Assessing the Performance of Real Estate Auctions

by

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Abstract

In the last 10 or 15 years auctions have gained attention as an alternative method of marketing real estate. The trend began in California in the mid 1970's, with some developers finding auctions an effective way to quickly sell a project without incurring large carrying costs. This method has gained more publicity in light of the S&L crisis, as the federal government, through the Resolution Trust Corporation, has gained possession of much troubled real estate which it must dispose of in a "timely" fashion. The fact that auctions would allow the government to sell large amounts of real estate in a relatively short period of time make them very attractive. However, the traditional view of real estate auctions is that they provide a bargain to the buyer because prices are significantly below "market value."

In a series of three papers, this dissertation studies the performance of real estate auctions. Chapter One develops a model that compares auctions and negotiated sales, giving predictions that are tested in subsequent empirical work. The model uses a search framework in which buyers look for a house that is a good "match" with their preferences. The paper shows that 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. Furthermore, the model predicts that auction discounts should rise in a down market with high vacancies and in a smaller market with fewer buyer and sellers, when there is a larger difference between houses. Finally, the auction discount falls when property is more homogeneous, because the match between buyer and house matters less in the final price.

The Second Chapter investigates the performance of real estate auctions in selling condominiums in the booming Los Angeles real estate market during the mid 1980's, finding that auctions perform quite well for the sellers. Estimates suggest that scattered site auctions, similar to sales held by many government agencies, sell property at a 9 percent discount. Auctions of properties in a single complex do better, selling units at a slight premium. The study computes discounts by comparing the appreciation rate of auction properties, measured with resales of auction units, with a market resale price index. This methodology is important in obtaining accurate results because it better controls for the quality of individual units, which is much lower for auction properties. The paper also looks for price declines during the course of the auction, finding little evidence of bargains later in an auction.

To test the prediction that auctions sell real estate at a larger discount in a down market, Chapter Three looks at Dallas during the late 1980's. As predicted by the theory, auction discounts in Dallas are much larger than in Los Angeles. Measured by resale price indexes, auction property sells for a discount that ranges between 9 percent for single site, minimum price auctions and 21 percent for auctions with an unpublished reserve price. Auctions with a minimum price seem to sell at a lower discount than those utilizing an unpublished reserve, but the results are not conclusive. The data present little evidence of a price decline over the course of the auction. Finally, properties that "fall through" from the auction and are sold afterwards are found to sell at a large premium over their auction price. This finding is consistent with the view that the auction discount is due to differences in sales technique, rather than the proposition that auctions permanently "taint" a property's image.

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Table of Contents

Introduction

Real estate auctions have been used in the US almost exclusively to dispose of property involved in foreclosure or bankruptcy. In the last 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 1970's, with some developers finding auctions an effective way to quickly sell a project without incurring large carrying costs. In the early 1980's auctions spread to other parts of the country, following the severe regional declines in prices first in the oil belt, and later in the Northeast.

This method has gained more publicity in light of the S&L crisis, as the federal government, through the Resolution Trust Corporation (RTC), has gained possession of much troubled real estate which it must dispose of in a "timely" fashion. As of 1991 the RTC had over $180 billion in assets, including over $18 billion in real estate.[1] Assets are expected to increase by over $200 billion in the next year or two. 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 government to sell large amounts of real estate in a relatively short period of time make them very attractive.[2] However, the traditional view of real estate auctions is that they provide a bargain to the buyer because prices are significantly below "market

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1 Wall Street Journal, 10/3/91.

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

value."

There is little doubt that real estate auctions have grown substantially in the last fifteen years in the U.S. By one estimate the dollar volume of real estate auctions has grown from $10 billion to $26.5 billion between 1981-1989.[3] The first major auctions appeared in Texas, Oklahoma, Louisiana and other oil belt states in the mid 1980's. Large banks and government agencies have sold many thousands of properties across Texas in the last 7 years, and there are still more properties in their portfolios. Many other banks and developers have resisted using auctions to sell off their REO, instead waiting for better times and higher prices. In holding their properties, sellers face substantial holding costs that can easily add up to 1-2% per month for unoccupied units. These carrying costs include interest, taxes, physical depreciation, insurance and continuing marketing costs.[4] (One auctioneer cites an internal estimate by the RTC that concludes that a property loses 48% of it's value if it remains unsold for 2 years.)

Many critics claim that the increase in real estate auctions is due to short-sighted sellers willing to get low prices for their property in order to make a quick sale. In a recent article in the Real Estate Finance Journal (1990), 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 the

[3] Martin, Stephen and Battle, Thomas, (1991). Sold: The Professional's Guide to Real Estate Auctions, Real Estate Education Company, USA, 12.

[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.

market can easily absorb. While conceding that auctions might be attractive if they sold properties for small discounts, he predicts that "Unfortunately...15 percent 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]

Chapter One develops a model that compares auctions and negotiated sales, giving predictions that are tested in subsequent empirical work. The model uses a search framework in which buyers look for a house that is a good "match" with their preferences. The paper shows that 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. Furthermore, the model predicts that auction discounts should rise in a down market with high vacancies and in a smaller market with fewer buyer and sellers, when there is a larger difference between houses. Finally, the auction discount falls when property is more homogeneous, because the match between buyer and house matters less in the final price. Many of these results are verified empirically in later chapters.

The Second Chapter investigates the performance of real estate auctions in selling condominiums in the booming Los Angeles real estate market during the mid

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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 5-10% 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 1-2% of the final sales price.

1980's, finding that auctions perform quite well for the sellers. Estimates suggest that scattered site auctions sell property at a 9 percent discount, while single site auctions do better, selling units at a slight premium. The results are computed with a resale price index, looking at subsequent resales of auction properties to compute estimated discounts. As a comparison, this paper also looks at hedonic estimates, concluding that hedonic equations can get biased estimates suggesting artificially large discounts. This is because auction properties are of lower than average quality, a factor that is not fully accounted for in hedonic equations. The paper also looks for price declines during the course of the auction, finding little evidence of bargains later in an auction.

To test the prediction that auctions sell real estate at a larger discount in a down market, Chapter Three looks at Dallas during the late 1980's. As predicted, auctioned property gets a discount that ranges between 9 percent for single site, minimum price auctions and 21 percent for auctions with an unpublished reserve price. The above results come from comparing subsequent auction prices with predicted prices obtained from resale price indices. As in the previous chapter, hedonic indices are shown to get artificially large discounts due to selection bias. The finding that single site condominiums have a much smaller auction discount may be because these are more homogeneous units than in the scattered site sales. Auctions with a minimum price seem to sell at a lower discount than those utilizing an unpublished reserve, but the results are not conclusive. The data present little evidence of a price decline over the course of the auction. Finally, properties that "fall through" from the auction and are sold afterwards are found to sell at a large premium over their auction price. This finding is consistent with the view that the auction discount is due to differences in sales technique, rather than the proposition that auctions permanently "taint" a property's image.

Overall, this study confirms that auctions, especially minimum price sales, may be a productive method of selling real estate for large sellers that face substantial holding costs of 1-2% per month and average holding times that can exceed a year. In addition, previous empirical work overstates the auction discount for these sellers, who would already have lower than average selling prices in order to sell quickly and save on the holding costs. The cost savings in a down market with a much greater time to sale seem to outweigh the lower price at auction. Evidence from other countries, such as Australia and New Zealand, that have an established use of auctions by small sellers suggests that auctions are more popular in good markets. Given the results of this study, one should expect to see auctions used more frequently to sell properties in good markets and for units that appeal to a wide audience, negating the observation of one critic who claimed: "Auctions will never survive the upturn in real estate markets."

Assessing the Performance of Real Estate Auctions

Chapter 1:

A Model of Auctions

Versus Negotiated Sales

I. Introduction

Real estate auctions have grown substantially in the US in the last 15 years, mostly in regions that have suffered downturns to their local real estate markets. Many observers have suggested that auctions will disappear as the US economy improves and financial institutions sell their glut of real estate. Others believe that US auctions will continue to grow, following the pattern of other countries such as Australia and New Zealand, where auctions are used more frequently in good times to sell property. Given that the US government, as well as many private banks and developers have tens of billions of dollars of real estate in their portfolios, the performance of auctions has important public policy implications. These implications may extend well into the future as the government looks for lessons on how to handle future crises involving financial institutions and real estate markets.

This paper will develop a model to look at how auctions differ from traditional, negotiated sales techniques. This contrasts with much of the previous literature, which focuses on these methods separately. The model will help to explain the subsequent empirical results which show that auctions often sell real estate at a significant discount (0-21%). Furthermore, properties transacted by auction in Dallas during the oil-price bust of the mid to late 1980's sold at a much larger discount (15-21%) than auctioned properties in Los Angeles (0-9%) during the boom of the mid 1980's.

First consider the discount at auction. This model uses a search framework in which buyers look for houses that are a good "match" with their preferences. Sellers also look for buyers to arrive with a good "match" to their property, and set an asking price that would only appeal to "well matched" buyers. (This is an explanation for why house prices are above replacement cost- sellers have some market power because houses are differentiated products.) In this context, auctions serve the purpose of selling a property quickly, but only to buyers that are in the market at a given time. This often results in poorer quality matches between buyers and houses. For sellers the potential tradeoff is clear- auctions provide a quicker sale, but at a lower price. Buyers face the prospect of a house that is a lower quality "match", but sells at a discount below market prices. Many sellers, such as the RTC, FDIC and private banks, face large holding costs and may find that auctions still represent the best way to sell their property.

A further goal of this model is to explain why auctions seem to perform worse in a downturn, such as that experienced by Dallas in the mid to late 1980's. In the context of this model, a "down" market is one in which the relative number of buyers decreases and the number of sellers increases. A downturn may be caused by greater unemployment or reduced real income which decrease the demand for housing. In the short run, however, the supply of housing is fixed at current levels. A greater number of houses for sale will reduce a buyer's willingness to pay for an auction property with a lower match quality. With a greater number of houses to choose from, a buyer will have more alternatives with better matches than the auction property. Similarly, a smaller number of buyers will reduce the current bids at an auction. Using this framework, we will show that the decrease in auction prices during a downturn is not just absolute, but also relative to prices in the negotiated sale market.

This paper compares auctions to negotiated sales, developing results that help understand the empirical work. Section II surveys the previous literature and its implications selling real estate. The basic model of negotiated sales is presented and solved in Section III, while Section IV adds auctions to the model. Section V gives the results of simulations assuming that mismatch costs are distributed uniformly. Finally, the results are summarized and additions to the model are considered.

II. Previous Research

The theory of optimal auctions is an area that economists have studied heavily in recent years, mostly focussing on 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] Much of the subsequent literature has focussed on relaxing the above assumptions to understand the circumstances under which some auction types dominate others (from the perspective of the seller, buyer or society) in maximizing surplus or making more efficient exchanges.[9]

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

[8] Actually, all auctions that fit the above conditions and have bids which are an increasing function of a bidder's valuation can be shown to be equivalent, both in terms of total surplus and sellers revenue.

