distributed valuations, the optimal strategy for a seller is to set a constant sales price rather than to lower the asking price over time. They conclude that a fixed asking price obtains a higher price than a Dutch auction which, according to Vickrey (1961), is equivalent to a sealed bid or English auction. Their prediction that auctions sell at a lower price is due to the fact that in any given period, the highest-valuation buyer will have a lower valuation

[14]This question is quite relevant given that sellers of items like wine, art, and real estate have a choice of sales technique, and that this choice may have a substantial effect on the sales price and time to sale.

than can be obtained by waiting for a longer period of time and drawing from a greater number of buyers. This result can be reversed, however, in the presence of a non-stationarity, such as a seller who faces a penalty for not selling in a fixed period of time. Salant (1991) shows that such a non-stationarity changes the optimal strategy to one in which price declines over time.[15]

Another approach is to consider a search environment in which buyers look for a house that is a good match with their preferences. Mayer (1992) develops a model in which a buyer's valuation for a given house is determined by comparing that property with other houses in the market. Auctions sell property at a discount because a quick sale results in a poorer match between house and buyer, on average, than could be obtained by waiting longer for a buyer in the search market. The extent of the auction discount depends on each bidder's outside opportunities in the search market. If more houses become available, the auction discount must rise in order to convince a given buyer to choose the house available for sale by auction. This is because a greater number of available houses in the search market means that a buyer forgoes a better (expected) match in order to purchase the auction property. As in the usual search model, an increased number of vacant and available units also leads to lower prices in the search market. Consequently, the model predicts that the (percentage) auction discount should rise in a down

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[15]Salant (1991) could be interpreted as providing a framework in which auctions obtain a higher price than a negotiated sale. In his model, realtors get higher prices than houses for sale by the owner because they increase the arrival rate of interested buyers. Many auctioneers claim that a large advantage of auctions is that they greatly increase the number of potential buyers who visit a property. If this were true, auctions might obtain higher prices, even in the Adams, Kluger, and Wyatt (1992) model.

market with high vacancies. The (absolute) auction discount rises at the same time that search prices are falling.

The model also shows that the auction discount falls when property is more homogeneous. With houses that are similar, the match between buyer and house has a smaller effect on the final price. The seller has less to gain by holding a property on the market waiting for a buyer with a good match, when all buyers have a similar valuation for that unit. This may explain why new condominiums are auctioned much more frequently than "one-of-a-kind" properties. Finally, the auction discount percentage rises in a smaller market, with fewer buyer and sellers, because the difference between houses is larger.

Empirical evidence on the revenue effects of various types of auctions and sales has been limited, mostly because there are few markets where more than one sales technique coexist.[16] One possible exception is bond markets, where several papers in the mid 1970s looked at the effects on bond interest costs of added competition and an increased number of potential bidders (Hendershott and Kidwell 1978; Hopewell and Kauffman 1977; Kessel 1971).[17] The issue was whether banks should be allowed to underwrite municipal revenue bonds. These studies found that bond issues in which banks were eligible as underwriters had lower interest costs, controlling for risk, than municipal revenue bonds. In a subsequent review of this work, Sorensen (1979) compared bond issues with only one or two bids, and found that, in the case of

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[16]See Cox, Robertson, and Smith (1982) for more information about experiments looking at revenue effects of various auction types.

[17]Brannman, Klein, and Weiss (1987) also conclude that prices increase with the number of bidders in auctions of a variety of different goods including bonds, oil leases, and timber.

unattractive bond issues, negotiated private placements had lower costs than auctions. This evidence supports the above-mentioned view that auctions perform better for items that appeal to a wider number of buyers.

Several recent papers have attempted to use real estate data to analyze the performance of auctions compared to negotiated sales, looking at both the U.S. and Australian markets. These papers use a similar methodology, first gathering a sample of sales that includes both auctions and traditional sales and then using hedonic price regressions to estimate the difference in sale price that results from using an auction.[18] Wright (1989) uses data from the U.S. Department of Housing and Urban Development (HUD) on its sales in the mid 1980s. Over this period HUD sold its properties using different methods, including auctions and brokered sales. In his empirical work, Wright found that auctions of single-family properties brought a sales price that was 63 to 86 percent of the price obtained using broker contracts, after accounting for property characteristics and financing considerations.[19] But the study includes no data on a property's condition, and limited information on location. Wright notes at one point that HUD chooses to auction a property in large part based on its condition and appeal to the market. Such choices would clearly bias the auction coefficient towards finding a large auction discount, since this information is not included in the hedonic model and is correlated with sales choice.

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[18]The "hedonic" regression uses various property characteristics such as square footage and the number of bedrooms to estimate a predicted sales price for a house. A dummy variable for whether or not the sale occurred at auction is also added, with the coefficient being interpreted as the effect of the sales technique on prices.

[19]The average auction discount over his whole sample was 25 percent.

Using data on land sales in Austin, Texas, the study by Gau, Quan, and Sternberg (1990) finds that auctioned properties sell at a significant, 33 percent discount. Their study also uses a hedonic regression to compare alternative sales techniques, including brokered sales and auctions, although they give no indication of how the sales method was chosen.

These results completely differ from those found by Lusht (1990) in a study of sales of single-family detached homes in Melbourne, Australia. Using data collected from an estate (real estate) agency, Lusht compared prices of properties sold before, during, and after an auction, as well as prices obtained from private listings that never involved an auction. He found that prices were highest for properties that sold before the auction, but that prices from private listings were 6.5 percent lower than auction sale prices, a difference that was statistically significant at the 5 percent level. The data were much more complete than in previously listed studies, and included variables on the right-hand side that were related to a property's condition and the method of sale.[20]

III. Methodology

The results from the studies of the performance of real estate auctions described above could well be explained by the methodology that was used. If the sales method for a property is chosen based on that property's attractiveness to the market, but this variable is not adequately controlled

[20]Lusht's study is also interesting in that it highlights how differently auctions are perceived in Australia compared to the United States. Australian auctions typically involve a single house, with the auction conducted by an agent of the local realtor. Auctions are perceived as more successful in boom markets, and the seller usually reserves the right to reject the highest bid. Up to 30 percent of all real estate is sold at auction, and at times in some sub-markets up to 80 percent of all properties are listed at auction.

for in the hedonic regression, the regression will attribute differences in attractiveness to the coefficient for the sales technique. For example, if the U.S. government chooses to auction only its worst properties, low average sales prices at auction could be a result of low-quality properties, not the poor performance of auctions.[21] Recently the RTC has revealed that its choice of a marketing strategy is based in part on a property's appraised value, with low-value properties (under $100,000) being auctioned. Poor quality, condition, and marketability likely contribute to a low appraisal, and these variables are difficult to measure. If they are not included in the hedonic variables, however, the resulting equation will give a biased estimate of the auction premium or discount. The opposite might be true in Australia, where high-quality properties appear more likely to be auctioned.