[9] English auctions are used most frequently in selling real estate, art, wine, used cars and many other goods. First price sealed bids are often used for procurement, drilling/mining rights and selling a variety of financial instruments, including US Treasury Notes.

This literature has conflicting applications to the sale of real estate by auction (Lusht, 1990; Vandell and Riddiough, 1990). On one hand, the likely presence of risk averse bidders causes first price, sealed bid auctions to have higher expected prices[10] (Milgrom, 1989; Riley, 1989). On the other hand, the fact that buyers have affiliated valuations suggests that English auctions might have raise seller revenue by encouraging buyers to bid more aggressively than they would in a first price auction.[11] (Milgrom and Weber, 1982; McAfee and McMillan, 1987; Milgrom, 1989) In addition, first price auctions are more difficult for bidders to prepare for, as buyers must not only determine their own private valuation, but must also model the bids of other potential participants. The predominance of English-style auctions for selling most real estate, the exception is some large commercial properties, suggests that the latter two concerns override the effects of risk aversion, but this proposition has never been tested. The above discussion suggests that for modelling real estate auctions, English auctions are the logical choice.

There is also a substantial literature analyzing search markets. Early papers focus on labor markets, attempting to explain why prices do not seem to clear the market at any given time.[12] These models generally assume that information is

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[10] Intuitively, a potential buyer will likely increase his/her bid in response to uncertainty over the winning bid. The higher bid creates less expected surplus, but a greater probability of being the winning bidder.

[11] Affiliation exists here because all buyers have a common value component in their valuation of a property (i.e., all are concerned to some extent with a property's resale value). Under English or second price auctions, buyers pay only slightly more than the second highest bid, providing greater assurances that their valuation is not out of line with that of others in the market. Thus buyers may bid more aggressively because they are less likely to suffer from the "winner's curse". See Milgrom (1989) for a fuller description of the "winner's curse."

[12] See Mortensen (1978); Diamond and Maskin (1979); Diamond (1982); and Hosios (1990) as examples of this literature.

symmetric, but that the matching technology is imperfect. When turnover occurs, workers (firms) cannot immediately find a replacement job (worker) that is a good match with their particular skills (needs). The search time creates unemployment and unfilled jobs, which serve the role of allowing better matches to occur between workers and jobs. Wages are a byproduct of negotiations between workers and firms about how to split the surplus obtained by a good match. Stocks of workers are considered fixed in the short run so shocks to demand (for workers) are only partially offset by wage changes. A second set of search models use imperfect information and spatial differentiation to derive a market with positive vacancies and price dispersion.[13]

Many of the characteristics of labor markets, described above, also apply to housing. There have been several recent papers that have used such a framework to describe the workings of housing markets. Wheaton (1991) derives a model in which there are two types of houses and two kinds of people. Households become mismatched with some probability, creating turnover. The paper shows that an imperfect matching technology leads to equilibrium vacancy rates, with some transitional households owning two houses. In this framework, small shifts in supply or demand lead to substantial price changes, but little change in demand. Prices for a given type of house are identical. Read (1991) shows that spatial differentiation and imperfect information can lead to a housing market with positive vacancies and price dispersion. Arnott (1991) takes a different approach to explaining vacancies, relying upon the heterogeneity in housing units to give landlords market power. Because

13 See Rothchild, (1974); Butters, (1977); and Burdett and Judd, (1983).

tenants are willing to pay a premium for their most preferred unit and all units are different, landlords set rents above the long-run replacement cost of housing. Free entry leads to equilibrium vacancies.

Despite the number of papers that look at auctions and search markets, there has been little attention given to markets in which both of these techniques exist simultaneously.[14] That is despite the fact that these markets may provide valuable insights into the advantages/disadvantages inherent in the choice of sales technique. Adams, Kluger and Wyatt (1991) attempt to compare these two techniques by modelling negotiated sales as a slow dutch auction. They show that if buyers arrive at an exogeneous rate with i.i.d. 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. The 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 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]

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[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.

[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 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 that visit a property. If this were

This paper will develop a partial equilibrium model that compares auctions with negotiated sales. We use an Arnott (1991) framework in which buyers have different valuations of the same property because it seems to provide the best framework to compare the sales techniques. In particular, this model allows for an interesting tradeoff. Auctions can sell a property quicker, but at a "cost" of a poorer match than might exist in the search/negotiated sale market. Simulations of short-run variations in the vacancy rate will also allow predictions about the relative merit of auctions in boom versus bust markets, something that has been missing from the literature to this point.

III. The Model

The model described below is quite similar to that in Arnott (1991), although it has been modified to describe housing sales. (Arnott considers the rental market.) To begin, assume that there are N households in a market. Each household enters the market to search for a house according to a Poisson process with an (exogenous) arrival rate, μ, and departs from their current house at an equal rate. Thus, at any given instant, there will be n ($=\mu N$) households searching for a house, and an equal number who have departed their current house. Once in the market, buyers costlessly observe all available properties, choosing the house with the lowest total price.[16]

true, auctions might obtain higher prices, even in the Adams, Kluger and Wyatt (1991) model.

[16] Notice that this differs from the Wheaton (1991) and Read (1991) frameworks in which search is costly and the matching technology is imperfect.

There is no homelessness; buyers instantly choose their most preferred house among A available houses, which includes a number of "excess" houses (V) that are unoccupied because the previous owner has already moved. In other words, A is equal to the number of houses whose owner's will depart in the current period, n, plus the number of vacant houses, V, that were vacated previously, but have not been sold. (i.e., $A = n + V$)[17]

The price of a house, p_i, is composed of a money price, m_i, paid to the seller, and a mismatch cost, x_i, that is incurred by the buyer because the house is not a perfect match. (i.e., $p_i = m_i + x_i$) Each buyer draws x_i from the p.d.f., f(x), with each draw being independently and identically distributed. Draws from f(x) are i.i.d. across both buyers and households. The mismatch costs stem from a house with characteristics that don't match a given buyer's preferences. For example, the house might have small bedrooms, but a large kitchen and family room, when a buyer prefers the opposite. It might have an old-fashioned kitchen instead of a modern one. Or hardwood floors instead of carpeted ones. In many cases, buyers will spend tens of thousands of dollars and hundreds of hours of work to transform a house according to their individual preferences. Some people will even "tear down" an existing property and replace it with a custom built home. Presumably buyers trade-off a higher selling price against the quality of match. These preferences are independent in that one

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[17] This differs from Arnott's formulation in which $A = V$. If time is continuous and matching is instantaneous, then there are no households to depart in the "current period." The distinction will be useful, however, in the subsequent simulations that are run in discrete time.

person's dream home is another's nightmare.[18]

Sellers are households that have departed the market for some exogenous reason and attempt to maximize the (expected) present discounted value of returns from the sale of the house. We ignore the fact that many selling households are also buyers in this or another housing market and that this impending purchase may affect their sales strategy.[19] Both buyers and sellers are fully informed about all of the market parameters, including f(x) and all asking prices, but sellers do not know any single buyer's x_i and thus cannot discriminate among individuals. In setting their asking price, sellers take the market as given, including the number of households (N), the number of available units (A) and the number of searching households ($n = \mu^* N$). Sellers then wait for a buyer to come along that is willing to pay their asking price.[20] As Adams, Kluger and Wyatt (1991) show, this is the optimal strategy so long as the arrival and departure rates are stationary.[21]

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[18] Recently in Syracuse a builder auctioned a pink castle with imported pink marble, that he had built for a couple that was divorced before the house was completed. Presumably this house was sold for considerably less than its construction cost, unless the builder was able to find another couple desiring such a property.

[19] See Stein (1992) for a model in which downpayment constraints combined with the fact that buyers are also sellers accentuates the real estate cycle. This is because sellers need to obtain a high price to get enough equity to purchase a new home. In a down market, this leads to some sellers setting artificially high asking prices, reducing transactions even further.

[20] There is no bargaining (a.l.a. Nash) in this model because sellers do not know a buyer's x_i and sellers have no residual valuation for their property. Any bargaining would likely take the form of offers at a percentage discount from the asking price. Thus the asking price used here is just the original asking price minus discounts.

[21] This result also depends on sellers having the financial ability to bear losses until a property sells. An owner who has purchased another house, for example, may face increasing pressure to sell his/her old house, leading to price cuts over time.

In total, there are n buyers each looking for a house among A ($=V+n$) available houses on the market. V is the number of vacant properties in addition to the n properties made available due to departures from the market in the current period.[22] Since each buyer chooses his/her best possible match, the average match quality will be the (expected) first order statistic with A draws (the number of available houses). Buyers with a given match may be drawn to another house with a higher mismatch cost if the seller is willing to cut the price a little bit. Thus sellers trade off a quicker sale with a lower price. When auctions are defined later in the paper, buyers will use their best possible price/match combination in the search market to determine their bids in the auction. Poorer matched households will be more likely to buy at auction.

An equilibrium exists in this search model if and only if the following three conditions are satisfied:

$$(i) \qquad m_0 = m_0(m, A)$$

This equation says that each individual seller has set his/her optimal asking price, m_0, given the market price, m, and the number of available units, and has no incentive to deviate by setting a higher or lower price.

[22] Arnott (1991) considers a continuous time model and does not address whether properties that are vacated by tenants in the current period can be immediately occupied in the next period without being vacant first. In this model, properties for sale in one period can be occupied in the next period without a transitional vacancy.

$$(ii) \qquad m_0 = m$$

Any equilibrium must also be symmetric. We rule out any mixed strategy equilibria where otherwise identical sellers might choose different asking prices.

$$(iii) \qquad \pi(A) = F$$

This condition implies free entry and exit. (i.e., The expected proceeds from selling a house equals the replacement cost.) Notice that we are solving for a long-run equilibrium here. In subsequent sections this requirement is relaxed and vacancy rates are allowed to vary, showing the effects of temporary shocks on auction and negotiated sale prices when supply is fixed in the short-run.

These three conditions will allow us to solve for the three remaining unknowns- m, m_0 and A. Initially we solve for the seller's optimum, taking the market as given. (Condition i) Then the zero profit and symmetry conditions are imposed, giving an equation in terms of vacancies.