This is a classic selection problem, where an omitted variable (attractiveness, quality) is possibly correlated with an included variable (method of sale) on the right-hand side. The usual solution to this problem is to use exogenous variables in a first-stage regression to predict the choice of sales method, and then use the predicted sales choice in the second-stage regression. In this case, however, it is difficult to get data that might help predict a seller's choice of sales method.[22]

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[21]Wright (1989) notes that this is probably a serious problem in his sample. The set of auctioned properties appears to be of much lower quality than average, as evidenced by the fact that auctioned properties were much more likely to be designated as "cash-only" sales, in which HUD was unwilling to provide any financing.

[22]The most obvious choice would be some estimate of the holding cost of the seller. Another possible variable would be the type of seller, using the hypothesis that large institutional sellers are more likely to use auctions because of reduced costs due to economies of scale.

Instead, this study will use a resale price index to look at the potential selection bias that derives from the unobserved differences in auctioned versus non-auctioned properties. Consider the following model:

$$(1) \quad P_{i,t} = X_i\beta + A_{i,t}\delta + T\theta + \epsilon_{i,t}$$

$$P_{i,t+\tau} = X_i\beta + A_{i,t+\tau}\delta + T\theta + \epsilon_{i,t+\tau}$$

$$P_{i+1,t} = X_i\beta + A_{i+1,t}\delta + T\theta + \epsilon_{i+1,t}$$

$P_{i,t}$ = log sales price of house i at time t.

X_i = vector of hedonic characteristics for property i, including the number of bedrooms, the number of bathrooms, location, quality, and the like.

$A_{i,t}$ = an auction dummy variable. $A_{i,t}$ = 1 when property i is auctioned in period t.

T = a vector of time dummy variables. T_t = 1 when a sale occurs at time t.

The usual hedonic model will estimate this equation as it stands, even though not all hedonic variables (Xs) are observed, under the assumption that the observed Xs are uncorrelated with the omitted variables. An alternative, first proposed by Bailey, Muth, and Nourse (1963) and refined by Case and Shiller (1987) and later Shiller (1991), is to use a resale price index (RPI). The original purpose of such an index was to control for the changing mix of properties that affected price indexes based on median sales prices. The RPI is created by taking the above equation, using only data on houses that sold more than once in the sample period, and differencing the data to net out the

individual effects from each house (the Xs). The resulting equation (2) has only dummy variables on the right-hand side.

$$(2) \qquad (P_{i,t+\tau} - P_{i,t}) = T'\theta + A'\alpha + \epsilon_{i,t}$$

$A'_{i,t}$ = an auction dummy variable. $A'_{i,t+\tau} = 1$ if property i is auctioned in period t+tau and $A'_{i,t+\tau} = -1$ if the property is auctioned in period t.

T' = a vector of time dummy variables. $T'_{t+\tau} = 1$ when a sale occurs at time $t+\tau$ and $T'_t = -1$ when the previous sale occurs at time t.

This method has several advantages over hedonic indexes.[23] Most important for this study, the (un)observability of many of the hedonic characteristics no longer matters in estimating the remaining coefficients, including θ, which measures the effect of using an auction on the final sales price. A second advantage is that the resale price index does not net out depreciation due to changing values of certain attributes. In this respect, the RPI more closely measures the true rate of appreciation that a buyer will get in purchasing a property. The fact that the RPI throws out so many observations is its chief disadvantage relative to a hedonic regression. It is certainly plausible that the units that sell more than once are different from those units that sell only once in the sample period. This might pose a potential problem if all units in the sample do not have the same expected rate of appreciation.

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[23]See Case and Shiller (1987); Shiller (1991); Case, Pollakowski, and Wachter (1991); Haurin and Hendershott (1991); and Goetzmann (1992) for more detailed discussions of the relative merits of the various methods of estimating resale price indexes.

In estimating the RPI, this study corrects for heteroskedasticity in the errors, as suggested by Case and Shiller (1987). They posit that errors in measuring price differences should increase with the time between sales. This would give additional weight to observations with a greater time between sales. Following Case and Shiller, a weighted repeat sale index (WRS) is calculated to correct for this problem. The first stage estimates the RPI, as above. The second stage regresses the squared residuals from the first stage on a constant and a variable for the number of quarters between the two sales. Using the coefficients from the second stage, a predicted variance is calculated and the original observations are weighted by the inverse of the predicted variance. These weighted observations are then used in the original equation. The study finds, as did Case and Shiller, that reweighting the observations has a small effect on the estimated quarterly coefficients, and almost no effect on the auction dummies.

In estimating the above equation, it is assumed that the coefficient on the auction dummy (θ) does not vary over time within the sample period. The hedonic equation also assumes that the vector of coefficients (ß) on the Xs does not change over time. Previous studies have argued that hedonic characteristics, such as an additional bedroom or bathroom, contribute a constant percentage to the value of a house and that this contribution is fixed over time. As Case and Shiller (1987) note, however, the WRS does not include depreciation, and this limits its comparison to hedonic indices. In comparing the different estimation techniques, it is important that depreciation be handled consistently. Otherwise, differences in age and depreciation between auctioned and non-auctioned properties could bias the

auction coefficient. To correct for this deficiency, this study uses the following model to control for changes due to depreciation:[24]

$$(3) \qquad (P_{i,t+\tau} - P_{i,t}) = T'\theta + A'\alpha + N\nu + \epsilon_{i,t}$$

N = a dummy variable representing a new property (less than 5 years old). N = 0 if the property is new at the time of both sales or not new at the time of both sales. N = -1 if the property is new in the previous sale and not new at the second sale.

Consistent with equation 2, ν can be interpreted as the premium for new properties in the sample.

IV. The Data

This study will focus on real estate sales in Dallas and Los Angeles during the mid to late 1980s. This was truly a tale of two cities, as is clear from Figures 1 and 2. From 1982 to 1985, both cities had a post-recession boom. In the mid 1980s, however, the oil bust hit Dallas and between 1985 and 1990, real house prices fell 30 percent and real condominium

[24]An alternative way to control for depreciation is to use a variable representing the difference in the property's age between sales. We argue that depreciation is much faster in the early years of a house and thus include a control for excess depreciation of a new property rather than a variable that treats all age differences as the same.

Figure 1

Real Price Indices for Los Angeles Condominiums

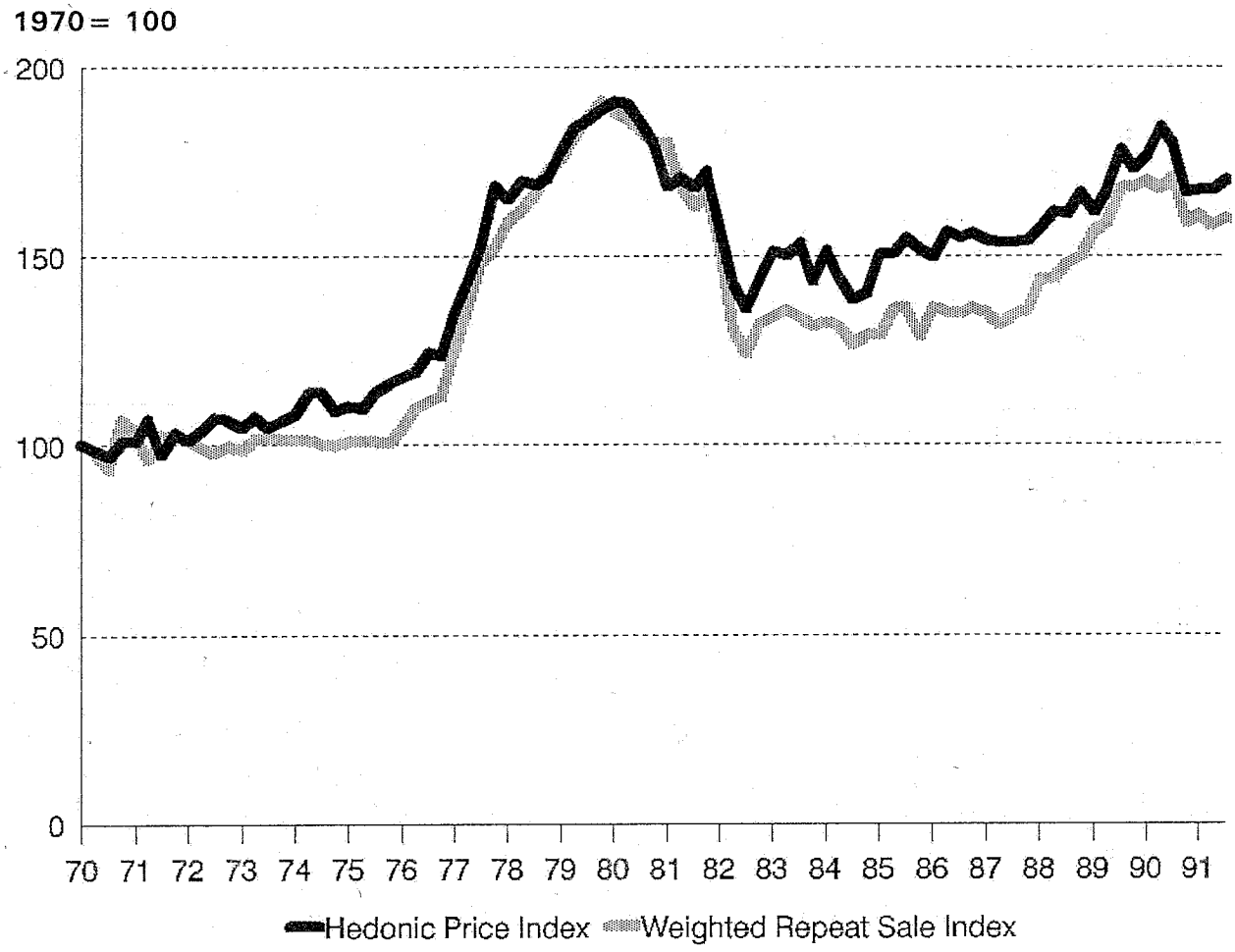
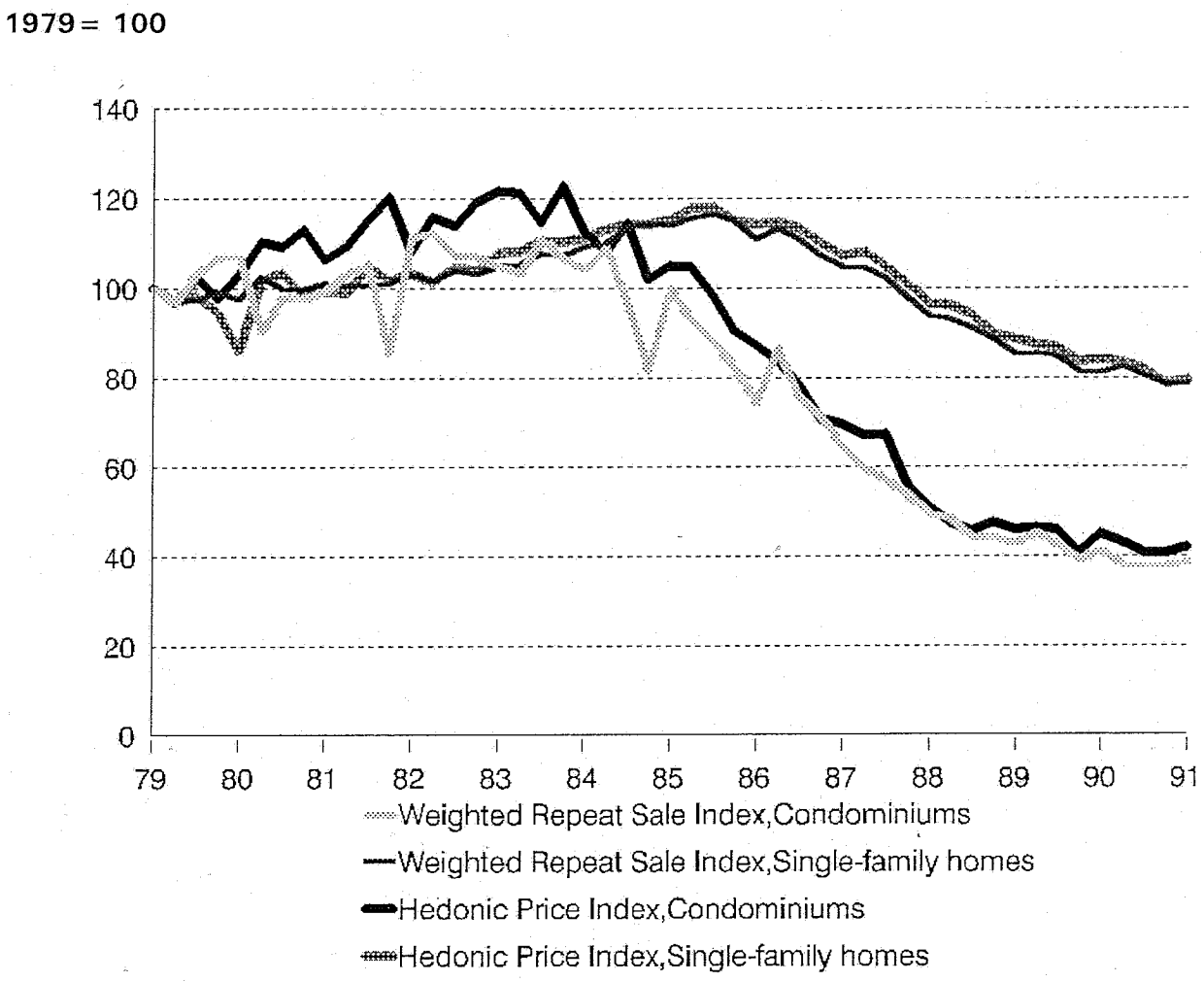