In setting an asking price a seller will maximize the (expected) present discounted value of profits, where profits are defined as follows:

$$(1) \qquad r\pi_0 = a(m_0;m,A)\,[m_0 - \pi_0] - c\,(1 - a(m_0;m,A)) \quad .$$

This equation is equivalent to the equilibrium condition in an asset market. Notice that

TABLE 1

Definition of Terms

Variable	Description
N	Total # of Households
V	# of Vacant (Excess) Houses
μ	Rate of Households Arriving Into and Departing From the Market
n	# of Households Searching for a House (= μ*N)
A	# of Available Houses (= μN + V)
m_i	Money Price of House i
x_i	Mismatch Cost of House i
p_i	Total Price of House i (= $m_i + x_i$)
f(x),F(x)	p.d.f., c.d.f. of x
x^1, x^2	1st Order Statistic, 2nd Order Statistic (minimum)
$g^1(x^1)$	p.d.f. of the 1st Order Statistic
$g^2(x^2)$	p.d.f. of the 2nd Order Statistic
c	Holding Cost of a Vacant Property
r	Real Interest Rate
T	Expected Time to Sale Given m,A (= 1/a)
F	Replacement Cost of a House
π	Expected Proceeds from Selling a House
m	Market (Money) Price of a House
v	Market Vacancy Rate (= V/U)
a	Market Arrival Rate* (= μN/A)
$v_0(m_0;m,A)$	Seller 0's Vacancy Rate Given m_0 ne m
$a_0(m_0;m,A)$	Seller 0's Arrival Rate* Given m_0 ne m
$\pi_0(m_0;m,A)$	Seller 0's (expected) Proceeds Given m_0 ne m

* The arrival rate represents the probability that a buyer purchases a property in a given period.

profits in this model are defined as the proceeds from selling a house and do not include the fixed cost of building the house. Equation (2) says that at any point in time a seller will equate the interest on an asset with its expected return. The return in (1) is the difference between the asking price (m_0) and the expected profits from holding the house another period times the arrival rate, $a(m_0;m,A)$. If the house is not sold the seller also pays a holding cost, c, in addition to the foregone revenue. The arrival rate is the rate at which a buyer arrives willing to purchase a property at the given asking price, m_0. It is equivalent to the probability that a house sells in a given period and depends on the market price (m) and the number of available houses in the market (A). If all asking prices were the same ($m_0=m$), then the arrival rate would be n/A, or the number of households searching divided by the total number of available houses. Simplifying (1), the seller will solve:

$$(2) \qquad \max_{m_0} \pi_0 = \left[\frac{a(m_0;m,A)}{a(m_0;m,A)+r}\right](m_0+c) - \left[\frac{c}{a(m_0;m,A)+r}\right] .$$

To derive the arrival rate, we need to show what happens to a seller that raises his/her price above the level set by the rest of the market. First, consider the first order statistic, $x^1(A;f(.))$ which is a random variable defined as the minimum of A draws from f(.). x^1 has p.d.f.:

$$(3) \qquad g^1(x^1;A,f(.)) = Af(x^1)(1-F(x^1))^{A-1} .$$

The (conditional) second order statistic, $x^2(x^1,A;f(.))$, is also a random variable and is defined as the second lowest of A draws from f(x), given that x^1 is the minimum. Conditional on x^1, x^2 has p.d.f.:

$$(4) \qquad g^2(x^2 \mid x^1; A, f(.)) = (A-1)\left[\frac{f(x^2)}{1-F(x^1)}\right]\left[\frac{(1-F(x^2))}{1-F(x^1)}\right]^{A-2} .$$

Following Arnott (1991) we define $Q(m_0;m,A)$ as the probability a buyer who would otherwise prefer unit 0 is deterred and chooses his/her second most preferred unit because $m_0 > m$. Thus $Q(m_0;m,A)$ equals $Pr(m_0+x^1 > m+x^2)$, which is equivalent to $Pr(m_0 > m+x^2-x^1)$. The later term is just the probability that m_0 is greater than m plus the expected difference between the first and second order statistic, which gives:

$$(5) \qquad Q(m_0;m,A) = \int_0^{\infty} g^1(x^1;A,f(.)) \int_{x^1}^{x^1+m_0-m} g^2(x^2 \mid x^1;A,f(.))\,dx^2 dx^1 .$$

Combining (3) and (4) into (5) gives:

$$(6) \qquad Q(m_0;m,A) = A(A-1)\int_0^{\infty} f(x^1) \int_{x^1}^{x^1+m_0-m} f(x^2)\,(1-F(x^2))^{A-2} dx^2 dx^1 .$$

We now define the arrival rate of buyers at unit 0 as follows:

$$(7) \qquad a_0(m_0; m, A) = \left(\frac{\mu N}{A}\right)(1 - Q(m_0; m, A)) \quad .$$

Equation (7) says that the arrival rate for house 0 is equal to the market arrival rate multiplied by the probability that a buyer is not deterred by $m_0 > m$. Because there is no homelessness and all buyers match with a house in a given period, the market arrival rate is just the number of buyers divided by the number of available houses.

Given the arrival rate, we can solve the seller's problem in equation (2), getting the following first order condition:

$$(8) \qquad m_0 = \frac{n + rA - (\delta Q/\delta m_0)\, cA(1 + r)}{(\delta Q/\delta m_0)\, rA} \quad .$$

The fact that sellers have symmetric positions implies that $(m = m_0)$ and $Q = 0$. This gives a simplified version of equation (6), which can then be used to solve for the derivative of Q with respect to m_0 as required in equation (8):

$$(9) \qquad \frac{\delta Q}{\delta m_0} = A(A - 1) \int_0^{\infty} (f(x^1))^2 (1 - F(x^1))^{A-2} dx^1 \quad .$$

Putting (9) into (8) gives an equation that governs the short-run price, when supply is fixed. Because of shocks to supply or demand, vacancies can vary around equilibrium rates. Later simulations of (8) will show that in the short-term, prices increase as vacancies decrease ($\delta m_0/\delta V<0$). For example, the economy might grow faster than expected, increasing demand for housing and reducing vacancies until more houses are be built. Similarly a downturn can lead to increased vacancies and reduced prices. Although the model can predict the direction of price changes, it is likely to magnify the extent of price movements. Any changes in vacancies are assumed to be permanent, with no resulting adjustments in supply. That affects upturns more than downturns, because supply can be increased more quickly than it can be reduced.

To look at long-run equilibria, we impose the free entry condition,

$$(10) \qquad \pi = \frac{a}{a+r}(m+c) - \frac{c}{a+r} = F \ ,$$

which says that the proceeds from building a house equal the replacement cost (F). It is equivalent to saying that net profits after entry costs equal zero. Combining free entry with the short-run condition (8), gives the following (long-run) expression to solve for A:

$$(11) \qquad A^2\left(\frac{\delta Q}{\delta m_0}(cr + Fr^2)\right) + A\left(\frac{\delta Q}{\delta m_0}(nc + nrF) - nr\right) - n^2 = 0 \ .$$

Equation (11) can be solved for many distributions, and simulated for others, to get an equilibrium vacancy rate and price level given the interest rate, holding costs, market size and replacement cost of housing.

For example, look at Figure 1 which graphs equations (8) and (10) using parameters from later simulations.[23] As expected, short-run prices are decreasing in vacancies. Prices in this model are very sensitive to changes in vacancies because the adjustments are assumed to be permanent. In hot markets, a small decline in the vacancy rate leads to large price increases, a factor seen in cities such as Boston and New York in the mid 1980's. In the long run, however, prices increase in vacancies. This result follows from the fact that long run prices are based on the cost of building and selling a property. A large vacancy rate translates into a greater time to sale and increased holding costs, causing a builder to charge higher prices to break even. The intersection of the free entry condition (10) and short-run price equation (8) is the solution to (11), the equilibrium vacancy rate. Note that (11) may contain multiple equilibria. In simulations with the uniform distribution, at most one of the three roots was ever positive. It was possible to find extreme parameter values that did not yield any positive solution.

IV. Auctions

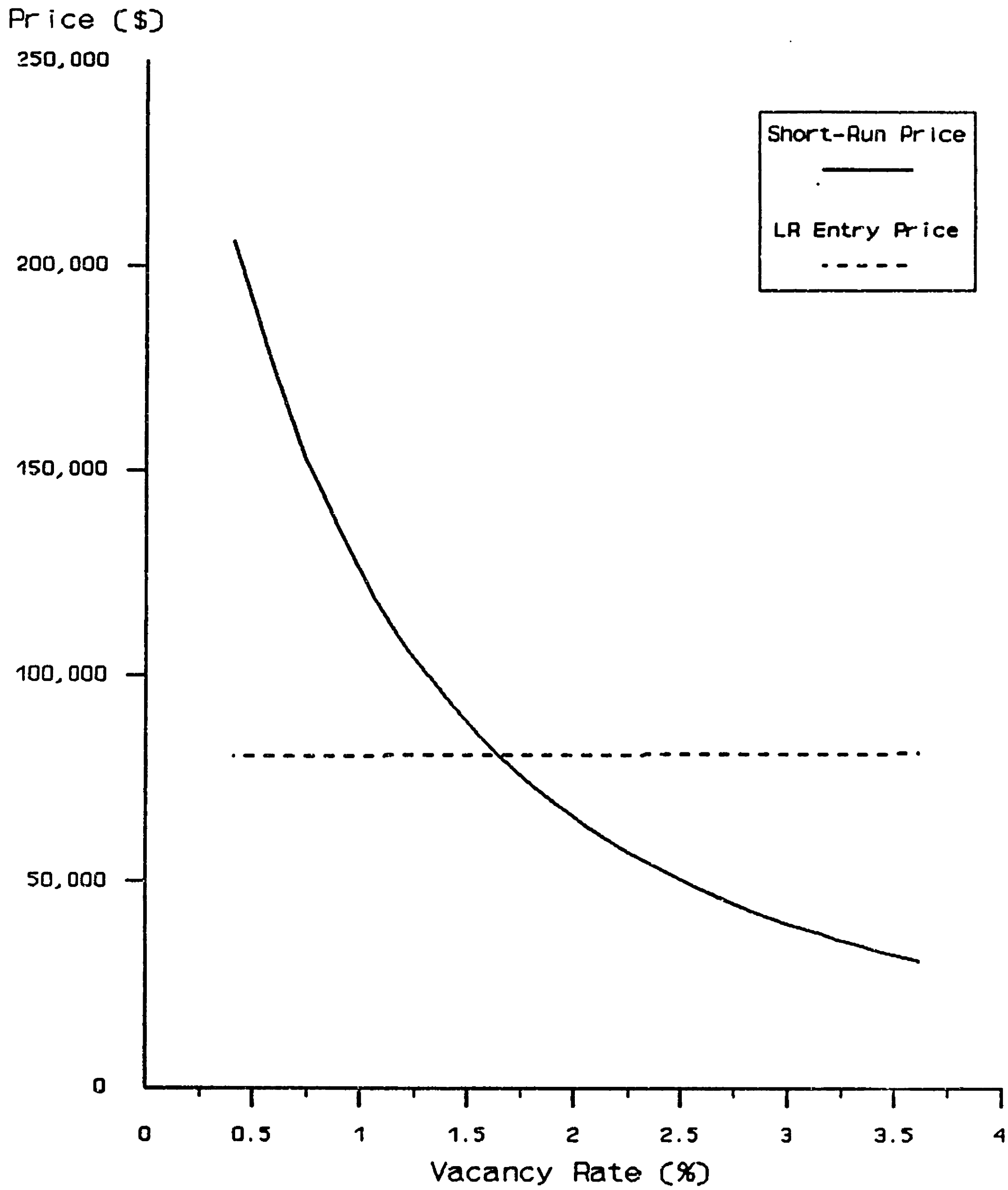
Now consider the possibility of auctioning property in this model. Think of a single seller holding an auction and assume that the auction price has no effect on m, the market price of real estate sold in the search market (calculated in Section III). The auction is attended by all the (n) buyers in the market at that time. Although buyers may "attend" the auction by observing a house's characteristics, in practice only buyers who have a high valuation will physically go to the auction site. Each buyer

[23] See the base case in Section V for the derivations of the exact equations used in Figure 1.

Figure 1

Simulation Results

Base Case



n= 50, Q= 80,000

determines his/her valuation by looking at the best alternative in the search market and his/her match with the auction property. We can calculate the price of a house at auction and compare it to the market price. Here we are interested both in the absolute discount/premium associated with auctions, and also how the auction price varies with changes in vacancies.

In the model, we will use an English style (ascending bid, open outcry), absolute (no reserve) auction. In the U.S., the vast majority of residential real estate is sold at English auctions. Many auctions, particularly foreclosure sales, have an unpublished or published reserve price, which theory predicts will raise the price of the property sold at auction.[24] Theory also suggests that publishing a reserve price will increase bids because it gives information about the seller's valuation of the property, reducing buyer uncertainty. The above theory, however, assumes a fixed number of buyers. If one assumes that buyers are more likely to attend an auction with a low, published reserve price, the result that sales prices are increased with announced reserves may not hold. It depends on the assumptions as to what kind of auction is optimal for the seller. Because auctions in this model do not have reserve prices, the results might well over estimate the discount associated with auctions.

In the English auction, buyers will bid their valuation after accounting for the winner's curse. The winner's curse is irrelevant in this model because a buyer's valuation completely depends on his/her match with a property. A buyer's valuation

[24] The intuition is that a binding reserve price can force the highest bidder to pay more than the second highest valuation for a property. See McAfee and McMillan (1987) for details.

is positive iff $p^a < p^1$. (i.e., The total price of the auction property is less than the total price of the buyer's most preferred non-auction property among the A available properties.) This implies that:

$$(12) \qquad m^a + x^a < m + x^1 \quad \rightarrow \quad m^a < m - (x^a - x^1) \ ,$$

where m^a is the auction (money) price, x^1 is the lowest mismatch cost of the A vacant houses, x^a is the mismatch cost of the auction property and m is the market price of all non-auction houses. Buyers with a poor match in the search market- a large user cost, x^1- or a good match with the auction house- a small x^a- are likely to be the high bidders.

The winning bid at this auction will be approximately equal to the second highest valuation, assuming the bidding increment is close to zero. In expectation, the highest bid will be equal to the market price, m, minus the second lowest draw from (x^a-x^1) with n draws, where n equals the total number of buyers in the market. From Section III we know that x^1 and x^a have density functions $g^1(x^1)$ and $f(x^a)$, respectively, that also depend on the number of available house and the number of buyers. Now define $z = x^a-x^1$, which has p.d.f.:

$$(13) \qquad h_{x^a-x^1}(z) = \int_{-\infty}^{\infty} f(x^a)\, g^1(x^a - z)\, dx^a \ ,$$

and c.d.f., $H(z)$. We can also define z^2 as the second lowest of n draws, with p.d.f.:

$$(14) \qquad h^2(z^2) = n(n-1)h(z)H(z)(1-H(z))^{n-2} .$$

Thus the expected price at auction is equal to the market price minus the expectation of z^2, or:

$$(15) \qquad E\{m^a\} = m - \int_{-\infty}^{\infty} h^2(z^2)\, z^2\, dz^2 .$$

As in the Section III, the auction price can be explicitly calculated for a limited class of distributions, and simulated for others. Using this model we can describe the short-term dynamics of a market where vacancies vary around the equilibrium levels, possibly due to local economic shocks. This is of particular interest in predicting how the auction premium/discount varies with the economic cycle.

We will now show that the percentage auction discount rises in a bust market, when short-term shocks cause the number of vacancies/available houses to rise or the number of searching households to fall. This result is striking because it says that even though negotiated sale prices fall in a down market, auction pries fall further. Notice, however, that the auction price (15) is always defined relative to the negotiated sale price. At the same time that the market price falls due to increased vacancies, the (expected) absolute discount at auction $E\{z^2\}$ actually rises, leading to a bigger percentage discount.

To show this result formally, we define the (percentage) auction discount as follows:

$$(16) \qquad pct.\ auction\ discount = 1 - \frac{m^a}{m} = 1 - \left(\frac{m}{m} - \frac{E\{z^2\}}{m}\right) = .$$

Thus the auction discount is the (expected) absolute auction discount divided by the market price in the negotiated sale market. In the short run, both the market price and the absolute auction discount are based upon the number of households searching for a house and the number of houses available.

First consider the search market. From simulations of equation (8) it is clear that $\delta m/\delta A < 0$ and $\delta m/\delta n > 0$.[25] This says that in the short-run, taking the number of houses as fixed, the market price increases with the number of households searching and decreases with the number of available houses. Both of these results are due to changes in competition. If the number of buyers increase or there are fewer houses for sale, there is greater competition for each available house causing sellers to raise their prices. The opposite is also true; less competition for purchasing each house leads to lower prices in the short-run. In the long-run, of course, entry or exit (e.g., depreciation) will return the stock to equilibrium levels.

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[25] For example, see Figures 1 and 2.

The absolute auction discount behaves in an inverse fashion, rising with vacancies and falling with the number of households searching. (i.e., $\delta(z^2)^*/\delta V > 0$ and $\delta(z^2)^*/\delta n < 0$.) First look at changes in the number of households searching for a house (n). As fewer households search there will be a smaller number of draws from the distribution of z, where z is the difference in mismatch costs between the auction house and the most preferred house in the search market. With fewer draws, $(z^2)^*$, the expected second lowest mismatch cost (n draws) will increase, causing the auction discount to rise. A boom with more bidders will have the opposite effect. More buyers will increase the number of draws from the distribution of mismatch costs, lowering the expected difference in mismatch costs of the winning bidder and reducing the (absolute) auction discount.

To show the effects of changes in vacancies, note that $z = x^a - x^1$. Increasing the number of vacancies causes the number of available houses to rise, which reduces the (expected) mismatch cost of the best alternative house in the search market (x^1). Since the (expected) mismatch of the auction house (x^a) does not change, the (expected) difference in mismatch costs between the auction house and the best alternative will rise for each draw of z. In other words, with more houses available the best alternative to the auction house is better and has a lower (expected) mismatch cost. Thus the auction discount rises as vacancies increase.

Putting together the results from the negotiated sale and auction markets, we conclude that the percentage auction discount will increase when a market is hit with a negative shock that increases vacancies or decreases the demand for housing/number of households searching. As vacancies rise, the denominator (the market price) falls and the numerator (the absolute auction discount) rises, leading to a bigger percentage discount at auction. The opposite occurs with changes in the number of households searching for a house. The intuition here is that buyers always choose auction bids/prices relative to prices in the negotiated sale market. A downturn has two effects. It lowers prices in the negotiated sale market, and also reduces the number of bidders, raising the average difference in mismatch costs ($z = x^{*} - x^{1}$) of the winning bidder. The latter result guarantees that auction prices fall faster than negotiated sale prices, leading to an auction discount that rises as a market suffers a short-term negative shock to vacancies.

V. Simulations

Given the above model, we can now set the basic parameters and solve for the auction discount. Table 2 provides a look at data on vacancy rates, market size and prices for 22 metropolitan areas in 1990. Because the vacancy data comes from the Census Bureau, there is no time-series variation. Several items are of interest here. Vacancy rates for owner occupied housing are much lower than for rental housing, likely due to lower turnover. It is hard to look at the effects of a current boom on vacancy rates, because, with the exception of Seattle, most markets seem to be flat. Vacancy rates seem to vary significantly with the cycle, although with some lag. For example, Dallas, which suffered a significant decline in real home prices, had a vacancy rate of 3.3%, while Cleveland, a city with steady growth, had a rate of only 1.1%.

TABLE 2

1990 Market Data, Various Cities[a]

City	Vacancy Rate[b]	# Homes Looked At[e]	NAR Median Price[d]	CT&T Median Price[c]	NAR Percent Change, 89-90[d]	NAR Percent Change, 85-90[d]
Atlanta	4.0	15.0	86.4	99.1	2.9	N.A.
Boston	2.6	15.1	174.2	166.2	.4	22.4
Chicago	1.3	13.5	116.8	132.1	9.2	44.0
Cleveland	1.1	14.2	80.6	79.9	7.2	25.2
Dallas	3.3	12.1	89.5	90.6	-4.2	-4.8
Denver	4.2	15.1	86.4	91.4	1.1	-2.5
Detroit	1.0	13.9	76.7	94.1	4.1	48.4
Houston	3.5	N.A.	70.7	N.A.	6.0	-10
Los Angeles	1.9	13.7	212.8	202.2	-.9	70
Miami	2.8	N.A.	89.3	N.A.	2.8	10.9
Minneapolis	1.5	14.4	88.7	96.9	1.7	18
New Orleans	4.4	N.A.	67.8	N.A.	-4.0	N.A.
Orange County	1.8	14.3	242.4	240.3	.3	80
Orlando	3.0	10.4	82.8	86.6	3.8	17.8
Philadelphia	2.2	12.4	108.7	121.2	4.6	46.9
Phoenix	3.8	14.1	84	88.7	6.6	12.3
San Francisco	1.7	12.8	259.3	247.4	-.5	78.7
Seattle	1.2	14.5	131.5	119.9	14.3	N.A.
Washington, DC	3.1	15.4	150.2	145.4	4.0	54.7

[a] All prices are in nominal terms.
[b] Source: 1990 U.S. Census, Vacancy Rate for Owner-Occupied Housing
[c] Source: Chicago Title & Trust Company's Survey of Recent Home Buyers, Includes Single Family Homes and Condominiums
[d] Source: National Association of Realtor, Includes Only Single Family Homes

There also seems to be a strong individual city effect. Later simulations suggest that equilibrium vacancy rates can vary significantly in individual markets due to differing market sizes, mismatch costs and replacement costs. That variation is apparent in the data. Even accounting for local cycles, vacancy rates seem to take a range of values depending on the city.