Figure 2

Real Price Indices for Dallas Condominiums and Single Family Homes



prices fell almost 60 percent.[25] Over this same time period, real estate prices in Los Angeles continued to rise, with real condominium prices increasing over 25 percent.

Data from these two cities allow a comparison of how auctions perform in boom and bust markets. The first U.S. (non-foreclosure) real estate auctions were held in California beginning in the mid 1970s, with many sales occurring in up markets. Auctions arrived later in Dallas, and mostly in response to the distress suffered by Texas financial institutions. The number of Texas commercial banking organizations fell by 16 percent, from a high of 1,261 in 1986 to a low of 1,019 in 1990. The number of savings and loan institutions fell even further, declining by over 60 percent (Clair 1991). In Los Angeles, the auction sample includes condominium sales between the end of 1981 and 1987 and is mostly concentrated in the period between 1983 and 1986.[26] The Dallas auctions occurred between 1985 and 1990 as the real estate market was falling, and include both single-family homes and condominiums.

Most of the data in this study involve traditional, negotiated sale transactions and come from county records. Because sales technique is not reported separately, it was also necessary to visit several auction firms to

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[25]The fact that condominium prices fell so much further than the prices of single family homes is striking, but not limited to Dallas. Case, Shiller, and Weiss, Inc. data shows a similar pattern in Los Angeles and San Francisco around the 1982 recession and in Boston during the recent downturn. In these three cities, however, the magnitude of the difference in depreciation rates between condominiums and single family homes is not as severe as in Dallas. Lack of financing, overbuilding, and the "second-class" perception of condominiums are possible explanations for this phenomenon.

[26]A few auctions in the sample date from 1981 and 1982, when the Los Angeles market suffered a slight decline. If these auctions are removed, the auction discount falls slightly from the reported results. This further strengthens the conclusion that the auction discount percentage rises in a down market.

collect information on auctions that these firms conducted in the two counties.[27] The auction data were then merged into the county records to obtain a data base that contained information on auction and non-auction properties, including multiple sales of the same unit. The resulting data set contains records on condominium sales in Los Angeles from 1970 to 1991 and both condominium and single family home sales in Dallas from 1979 to 1991. Very few Los Angeles single-family homes were in the auction sample, so these units were not included in this study. The data collection and merging process is described in more detail in the Appendix.

All of the auctions in the sample were conducted using an open outcry English-style technique. The sample includes two types of sales, auctions of units at a single site and auctions where the units are scattered over a large geographic area. Single-site auctions involve a large number of condominiums from a development, which are usually new and unoccupied. The seller in this case is a developer or bank wishing to sell all remaining units at one time and reduce holding costs.[28] The typical scattered-site auction is commissioned by an institution such as the Federal Deposit Insurance Corporation (FDIC), the Resolution Trust Corporation (RTC), or a private bank and contains hundreds of properties in as many as five or six counties and three states. These typically are older units that were obtained through the foreclosure process. Commercial land and structures are auctioned alongside single-family homes and condominiums.

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[27]The surveyed firms agreed to give information on all auctions conducted in those cities rather than choosing their best sales.

[28]One sign that auctions have become firmly accepted in the Southern California market is the existence of some builders that build almost exclusively for sale at auction.

Tables 1 and 2 give a summary of the mean values for the complete sample, as well as for the set of auction properties. These tables clearly suggest that the properties that are auctioned are very different from the average properties sold over the sample period. Auction properties tend to be smaller, both in terms of square feet and the number of bathrooms, and they sell for significantly lower prices.[29] The evidence supports the notion that even in California, where auctions are received better than in most parts of the country, auctioned units appear to be different types of units and are bunched at the low end of the market. Just from looking at these tables it is clear that either auctions sell properties at a big discount or there are other characteristics of the auctioned units (such as quality) that make them less desirable.

V. Empirical Evidence

As expected, the hedonic equations show that auctions sell property at a significant discount. The auction coefficients in Tables 3 and 4 suggest that minimum-price auctions sell property at a discount that ranges from 6 percent in Los Angeles to 17 percent in Dallas.[30] This is consistent with the prediction (Mayer 1992) that the auction discount percentage should be higher in a bust market (Dallas) than in a boom market (Los Angeles). Unpublished

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[29]For purposes of comparison, the sales prices were deflated to 1990 dollars, using the weighted repeat sale index reported later in the paper. Also, the reported age is the age of the property on the date of sale.

[30]Because prices are measured in logs, a coefficient of -0.1864 on minimum-price auctions is equivalent to a price of 0.83 times the negotiated sale price, or a discount of 17 percent. See the Appendix for a discussion of the coefficients on the hedonic characteristics.

Table 1
Sample Means, Los Angeles
(Standard Errors)

Condominiums	Full Sample	Auction Sample
Number of Observations	124,420	285
Sale Price[a]	$174,605 (116,078)	$138,516 (57,488)
Square Footage	1,277 (614)	1,039 (331)
Full Baths	1.80 (.60)	1.79 (.69)
Half Baths	.37 (.49)	.03 (.17)
Bedrooms	2.19 (.81)	1.75 (.67)
New Units	.53 (.50)	.35 (.48)
Age	7.00 (7.96)	9.40 (6.86)

[a]Sales prices are deflated by the weighted repeat sale index calculated in Section V, to provide a constant means of comparing prices.