The National Association of Realtors' numbers are useful in looking at the effect of a downturn on average sales time, a key variable to judge the results of later simulations. Although this data is not available at the city level, Table 3 shows national statistics on sales volume, median prices and number of months supply on the market. As Case and Shiller (1989) and others have shown, median prices do not fully reflect downturns in the market, as the mix of houses sold changes over time. During the downturn of the mid 1980's volume seems to fall much more rapidly than median prices, with the former having the predominant effect on average sales time. Even aggregated at the national level, supply varies from 8 to 12.5 months of houses on the market. Anecdotal evidence suggests that average time to sale varies much more in individual cities, although there are few hard numbers available.

We now attempt to simulate the above model, using parameters for the variables in the first order condition (11), including the mismatch cost, x. Unfortunately, there is no easy data on the range of mismatch costs between houses. We will use the uniform distribution over [0,L] to describe x. Future research might look at the normal distribution, which gives a lower probability of finding houses that

Table 3

National Sales Statistics, 1976-1991

Year	Sales Volume (Millions)	Percent Change in Volume, 1 Year	Median Sales Price (000's)	Percent Change in Price, 1 Year	Average Supply of Houses, (Months)
1976	3.064	23.7	38.1	7.9	N.A.
1977	3.650	19.1	42.9	10.0	N.A.
1978	3.968	8.7	48.7	13.5	N.A.
1979	3.827	-3.6	55.7	14.4	N.A.
1980	2.973	-22.3	62.2	11.7	N.A.
1981	2.419	-18.6	66.4	6.3	N.A.
1982	1.990	-17.7	67.8	2.1	12.5
1983	2.719	36.6	70.3	3.7	10.5
1984	2.868	5.5	72.4	3.0	10.8
1985	3.214	12.1	75.5	4.3	9.9
1986	3.565	10.9	80.3	6.4	8.9
1987	3.526	-1.1	85.6	6.6	8.4
1988	3.594	1.9	89.3	4.1	8.6
1989	3.440	-4.3	93.1	4.3	8.0
1990	3.296	-4.2	95.5	2.6	9.2
1991	3.220	-2.3	100.3	5.0	9.1

All prices are in nominal terms.
Source: National Association of Realtors

are extremely good or poor matches with an individual buyer. The upper limit between the best possible house ($x_i=0$) and the worst possible unit ($x_j=L$) is L, which is assumed to be $80,000, the same level as the replacement cost of a house. Even with such a large range, the average difference in mismatch costs between houses in a market with 100 available house will only be $800. Given that some buyers will even tear down an existing house to build another one, or build a custom house in an overbuilt market like Texas, the assumed range of mismatch costs might be low. We experiment with a range of values of L in the simulations, finding that this variable has a significant effect on prices.

Using the uniform distribution for $0<x<L$ gives $f(x)=1/L$ and $F(x)=x/L$. Substituting f(x) and F(x) into the arrival rate equation (9) gives $\delta Q/\delta m_0=A/L$. Combining this equation with (8) gives the following solution for the short-run market price:

$$(17) \qquad m = \frac{L(n + rA) + cA^2(1 + r)}{A^2 r}$$

and combining with the free entry condition from (10):

$$(18) \qquad m = \frac{F(a + r) + c}{a} - c$$

gives the following equation for vacancies:

$$(19) \qquad A^3(rc + r^2F) + A^2(rnF + nc) - A(rn) - n^2L = 0 \ .$$

Simulations of (19) will show the order of magnitude of the auction discount given reasonable parameters. First it is necessary to establish a time period, 3 months, in which buyers select a house. Although the model assumes that buyers immediately observe all available houses, in practice that search takes some period of time. The search time of 3 months fits with data from the National Association of Realtors, but is a bit lower than the period of time suggested by the Chicago Title and Trust survey. The lower number is used because there is no rental market and no homelessness in the model, so buyers must be able to match in a given period. In the base case, real interest rates are set at .5% per period, or 2.02% per year. The cost of holding a vacant unit, above and beyond the foregone interest, is initially assumed to be 0. For short vacancies this is probably realistic.[26] In a market where houses are vacant well over a year, vandalism and physical depreciation becomes more of a problem and values of $c>0$ would be appropriate. Because these simulations are intended to get predictions about the Dallas market, we will use a replacement cost of $80,000.

Finally, the size of the initial search market is set at 2500 houses. This says that after a buyer chooses the approximate house and lot size (square footage) and the preferred neighborhood(s) there are about 2500 houses that fit that description. That seems to be reasonable in many markets. In practice, the search is narrowed considerably because only a small percentage of those houses will be available for sale.

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[26] As the RTC has discovered, properties that are unoccupied for long periods face substantial additional maintenance costs, including the risk of vandalism.

With a steady-state turnover/arrival rate of 1.67% per period, there will be 50 buyers searching for housing in a given period. (A turnover rate of 1.67% gives an average duration of about 15 years.)

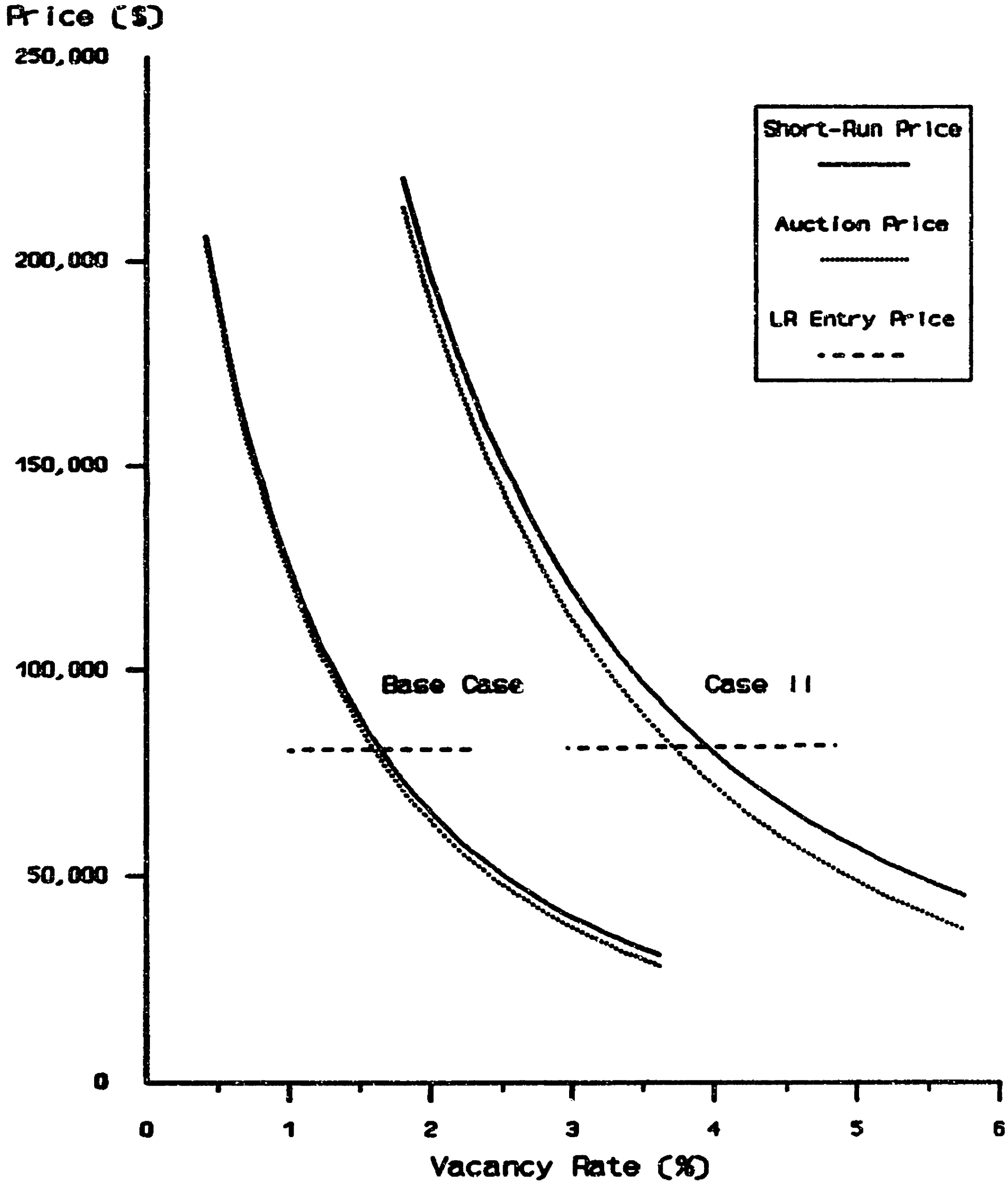
These parameters are summarized on the first line of Table 4, which also gives the results of simulating the auction model for the base case. These simulations suggest that in a market of 2500 houses there would be 100 units available for purchase, with half of those being vacant and the other half with owners who will move out next period. Using these numbers gives a market with a vacancy rate of 1.6% and an average time on the market of 6 months. A look at Table 2 suggest that these numbers are a bit low relative to many U.S. cities. One possibility is that in 1990 many of the cities surveyed were suffering from "down" real estate markets, causing above normal vacancy rates. Time to sale (Table 3) is harder to measure because of the discouraged seller effect, but the base case seems to underestimate this variable relative to actual time to sale.

Figure 2 graphs the long-run (free entry) and short-run conditions, showing the short-run dynamics that describe how the housing market adjusts to shocks when the housing stock is fixed. Seller behavior is characterized in the short-run by the first-order condition (17), with the (long-run) zero profit condition, (18), no longer binding. The seller maximizes his/her profit and those who own homes may actually earn positive or negative profits while the market adjusts back to equilibrium. The downturn in Dallas is a good example. Demand for housing fell sharply, with some households selling properties without being replaced by willing buyers. This led to an increase in

Figure 2

Simulation Results

Base Case vs. Case II



Case II: Small Mkt, Large Mismatch Cost

vacant units and a decline in prices/profits. (See Table 2.)

Figure 2 shows how the Base Case (BC) is affected by (short-run) shocks to vacancies, measured with the vacancy rate. (A similar graph can also be drawn with time to sale.) Market and auction prices are graphed together. Clearly prices fall as vacancies rise and vice-versa. Price increases are particularly steep as the vacancy rate moves further below the equilibrium level. The equilibrium vacancy rate is marked by the intersection of the long and short-run equations. Notice that the auction discount, the difference between the two price lines, is increasing as vacancy rates increase and prices fall. Thus the auction (percent) discount increases with vacancies, as is shown in Figure 3. Although predicted discount for the base case rises as the market falls, it never reaches 15 or 20 percent of the market price, the level estimated for Dallas in a subsequent chapter.