Table 2
Sample Means, Dallas
(Standard Errors)

Single-Family Homes	Full Sample	Auction Sample
Number of Observations	139,480	234
Sale Price[a]	$104,316 (104,932)	$66,332 (75,431)
Square Footage	1,799 (771)	1,645 (959)
Full Baths	1.91 (.71)	1.82 (.75)
Half Baths	.21 (.42)	.22 (.43)
Garage/Carport	.91 (.29)	.77 (.42)
Age	18.32 (15.60)	17.53 (17.22)
Neighborhood Cost Factor	1.30 (.28)	1.23 (.34)
Condominiums		
Number of Observations	10,423	235
Sale Price[a]	$47,051 (52,949)	$23,932 (21,860)
Square Footage	1,062 (405)	808 (241)
Full Baths	1.44 (.60)	1.17 (.40)
Half Baths	.21 (.42)	.12 (.33)
Garage/Carport	.09 (.28)	.01 (.09)
Age	8.69 (8.02)	5.89 (6.23)

[a]Sales prices are deflated by the weighted repeat sale index calculated in Section V, to provide a constant means of comparing prices.

Table 3
Hedonic Regression Results[a], Los Angeles Condominiums, Auction Coefficients
(Standard Errors)

Dependent Variable	Sales Price[b] (1)	Sales Price[b] (2)	Sales Price[b] (3)
Methodology	Hedonic	Hedonic	Hedonic
Minimum Price	-.0623 (.0212)		
Minimum Price Single-Site		.0054 (.0249)	
Minimum Price Scattered-Site		-.2415 (.0404)	
Top Third			-.1136 (.0445)
Middle Third			-.0829 (.0417)
Bottom Third			-.1493 (.0376)
N	124,419	124,419	124,419
R^2	.6632	.6632	.6632

[a]All equations contain controls for unit characteristics and sale date. See the Appendix for a more complete presentation of the other hedonic coefficients in these regressions.
[b]Variable is in logs.

Table 4
Hedonic Regression Results[a], Dallas Single-Family Homes and Condominiums, Combined, Auction Coefficients
(Standard Errors)

Dependent Variable	Sales Price[b] (4)	Sales Price[b] (5)	Sales Price[b] (6)
Methodology	Hedonic	Hedonic	Hedonic
Unpublished Reserve Scattered-Site	-.3709 (.0194)	-.3673 (.0194)	
Minimum Price	-.1864 (.0274)		
Minimum Price Single-Site		.0168 (.0448)	
Minimum Price Scattered-Site		-.3074 (.0346)	
Top Third			-.2668 (.0247)
Middle Third			-.3288 (.0258)
Bottom Third			-.3484 (.0307)
N	149,903	149,903	149,903
R^2	.9992	.9992	.9992

[a]Single-family homes and condominiums have separate variables in the hedonic equation. This is equivalent to stacking the regressions for the two groups with the restriction that the auction coefficients are equal. All equations contain controls for unit characteristics, age of the property, and sales date. See the Appendix for more detail.
[b]Variable is in logs.

reserve sales seem to sell at a much lower prices than sales with a published minimum price.

The results change quite a bit when the minimum-price auctions are broken apart into single-site and scattered-site sales. The difference between the coefficients for unpublished reserve and minimum price sales is narrower, but still significant at the 5 percent level. Discounts at Los Angeles scattered-site auctions remain smaller than discounts in Dallas, although that difference has also declined. Interestingly, the single-site auctions seem to sell property at a small though statistically insignificant premium. The estimated discount for Dallas scattered-site auctions of about 31 percent is similar to other hedonic studies including Gau, Quan, and Sternberg (1990), who looked at land sales near Austin, Texas, and Wright (1989), who studied HUD auctions. Tables 3 and 4 give conflicting indications regarding a price decline over the course of the auction, as suggested by several studies of single-site condominium auctions. The Los Angeles regression shows no evidence of declining prices, although the discount in the last third of the auction is slightly larger than in the previous two-thirds. However, the Dallas model shows a statistically significant (4 percent level) decline in prices over the course of the auction.[31]

Both the hedonic regressions (Tables 3 and 4, HPI) and the weighted repeat sale equations (Tables 5 and 6, WRS) also contain quarterly dummy variables that can be used to create price indices, which are charted in Figures 1 and 2. These indices are consistent with other series for the two cities, including the Case and Shiller (1987) index for Dallas and the

[31]The difference between the top third and middle third coefficients in the HPI regression has a t value of 1.816, which is significant at the 4 percent level with a one-sided test.

Table 5
Weighted Repeat Sale Regression Results[a], Los Angeles Condominiums, Auction Coefficients
(Standard Errors)

Dependent Variable	Price Difference[b] (7)	Price Difference[b] (8)	Price Difference[b] (9)
Methodology	Resale (W)	Resale (W)	Resale (W)
New	.0342 (.0056)	.0347 (.0056)	.0343 (.0056)
Minimum Price	-.0144 (.0234)		
Minimum Price Single-Site		.0371 (.0295)	
Minimum Price Scattered-Site		-.1015 (.0383)	
Top Third			-.0023 (.0509)
Middle Third			.0009 (.0491)
Bottom Third			-.0319 (.0363)
N	17,891	17,891	17,891
R^2	.6386	.6388	.6386

[a]All equations also contain a dummy variable for each quarter. These coefficients are plotted in Figure 1.
[b]Difference of Log Prices.

Table 6
Weighted Repeat Sale Regressions Results[a], Dallas Single-Family Homes and Condominiums, Combined Sample, Auction Coefficients
(Standard Errors)

Dependent Variable	Price Difference[b] (10)	Price Difference[b] (11)	Price Difference[b] (12)
Methodology	Resale (W)	Resale (W)	Resale (W)
New (Single-Family)	.0415 (.0033)	.0415 (.0033)	.0415 (.0033)
New (Condominiums)	.0526 (.0198)	.0496 (.0199)	.0528 (.0197)
Unpublished Reserve Scattered-Site	-.2407 (.0316)	-.2401 (.0316)	
Minimum Price	-.2083 (.0490)		
Minimum Price Single-Site		-.0940 (.1128)	
Minimum Price Scattered-Site		-.2349 (.0544)	
Top Third			-.2245 (.0387)
Middle Third			-.2206 (.0511)
Bottom Third			-.2348 (.0505)
N	28,154	28,154	28,154
R^2	.4036	.4037	.4036

[a]Difference of Log Prices.
[b]Single-family homes and condomimiums have separate time dummies and different estimated weights in the WRS equation. This is equivalent to stacking the regressions for the two groups with the restriction that the auction coefficients are equal. The coefficients for the time dummies are graphed in Figure 2.

National Association of Realtors (NAR) index of median sales prices. As Case and Shiller found, the NAR index does not fully reflect downturns. They attribute the differences to the NAR's use of median sales prices, which depend on the mix of houses sold at a given time. The hedonic (HPI) and resale (WRS) price indices appear to track each other quite closely during the whole period, although the WRS seems to have a slightly lower appreciation rate over time. This may be due to differences in the way the indices handle depreciation, as noted in Section III, or to different appreciation rates for properties that sell more frequently and thus are more likely to be repeat sales within a fixed time period. Later calculations will address both of these issues.

As noted in the methodology section, the hedonic regression suffers from a selection problem that would affect the auction coefficients. Estimates from weighted resale price equations (Tables 5 and 6) provide strong evidence of such a bias, especially for scattered-site auctions. Selection is a particular problem in these sales because the properties come from portfolios of large institutions and are usually of lower quality. In fact, many institutions choose units to be auctioned <u>because</u> they are less desirable and harder to sell. In Dallas, the estimate of the discount for property sold at an unpublished reserve auction falls from 31 percent to 23 percent using the weighted resale price equation. Whereas the hedonic estimates suggested that the unpublished reserve auctions had a larger discount than minimum-price auctions, the WRS estimates show no difference between the two sales types. Again, this could be explained by the fact that many unpublished reserve sales consisted of government properties that were of lower quality than the units in minimum-price auctions, mostly conducted for private banks.

Although the auction discounts in Dallas declined when estimated by the WRS equation, those discounts were still significantly larger than in Los Angeles. For example, the WRS equation found a discount of about 10 percent for scattered-site, minimum-price auctions in Los Angeles, but a 21 percent discount for the same sales type in Dallas. Single-site, minimum-price auctions also sold property at a larger discount in Dallas than in Los Angeles, although the result is less clear for this sales type because the standard error associated with the Dallas coefficient is large. The high standard error is probably due to the relatively small number of units sold at single-site auctions in Dallas.

The difference in premia between the single-site and scattered-site sales is pronounced in both cities, even using the WRS estimates. These auctions can be expected to have different discounts, for several reasons. The single-site auctions involve newer units designed to appeal to a wide audience with similar preferences. Buyers of scattered-site units that are older and less contemporary might have much more dispersed preferences over those properties. Mayer (1992) suggests that homogeneous properties have a lower auction discount because there is less to be gained if the seller holds out for a buyer who really likes the unit. In addition, scattered-site auctions are more difficult to market, given their diverse set of properties. Single-site auctions can more easily focus on buyers of a particular type of property in one location. The larger discount for scattered-site units could also be partially due to measurement error. Some of these properties may have been in poor shape after having been previously occupied by owners who were evicted. Because the included condition variable is an imperfect measure of changes in condition, some bias could still have occurred.

Interestingly, the Los Angeles WRS regressions show that properties in single-site auctions sell at a premium of 3.5 percent, although the coefficient is still not significant at conventional levels. The suggestion that some properties at auction actually sell at a premium is surprising, particularly because that result would suggest that most developers would be better off selling their projects quickly at an auction, gaining cost savings and price increases. One explanation is that most of the single-site auctions took place early in the sample period at a time when auctions were beginning to receive a lot of attention, in the media as well as with potential buyers. Consequently, bids might have been higher than anticipated. It is also possible that this type of auction in a boom market attracted buyers who were susceptible to overbidding, as in the "winner's curse."[32]

Looking at Figures 1 and 2, it is clear that the WRS and HPI indices are similar, but do not exactly track each other. A possible explanation of the difference is that these indices are estimated on different sets of properties. Resale properties are older, smaller, and less expensive than properties that sell only once, and they may have different appreciation rates. To test this view, the HPI was run on the subsample of properties that sold more than once in the sample. Although not reported here, the auction coefficients are remarkably similar in the whole sample and the repeat sale subsample. For example, the estimated coefficient for unpublished reserve auctions increases from -0.3709 to -0.3821. The minimum price coefficient goes from -0.3074 to -0.3372 while the single-site coefficient is virtually

[32]The WRS in Los Angeles was also run with separate dummies for the four largest single-site auctions, to see if one particular auction was driving the point estimates. The coefficients for the four auctions were remarkably stable, ranging from 3 to 7 percent premiums, although none were significant at the 5 percent level.

unchanged. The Los Angeles equations behave in a similar fashion, showing no significant change in the HPI results when looking at properties that sell more than once. This is consistent with Clapp and Giaccotto (1992) who find that appreciation rates between single-sale and multiple-sale properties can vary over the short run, but are quite similar for time horizons of over three years.

Evidence of price declines over the course of the auction disappears in the WRS results. Whereas in Dallas the HPI coefficients show a significant price decline after the first third of the auction, discounts are constant in the WRS model. Once again, the difference between these two methods may be due to the selection problem. Auctioneers profess that they put desirable properties at the beginning of an auction to attract healthy competition and higher prices, which they hope will carry through to some of the less desirable units that follow. Hedonic estimates that cannot control for all of the characteristics that make a property desirable may find that order has a large effect on prices because order is correlated with desirability, rather than for any structural reason. This could explain the results in Gau, Quan, and Sternberg (1990) and Vanderporten (1990), which use a hedonic methodology.