There are several possible changes that might raise the predicted discount in a downturn. Auction properties may be in smaller, less common market segments. A smaller market means that fewer houses will be available at any time, increasing the difference in mismatch costs between houses. That gives sellers greater market power, leading to increased prices. Auction discounts will be higher for the same reason. The (expected) difference between the auction property and the next best alternative will be greater with fewer properties for sale, leading to a bigger discount. In this model a smaller market is equivalent to a larger range of mismatch costs. When mismatch costs rise, the equilibrium vacancy rate increases, as does the percentage auction discount. The results of these combined effects (smaller market and larger mismatch costs) are shown in Figure 2, labeled Case II. The equilibrium vacancy rate for Case II is much higher than the Base Case, because of larger mark-ups due to stronger buyer preferences between houses.

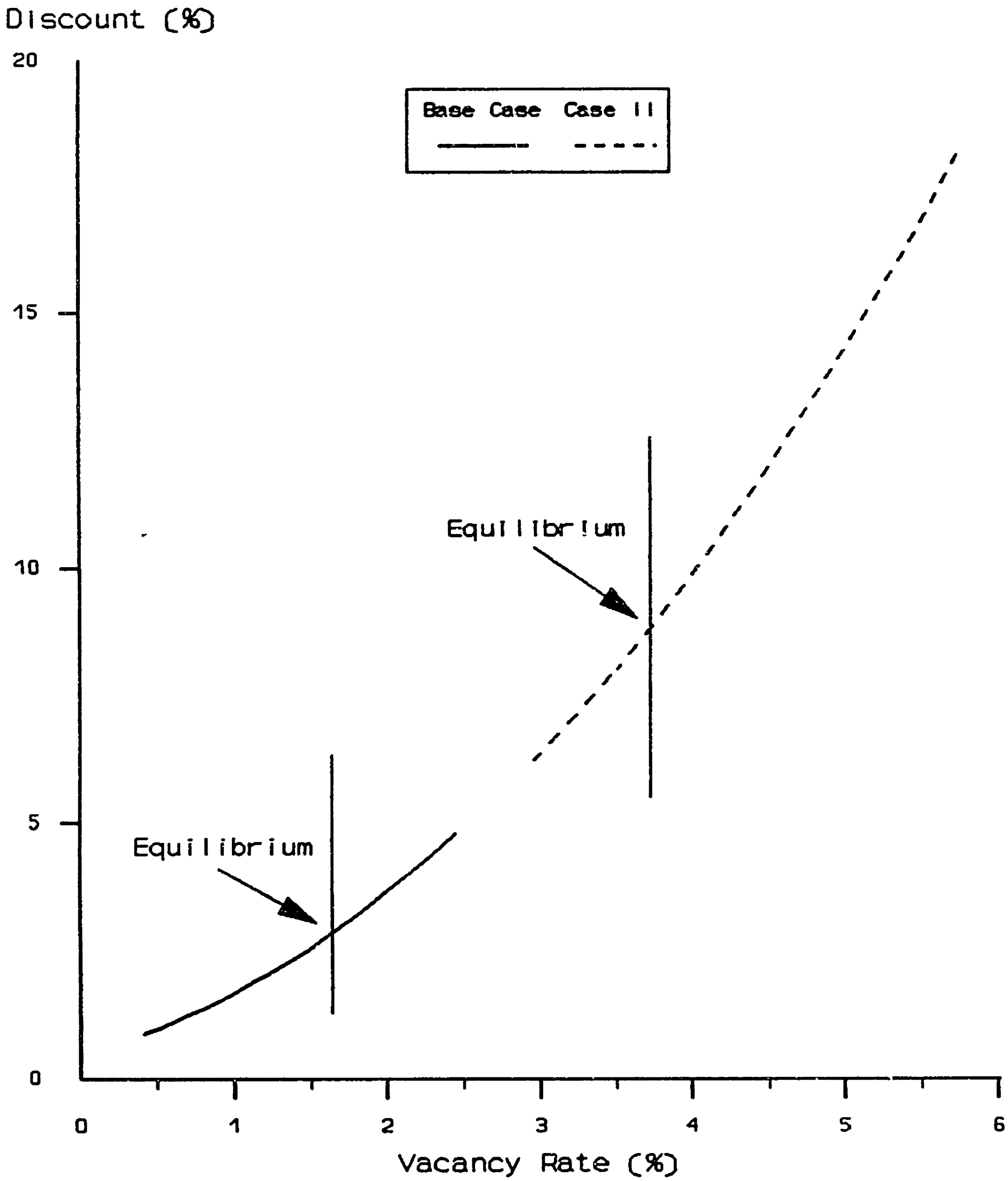
Figure 3 shows how the auction discount rises in Case II compared to the Base Case. Although the lines look to be the same, they represent very different situations. The Base Case has a smaller equilibrium vacancy rate and a lower auction discount when the vacancy rate deviates from the long-run equilibrium. Case II, by contrast, has significantly higher auction discounts in the long-run, as well as the short-run when the vacancy rate moves away from equilibrium. The latter case gets double digit auction discounts that more closely approximate the discounts found in Texas. Together, these simulations suggest that auctions might get large discounts in areas that have suffered significant downturns, particularly if auction properties have a greater variance in mismatch costs and a smaller market than other properties in the sample.

This last result is especially important given the types of properties that are often sold in (US) auctions by banks and government sellers. Many times, banks choose to auction properties that are hard to sell conventionally, either because the units are of lower quality or because they are different than other properties in the area. This suggests a smaller potential market, which could lead auction properties to sell at a bigger discount relative to the average property. This is consistent with later empirical work on Los Angeles and Dallas, which find that single site auctions of (new) condominiums sell property at a smaller discount than scattered site condominium auctions. The former were built as homogeneous units likely to appeal to a broader

Figure 3

Simulated Auction Discount

Base Case vs. Case II



Case II: Small Mkt, Large Mismatch Cost

market, while many of the condos in the scattered site auctions were older, lower quality and in smaller complexes, thus attracting a smaller audience.

Notice that short-run prices rise very quickly as the vacancy rate declines below the equilibrium level. This movement of prices is because entry is restricted and changes to vacancies are assumed to be permanent. In a boom, new houses can be built in as little as 3-6 months and new condos in a year or two. Thus it is unlikely that permanent shocks to vacancies would occur as simulated. Price increases in booms are not only due to shortages of existing houses, but also to a fixed amount of land within a close proximity of many desired locations. Prices rise at least partially due to increases in land values, which are reflected in the replacement cost, f. In busts, on the other hand, this model may do a better job of predicting price declines. The housing stock is fixed, so decreases in demand with little population growth can result in positive and permanent shocks to vacancy rates. This is consistent with some price indices in depressed areas. Real condominium prices in Dallas County fell over 60% between 1985 and 1989.

Table 4 shows the effect of varying parameters on the equilibrium vacancy rate, house price and time to sale. This gives some idea of how various parameter values affect the vacancy rate or average sale time. Notice that these are equilibrium results, meaning that the zero profit condition applies, while many of the numbers quoted in Tables 2 and 3 may result from markets that have been hit by short-term shocks.

Increasing the holding cost or interest rate, which makes it more expensive to

TABLE 4

Equilibrium Vacancies, Various Parameter Values

Int. Rate (%)	Cost ($)	House-holds in Search	Repl. Cost ($)	Max. Mis-match ($)	Vacan-cies	Price	Vac. Rate (%)	Avg. Sale Time (mths)
r	c	n	f	L	V	m	v	
.005	0	50	80,000	80,000	50	80,800	1.6	6
.0025	0	50	80,000	80,000	91	80,046	2.9	8.5
.075	0	50	80,000	80,000	31	82,276	1.0	4.9
.005	100	50	80,000	80,000	39	81,796	1.3	5.3
.005	250	50	80,000	80,000	28	82,268	.9	4.7
.005	0	50	60,000	80,000	65	61,187	2.1	6.9
.005	0	50	100,000	80,000	39	101,896	1.3	5.3
.005	0	50	200,000	80,000	13	202,832	.4	3.8
.005	0	50	200,000	200,000	50	202,000	1.6	6
.005	0	150	80,000	80,000	23	80,652	.3	3.5
.005	0	100	80,000	80,000	41	81,046	.7	4.2
.005	0	25	80,000	80,000	45	82,776	2.9	8.4
.005	0	15	80,000	80,000	39	83,786	4.2	10.8
.0075	0	100	80,000	80,000	15	81,351	.2	3.5
.0075	0	25	80,000	80,000	32	83,480	2.1	6.8
.0075	0	15	80,000	80,000	29	84,462	3.1	8.8
.0025	0	100	80,000	80,000	100	80,400	1.6	6
.0025	0	25	80,000	80,000	75	80,800	4.8	12
.0025	0	15	80,000	80,000	62	81,997	6.4	15.4
.005	0	50	80,000	40,000	20	82,204	.7	4.2
.005	0	50	80,000	120,000	72	81,607	2.3	7.3
.005	0	25	80,000	120,000	61	82,520	3.9	10.3

keep a vacant property, reduces the equilibrium time to sale. A larger replacement cost cuts the vacancy rate, because entry is more expensive. However, if the maximum mismatch cost is scaled up by the same proportion as the replacement cost, then vacancy rates do not change. It is plausible that mismatch costs are greater in high house price cities. For example, San Francisco probably has higher repair expenses and the implicit wages for homeowners than Dallas or Houston.

The positive correlation between maximum mismatch cost and the equilibrium vacancy rate is due to increased monopoly power. A bigger range of mismatches means that a seller will be able to raise price further above cost, giving higher profits. This leads to greater entry, more vacancies and a longer time to sale. There is a similar relationship between market size (total number of households) and vacancies. More houses being sold increases competition and reduces profits, resulting in a smaller vacancy rate. A measure of market power is the ratio of the market size to the maximum mismatch cost. A bigger market and/or a smaller mismatch cost mean that houses are closer substitutes, leading to less market power, lower profits, fewer vacancies and a lower vacancy rate.

The above simulations using the uniform distribution always suggest that auctions sell property at a discount. That conclusion might not be universal depending on the distribution used in equation (15) to solve for auction prices. Assuming that the cost of running an auction is approximately the same as negotiated sales, it is troubling that auctions might sell property at a premium.[27] This model solves for a partial equilibrium and auctions are assumed to be an insignificant part of the market. Because sellers are identical, a premium at auction would imply that all sales would be auctions, creating a situation in which no symmetric equilibrium exists. Because there is a positive vacancy rate (there are more units than buyers), all units cannot sell at absolute auction without driving prices to zero.

This problem can be resolved by adding to a seller's choice of sales techniques. This model assumes that the seller is unable to raise his/her price if there are two or more buyers willing to pay that asking price. A premium at auction in this model would due to the fact that bidders competing for a property can raise bids above an asking price that was set using an "expected" valuation. (i.e., There is some probability that two or more buyers will value a property at more than the asking price. In hot markets, the probability of multiple bidders may increase enough to make competition perform better than setting an asking price.) Sellers may be able to get the best of both techniques by setting an asking price and holding an auction if two or more buyers offer to buy the house. This happens quite frequently in boom markets (e.g., New York City in the mid 1980's), when realtors will request that multiple prospective buyers submit bids for a popular property.