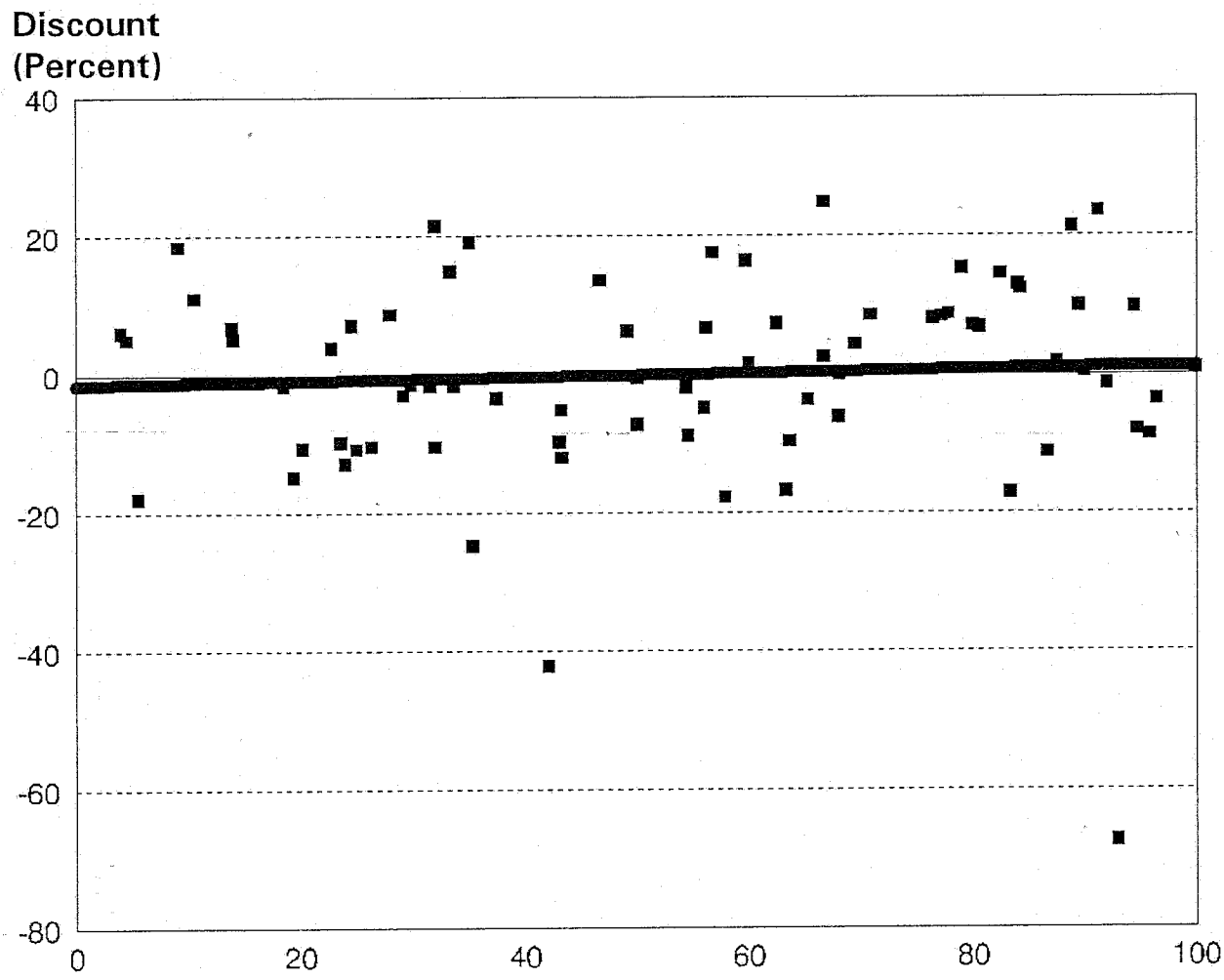
Ashenfelter and Genesove (1992), however, find evidence of price declines in two single-site condominium auctions by looking at resales of properties whose auction sale fell through. They find that auction prices decline with order much more steeply than the subsequent resale prices. Given that each scattered-site property appeals to a different group of buyers, it might be surprising to find price declines among those units. A house might be sold immediately after a commercial lot in another state, for example.

Figure 3 breaks apart the Los Angeles and Dallas samples further, including only resales of single-site units. Price residuals were calculated for each auction unit by taking the auction price and subtracting off a predicted auction price using a subsequent sale of that property and the WRS price index. Those residuals were then divided by the auction sales price to get a percentage discount or premium at auction. Finally, the mean discount for each auction was subtracted off, giving a corrected auction discount with an expected mean of zero.

Figure 3 plots the corrected discount against the order percentile, for each auction. The trend line shows no evidence of a price decline over the course of the auction. In fact, prices seem to be quite flat. There are several ways to reconcile these results with the findings of Ashenfelter and Genesove (1992). It is possible that the declining price anomaly is present only in some auctions or that it is a small effect relative to the noise from repeat sales long after the auction. This is consistent with Ashenfelter's (1989) finding that prices at wine auctions sometimes rise, although declines are twice as likely as increases. If the order of magnitude of the price declines is small relative to the variance in resale prices, it might require a significantly larger sample to find statistically significant evidence of the declining price anomaly. Another possibility is that cash-constrained developers use a one-price-per-unit strategy for quickly selling condominiums that have fallen through at auction. This scenario suggests that sales by the developer immediately following an auction might not be equivalent to sales in subsequent years and might be biased towards finding price declines.

Figure 3

Corrected Auction Discount (Percent) for Single-Site Auctions with Trend Line



The Auction Discount is calculated to have an expected mean of zero.

VI. Conclusion

The results from this research indicate that auctions are a viable method of selling real estate. Auctions in Los Angeles during the real estate boom of the mid 1980s sold property at an estimated discount that ranged between 0 and 9 percent, while similar sales in Dallas during the real estate bust of the late 1980s produced discounts in the 9 to 21 percent range. This evidence is consistent with a theory (Mayer 1992) that predicts larger percentage discounts in down markets. Although these results differ from previous studies of U.S. auctions that found much larger discounts, a comparison of methodologies suggests that previous papers that use a hedonic equation suffer from a selection bias problem, pushing auction coefficients towards finding larger discounts. This study also finds evidence that scattered-site auctions sell at a larger discount than the more homogeneous sales of single-site condominiums. Finally, no evidence was found of price declines over the course of an auction, even for single-site auctions.

A particularly interesting result is that publishing a reserve price does not affect estimated auction prices. One explanation is that the reserve price carries little new information. Buyers know that most institutions have no value for a property other than the opportunity cost of a future sale. In addition, the sellers may have little private information about the auction property, given that most of the real estate comes from bank portfolios of foreclosure property. Still, the lack of an effect from publishing the reserve price is surprising, given the effort made by some sellers to keep the reserve price hidden. A possible reason for this behavior is that many sellers are concerned about collusion among buyers. This would be especially relevant in auctions that involve the same set of bidders in repeated

interaction. Although collusion is not an issue for these real estate auctions, it might be more of a concern for goods such as highway contracts and heavy machinery.[33]

The findings in this paper suggest that auctions are still a viable sales strategy, especially for sellers that can take advantage of the economies of scale in holding a large auction. Although discounts increase in down markets, so does the average time to sale for negotiated sales. This is important for institutions like the RTC and FDIC that face holding costs averaging as much as 1 to 2 percent per month and average sales times that can exceed a year for some types of property. In addition, this paper probably overestimates the auction discounts for large institutions with high holding costs. The RTC and FDIC price their properties aggressively in order to reduce sale times, resulting in lower prices than might be obtained by a private seller who is living in a property and thus has lower holding costs. Developers of single-site properties should find auctions quite attractive given the small discounts obtained at these types of sales. Considering the results of this study, it is not surprising that some California developers even build projects with the intent of selling all the units by auction.

This paper suggests much scope for future research on the more general question of whether the timing of sales of large amounts of real estate can affect prices in a market. In particular, can the government "flood" a market, bringing down prices and reducing its own revenue? From the perspective of a large seller, what is the opportunity cost of selling at auction? Does such a seller normally sell at a discount to market? If so,

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[33]See Porter and Zona (1992) for evidence of bid rigging in highway procurement auctions.

how much? This paper provides a baseline that can be used to perform simulations of the decision faced by an owner of large amounts of real estate. These results could also be extended to commercial property, which provides the bulk of real estate in the portfolios of most large institutions.