That policy is quite similar to a published-reserve auction, where a seller accepts bids above a reserve (asking price). In Australia, reserve auctions are a much larger

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[27] For large enough sales (hundreds of units), auctions can actually be cheaper than realtor sales. A typical fee would involve a fixed payment of 1-2% plus commission of 4% on all property sold.

percentage of the market in a boom than in a bust, although the reserves are rarely published.[28] Lusht (1990) reports that during some booms, reserve auctions can make up as much as 80% of sales in sub-markets of Melbourne. Economies of scale might explain why most sellers here do not choose to auction in booms, but this is not convincing. In England and Australia, auctioneers hold large sales in which they sell properties that belong to individual owners.[29]

The US pattern of auctioning in down markets might well be explained by the existence of a few sellers (e.g., RTC or FDIC, or a private developer holding short-term "balloon" financing) that face higher holding costs than others in the market. The high-cost sellers will set a lower price than the rest of the market in order to sell the property.[30] For these sellers, auctions may be more attractive because of the quicker time to sale. Removing the cost symmetry could create a separating equilibrium in which auctions are attractive only for high-cost sellers. That describes the U.S. experience, where most auctions are held by large institutions. This discussion also suggests that sales prices of government properties will be below prices of other units in a market where most sellers have lower holding costs. In that case, subsequent empirical work may overestimate the discount associated with auctioning a property

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[28] See Chapter 3 for a further discussion of published and unpublished reserves.

[29] The vast majority of auctions in Australia are reserve sales, and a third or more of all properties do not sell at the auction because the high bid was rejected by the seller.

[30] Using x distributed uniformly on [0,L], it is possible to solve for the probability that a buyer is attracted by $m_0 < m$:

$$Q(m_0;m,V) = L^{-4}\left(1 - \left(1 - \frac{m_0 - m}{L}\right)^V\right)$$

Plugging into the first order condition (8), it can be shown that $\delta m_0/\delta c < 0$.

by comparing government auction prices with negotiated sale prices of individual (low-cost) homeowners.

VI. Extensions and Conclusion

This model makes several predictions about prices at auction versus negotiated sale that will be tested in later chapters:

i. Auction prices should be lower than prices for houses sold at negotiated sales, with the possible exception of auctions held in very hot markets. Buyers do not bid up the price because, on average, the auction property is a poorer match (has a higher mismatch cost) than their best alternative in the negotiated sale market.

ii. As a housing market improves and vacancies decline in the short-term, possibly due to positive economic shocks, the auction discount falls. In a boom market, increased competition between buyers for a few houses raises the probability that multiple buyers will arrive with a good match for a single house, increasing the auction price. In a bust, auctions sell at a much larger discount.

iii. Houses that have a lower range of mismatch costs, L, will be auctioned at a smaller discount. In this model auction discounts are due to mismatches between buyers and houses. Units that are more homogeneous have a smaller relative mismatch cost and thus a smaller discount. Overall, a lower L leads to a more efficient market with diminished mark-ups, lower vacancies and a smaller time to sale. Sales technique matters less when buyers have more similar valuations of the same property. Large markets have the same effect. The difference in mismatch costs between houses declines as a buyer has more units to choose from, reducing mark-ups. This may explain why subsequent empirical work finds that single-site condominiums, built for a homogeneous market, sell at a much smaller discount than other condominiums.

iv. For high-cost sellers, comparing auction prices to "market" prices will exaggerate the auction discount. These sellers would normally cut the selling price below the "market" in order to sell quicker and avoid additional holding costs.

There are several possible extensions to this model that should be considered in future research. Adding search costs, for example, may reduce the predicted auction discount. If buyers pay some cost to visit each property, they would prefer to visit auction properties because those units would sell, on average, at a lower price. From the buyer's perspective, each house has an equal probability of being a good match with a low mismatch cost, but auction houses may be less expensive. As more buyers attend auctions, they will reduce the auction discount by increasing competition, which raises prices, and also reducing the chance of being the winning bidder. Buyers will equate the marginal cost of visiting another house with the surplus gained from buying that house multiplied by the probability of being the high bidder.[31]

The model might be extended to consider different types of auctions, absolute

[31] Auctioneers often claim to attract as many as a year's worth of buyers in the six weeks preceding an auction.

and reserve. Alternatively, sellers could be given the option of auctioning property if two or more buyers are willing to meet the asking price, similar to a reserve auction. In a model where buyers are informed about all properties, such a strategy would eliminate the possibility that absolute auctions outperform negotiated sales. A shock-adjustment rule could be added to the first-order condition that governs short-term dynamics. Such a rule would dictate the speed at which the market returns to the long-term equilibrium with zero-profits and free entry. Expectations could also be modeled. Finally, we might use other distributions to describe the mismatch costs. The normal distribution might increase the discount associated with auctions in a downturn by having a greater change in mismatch cost associated with a diminished number of bidders.

The results of this paper seem to fit nicely with the evidence in Australia, where auctions may represent about a quarter of all sales. As documented by Maher (1989) and Lusht (1990), auctions are used more frequently in boom markets and for "hot" properties. This pattern is exactly the opposite of that found in the U.S. Although the subsequent empirical work finds that U.S. auctions do better in up markets, auctions continue to be viewed as a sales method of last resort in down markets. One can only guess as to whether the perceptions of market participants will change enough to allow auctions to continue their growth as the economy improves.

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Assessing the Performance of Real Estate Auctions

Chapter 2:

Evidence From Los Angeles

During the Mid 1980's

I. Introduction

Real estate auctions have been used in the US almost exclusively to dispose of property involved in foreclosure or bankruptcy. In the last 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 1970's, with some developers finding auctions an effective way to quickly sell a project without incurring large carrying costs. In the early 1980's auctions spread to other parts of the country, following the severe regional declines in prices first in the oil belt, and later in the Northeast.

This method has gained more publicity in light of the S&L crisis, as the federal government, through the Resolution Trust Corporation (RTC), has gained possession of much troubled real estate which it must dispose of in a "timely" fashion. Currently the RTC has over $180 billion in assets, including over $18 billion in real estate. Assets are expected to increase by over $200 billion in the next year or two. (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 government to sell large amounts of real estate in a relatively short period of time make them very attractive.[32] However, the traditional view of real estate auctions is that they provide a bargain to the buyer because prices are significantly below "market value."

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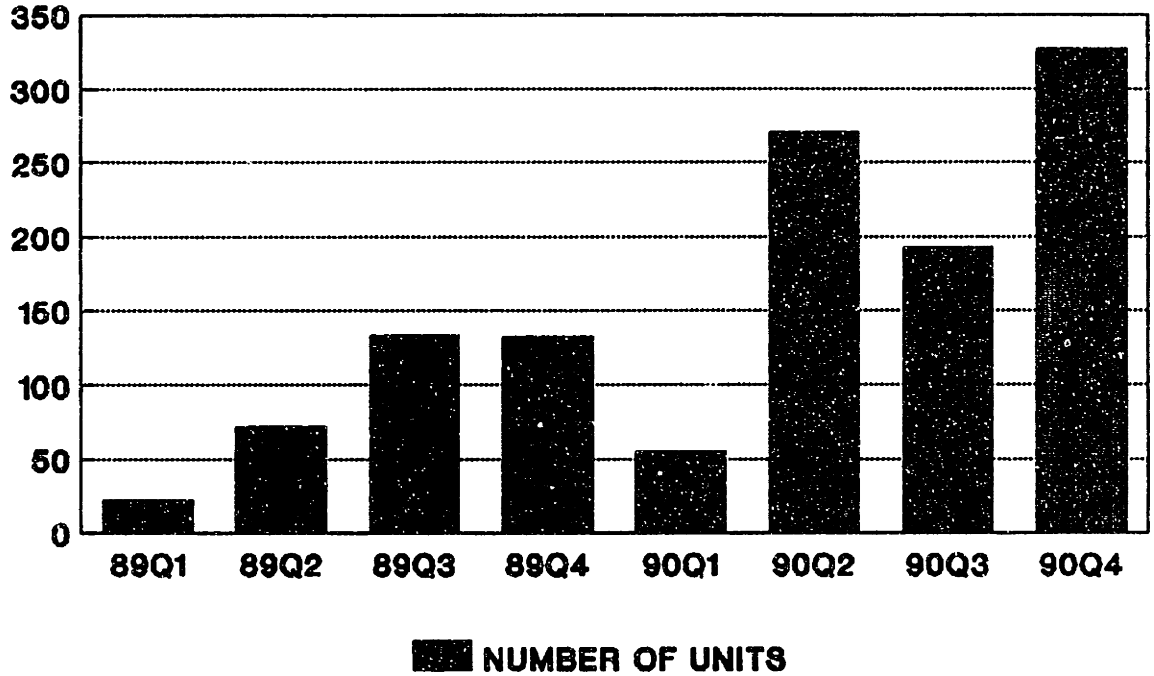
[32] Of the $180 billion of assets sold by the RTC, open outcry auctions represent only $183 million, mostly low priced residential real estate. (Wall Street Journal, 11/21/91)

The Boston area provides an illustrative case study of the growth of auctions following the decline in real estate prices after 1989. Advertisements in the Boston Globe for non-foreclosure auctions have increased from a small number of single property auctions prior to 1988 to 126 auctions of 359 properties in 1989, to 118 involving 846 properties in 1990. (Figure 1) The large increase in units for 1989 and 1990 came as many condominium developers decided to auction off the remaining units in projects that were having difficulty selling, even at "reduced" prices. These numbers represent a large percentage of the sales of new condominiums in the Boston area. This growth in auctions should continue as several large banks as well as the RTC prepare to reduce their increasing inventories of REO (Real Estate Owned).

This paper will estimate the relative returns to auctions and negotiated sales for large holders of real estate in terms of costs and price differences. Section II describes the growth of real estate auctions and looks at alternative views about the success of auctions in allowing an owner to quickly sell property at a reasonable price. The theory of optimal auctions is reviewed and applied to real estate auctions in Section III. Previous empirical results regarding auctions of various types of goods, including real estate, is also summarized. Section IV describes the data used in this study. This data includes information on condominium auctions as well as sales data from a large number of condominium sales in Los Angeles County from 1970 to 1991. The empirical work in Section V 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/discount associated with auctions. This work further explores how the premium varies for different types of

FIGURE 1
AUCTION ADVERTISEMENTS



SOURCE: BOSTON GLOBE

properties, and looks for evidence of price declines during the course of an auction. Finally these results are applied to the government's problem in selling the substantial real estate portfolios gained from the savings and loan crisis.