Appendix: Description of the Data

Extensive information about condominium sales in Los Angeles County between 1970 and the third quarter of 1991 was obtained from the Damar Corporation in Los Angeles. The Dallas data come from the Dallas County Appraisal District (DCAD), which collects information on all of the county's real estate in order to calculate tax appraisals. These data sets contain observations on the sales price and date as well as various property characteristics for properties sold during the sample period. They also include information on a property's condition and quality.

The Damar data were gathered mostly from the California Market Data Cooperative (CMDC), which gets its information from county records as well as from members of the Society of Real Estate Appraisers, who fill out detailed information on all sales. Although the data are quite extensive, they do not contain information on all sales and frequently are missing variables for particular sales. Although the missing data may limit the variables that can be used in the hedonic estimations, there is no reason to believe that the data omissions are systematic in a particular way that might bias the empirical results.

The DCAD also collects sales prices, but this variable is incomplete because Texas law does not require parties to a real estate transaction to report the final sales price. Given the importance of current prices in determining an accurate assessment, the DCAD attempts to collect sales prices from the various county groups involved with real estate. These sources include the local Multiple Listing Service, the appraisers, other groups of real estate professionals, and any other source that collects prices. Because of the lack of reporting, it is impossible to determine how complete the data

are, but the DCAD is confident enough of these data to use them for tax appraisal purposes. To the extent that biases exist, it is likely a result of the under-reporting of private transactions that do not involve a realtor or a bank appraisal. Also, because properties are not inspected every year, some variables are not filled in for all units, including the condition variable, which exists only for a subset of properties.

Information on auctions was obtained in visits to one or more firms that conducted auctions in Dallas and Los Angeles in the 1980s. The L.A. sample contains information on 21 English-style auctions between 1981 and 1987, with all auctions conducted as absolute sales above previously published minimum prices that varied by property. Ten of these sales were scattered-site auctions, while the remaining eleven were single-site auctions. The seller in these cases was a developer or bank wishing to sell all remaining units at one time.

The Dallas sample contains data on 21 English-style auctions, most of which were scattered-site auctions. One auction was a single-site sale of 185 units in a condominium complex, with a published minimum price. All but two of the auctions maintained some type of reserve price. The other two auctions were absolute, with all properties selling at the highest bid, regardless of price. Of the reserve auctions, some utilized a published minimum price, above which the highest bid was always accepted. These are referred to as minimum bid sales. The other auctions had an unpublished reserve, meaning that the seller reserved the right to reject the highest bid. Most minimum bid sales were conducted by private banks, whereas government sales tended to have unpublished reserve prices.

The auction information was merged into the transaction data sets by hand, using the property's address to identify matched resales. In the combined data set, properties were matched on house number, street name, unit number, and city, although some Los Angeles units were missing data on city and zip code. Given the potential of mismatches or changes in a property's condition, the resale price data were filtered to ensure that for all matched sales, the unit in both sales contained the same reported number of rooms, bedrooms, bathrooms, and square footage and was in a similar reported condition.[34] Finally, observations were deleted if they showed appreciation or depreciation of more than 500 percent over five years, on the grounds that these observations were either mismatches or coding errors.[35]

Using recent appraisal forms, all auction properties were removed from the sample if they were in poor condition, on the grounds that these properties were likely to be fixed up before a subsequent resale or had been allowed to deteriorate substantially from a previous sale. Either of these possibilities would lead to an artificial downward bias on the coefficient for the auction price. For example, consider a property that is purchased at auction in poor condition and renovated. The subsequent sales price would rise even with no appreciation in the rest of the market. Without a control for the change in condition, the price increase would be attributed to a low auction price. Despite these efforts to control for changes in auction

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[34]A property's condition was reported as poor, fair, average, good, or excellent. Following Case and Shiller (1987), all resales that reported changes of more than one group up or down were deleted to ensure that the estimated index was not biased as a result of unobserved depreciation or appreciation in the base properties.

[35]Although not reported here, the deletions on the basis of excess appreciation or depreciation had no effect on the reported results.

properties, the improvement bias may still cause the WRS to overestimate the discount associated with auctions. The appraisal reports suggest that most auction properties are in worse than average condition because of remaining vacant for a period that can be as long as several years. Also, many of these units were previously foreclosed upon, leading their former owners to stop doing preventive maintenance when they realized they would lose their homes. Some previous owners even stripped their homes of all appliances.

Table A1 reports the coefficients for housing characteristics in the hedonic regression described in Section III. These coefficients are significant, with the exception of half baths in Los Angeles condominiums, and most are of expected sign and magnitude. Clearly, square footage is the most important variable in terms of explanatory power, with an elasticity that varies between 1.1 and 1.4. The neighborhood cost factor estimated by the DCAD for single-family homes has a moderate effect on price, with a doubling of the cost index leading to a 29 percent increase in the house price. This may be due to the fact that more expensive areas have nicer houses, and the DCAD index may attribute "too much" of the price to the neighborhood as opposed to individual houses. The coefficient on bedrooms in Los Angeles is negative because square footage is held constant. It suggests that people prefer condominiums with a smaller number of larger rooms. The negative term on half baths in Los Angeles and on both bath types in Dallas condominiums is surprising. This variable may be measured with error, as some property listings show all bathrooms as full baths. A more likely possibility is that some non-included variables are correlated with the bathroom coefficients. For example, more recently constructed condominiums in Dallas may be of

significantly lower quality, but contain more bathrooms per unit than older condominiums.

Table A1
Hedonic Regression Results[a], Los Angeles and Dallas
(Standard Errors)

	Los Angeles Condominiums	Dallas Condominiums	Dallas Single-Family Homes
Dependent Variable	Sales Price[b]	Sales Price[b]	Sales Price[b]
Intercept	2.611 (.046)	1.234 (.106)	1.737 (.026)
Square Feet[b]	1.100 (.005)	1.410 (.014)	1.147 (.004)
Bedrooms	-.1668 (.0016)		
Full Baths	.0491 (.0026)	-.0239 (.0078)	.1590 (.0020)
Half Baths	-.0051 (.0026)	-.1203 (.0094)	.0948 (.0022)
Garage		.0407 (.0142)	.1156 (.0030)
Neighborhood Cost Factor			.2520 (.0039)
N	124,419	10,422	139,479
R^2	.6632	.7373	.7780

[a]All equations also contain dummies to control for age of the property and the time of sale. Coefficients for the time dummies are graphed in the text and are highly significant. Coefficients for the age dummies are not reported, but are also highly significant.
[b]Variable is in logs.

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