II. Growth of Real Estate Auctions

There is little doubt that real estate auctions have grown substantially in the last fifteen years in the U.S. By one estimate the dollar volume of real estate auctions has grown from $10 billion to $26.5 billion between 1981-1989. (Martin and Battle, 1991) This growth has mostly paralleled the downturn in local real estate markets.[33] Unlike foreclosures, the typical real estate auction has 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. Sellers attempt to provide some financing and in many cases will make the sale contingent upon the buyer qualifying for that financing. To bid, a buyer must present cash or a cashier's check for 2-10% of the property's expected sales price. Most auctions have at least some properties that sell on an "absolute" basis, sometimes above a specified minimum, in an effort to show potential buyers that the seller is anxious to sell the properties.[34] Some sellers,

[33] Here it is important to note the difference between the real estate auctions described in this paper and foreclosure auctions that are 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 likely not attractive to the usual purchaser of residential real estate. The typical foreclosure serves the legal purpose of allowing 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 80-90% of the time and market the property using more conventional means.

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

including most government agencies, are sufficiently risk averse that they require that most properties sell with "reserve" (i.e., the seller reserves the right to reject the highest bid.)

This pattern first appeared in Texas, Oklahoma, Louisiana and other oil belt states in the mid 1980's. Major banks and government agencies have sold many thousands of properties across Texas in the last 7 years, and there are still more properties in their portfolios. Many other banks and developers have resisted using auctions to sell off their REO, instead waiting for better times and higher prices. In holding their properties, sellers face substantial holding costs that can easily add up to 1-2% per month for unoccupied units. These carrying costs include interest, taxes, physical depreciation, insurance and continuing marketing costs.[35] (One auctioneer cited an internal estimate by the RTC that concluded that a property loses 48% of it's value if it remains unsold for 2 years.)

Many critics claim that the increase in real estate auctions is due to short-sighted sellers willing to get low prices for their property in order to make a quick sale. In a recent article in the Real Estate Finance Journal (1990), 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 the market can easily absorb. While conceding that auctions might be attractive if they sold properties for small discounts, he predicts that "Unfortunately...15 percent to 20

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[35] 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.

percent discounts are the exception."[36] In addition, Ginsburg and other critics claim that auctions of large projects "taint" a property's image and increase risk for a seller.[37]

III. Previous Research

The theory of optimal auctions is an area that economists have studied heavily in recent years, providing many strong conclusions about the relative merits of different types of auctions.[38] 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. Others have shown that under these conditions, the optimal auction is equivalent to an English auction with a reserve price.[39] Much of the subsequent literature has focussed on relaxing the above assumptions to explain the matching of certain types auctions with particular goods.[40]

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36 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..."

37 The typical auction contract requires the seller to pay for all marketing expenses in addition to a commission of 5-10% 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 1-2% of the final sales price.

38 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).

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

40 English auctions are used most frequently in selling real estate, art, wine, used cars and many other goods. First price sealed bids are often used for procurement, drilling/mining rights and selling a variety of financial instruments, including US Treasury Notes.

This literature has conflicting applications to the sale of real estate by auction. (Lusht, 1990; Vandell and Riddiough, 1990) On one hand, the likely presence of risk averse bidders or sellers causes first price auctions to have higher expected prices.[41] (Milgrom, 1989; Riley, 1989) On the other hand, if buyers have affiliated valuations they will bid more aggressively at English-style auctions than they would at a first price, sealed bid sale.[42] (Milgrom and Weber, 1982; McAfee and McMillan, 1987; Milgrom, 1989) In addition, first price auctions are more difficult for bidders to prepare for, as buyers must not only determine their own private valuation, but must also model the bids of other potential participants. The predominance of English-style auctions for selling most real estate, the exception is some large commercial properties, suggests that the latter two concerns override the effects of risk aversion, but this proposition has never been tested.

We focus here on reserve setting, which is tested subsequently in Chapter 3. Theory shows, under most circumstances, the optimal auction will include a reserve that is usually greater than a seller's valuation of his/her own property. Intuitively, a reserve can force a bidder to raise his/her bid in order to compete with the seller. The reserve is only binding if it is above the bid of the second-highest valuation buyer. The risk in setting a reserve is that it is so high that the highest-valuation buyer does 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. If a monopolist raises

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[41] Intuitively, a potential buyer will likely increase his/her bid in response to uncertainty over the winning bid. The higher bid creates less expected surplus, but a greater probability of being the winning bidder.

[42] This result follows because buyers are less concerned with the "winner's curse" when bids are affiliated. Under English or second price auctions, buyers pay only slightly more than the second highest bid, providing greater assurances that their valuation is not out of line with that of others in the market.

price above marginal cost, he/she loses some sales, but makes up for the lower volume with a higher price.

Unfortunately, there is no way to test this theory without having good information about how sellers actually set reserves. Instead, we will look at whether a seller should publish the chosen reserve price. In most auctions, including sales of real estate in Australia and New Zealand, sellers take great care to keep the reserve price secret. That differs from the practice in some US sales where the reserve is published as a minimum price. Sellers are prohibited from bidding above that minimum and are required to accept the highest price. 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 (1982a) 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 don't publish any information at all. The exception is when 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 his/her profits at the expense of the seller. Using a sample of oil tract sales, Hendricks and Porter (1988) show that informed bidders, those that own neighboring tracts, have positive returns to bidding and uninformed buyers have a zero expected surplus.

Other papers suggest that the possible existence of the winner's curse explains why few sellers choose to release reserve prices.[43] Kagel and Levin (1986) conduct experiments of mock auctions with volunteers and find strong evidence of the winner's curse in larger groups (6-7 players), despite the fact that the players have participated in several previous auctions.[44] When the players have better information, they bid more accurately and the seller loses revenue. Studies of 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 of the winner's curse, but that result is contradicted by studies of savings and loan and drainage lease sales. Previous investigations of real estate auctions in the US using hedonic equations find large discounts at auction.[45] However, the previous chapter did find that single-site auctions in Los Angeles County sold at a small premium, as did a study of Australian auctions.[46] That could explain why Australia relies upon reserve auctions and uses them in "boom" markets.

Much of the above theory relies upon 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

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[43] See Kagel and Levin (1986) and Vandell and Riddough (1990).

[44] Kagel and Levin find less significant evidence of the winner's curse in smaller groups (3-4 players) and in groups of "super experienced" bidders.

[45] 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.

[46] See Lusht (1990). In the LA study, the premium of 3.5% was not statistically significantly different than zero, while Lusht found a significant premium of up to 6.5%, depending on the sales comparison group.

"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% higher than auctions with an unpublished reserve.

The risk in setting a low minimum bid is that the auction might attract few bidders and the owner will be forced to sell at a price significantly below his/her valuation. Ironically, most government auctions use unpublished reserves, despite the fact that the government conducts many more sales, lowering its overall risk of low prices. This risk aversion may stem from the fact that the media closely scrutinizes its transactions. For example, a Boston TV station recently ran an "investigative" series in which they claimed that government auctions were "give-aways", using a couple of sales at a single auction as evidence.

Empirical evidence on the revenue effects of various types of auctions/sales has been limited, mostly because there are very few markets where more than one sales technique coexist simultaneously.[47] One possible exception is bond markets, where several papers in the mid 1970's looked at the effects of added competition and an

[47] See Cox, Robertson and Smith (1982) and Cox, Smith and Walker (1984) for examples of experiments about revenue effects of various auction types.

increased number of potential bidders on bond interest costs.[48] (Hendershott and Kidwell, 1978; Hopewell and Kauffman, 1977; Kessel, 1971) 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 the municipal revenue bonds. In a subsequent review of this work, Sorensen (1979) compared bond issues with only one or two bids, and found, in this case with 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.

A second strand of the applied auction literature has looked at particular aspects of an auction to explain price behavior. Studies of bond auctions, mentioned above, demonstrate that prices are increasing with the number of bidders. There have been several recent studies of the "winner's curse", with mixed results about the existence of significant abnormal, post-auction returns.[49] Using evidence from wine and art auctions, Ashenfelter (1990) has shown that over the course of an auction there are significant price declines, even for identical cases of wine. He attributes these declines to a combination of risk aversion and quantity constraints among buyers. Gau, Quan

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

[49] The "winner's curse" is a phenomenon that results if the bidders for an item do not fully account for the uncertainty in estimating that item's value. If buyers' valuations are identically and independently distributed and buyers bid up to their valuation at an English auction, the winner will often find that the item is worth less than the winning bid. In other words, conditional on having the highest valuation among identical bidders, the winner should expect to have overestimated the true value of an item. The optimal response to the "winner's curse" is for bidders to shade their bids. Hendricks and Porter (1988) in studies of oil tract auctions, and Theil (1988) in a study of highway construction bids, found no evidence of below-normal returns, while Brannman, Klein and Weiss (1987) find some such evidence in several different auctions.

and Sternberg (1990) and Vanderporten (1990) have similar evidence from individual real estate auctions. Each of these studies uses data from a particular auction sale and estimates prices as a function of various property characteristics and a variable representing the order at the auction. Both find that properties in later parts of the auction sell at significant discounts.

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 sales price due to using an auction.[50] Wright (1990), uses data from the Department of Housing and Urban Development(HUD) sales in the mid 1980's. Over this time 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% of the price obtained using broker contracts, after accounting for property characteristics and financing considerations.[51] This study has several major flaws. In particular, there is 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 upon its condition and appeal to the market. Such choices would clearly bias the auction coefficient towards finding a large auction discount.

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[50] The "hedonic" regression uses property characteristics such as square footage, number of bedrooms, etc... 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.

[51] The average auction discount over his whole sample was 25%.

Using data covering on land sales in Austin, Texas, Gau, Quan and Sternberg (1990) find that auctioned properties sell at a significant, 33% 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 single family detached home sales in Melbourne, Australia. Using data collected from an (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% lower than auction sale prices, a difference that was statistically significant at the 5% level. This data was 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 choice of how a property was sold. Unfortunately, the study did not instrument for sales choice, instead running a single reduced form regression.[52]

IV. Methodology

The differences in the above studies about the performance of real estate

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

auctions could well be explained by the methodology used. If the sales method of a property is chosen based on its attractiveness to the market, but this variable is not adequately controlled for in the hedonic regression, the regression will attribute differences in attractiveness to the coefficient for the sales technique. For example, if the US 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.[63] Recently the RTC has revealed that it chooses a marketing strategy 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 biased estimate of the auction premium/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 sellers choice of sales method.[64]

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[63] 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 fact that auctioned properties that were much more likely to be designated as "cash-only" sales, in which HUD was unwilling to provide any financing.

[64] 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

Instead, we 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:

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

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

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

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

X_i = vector of hedonic characteristics for property i, including # of bedrooms, # of bathrooms, location, quality,...

$A_{i,t}$ = a 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 (X's) are observed, under the assumption that the observed X's are uncorrelated with the omitted variables. This gives as unbiased estimate of prices based upon the observed X's. An alternative, first proposed by Bailey, Muth and Nourse (1963), 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 that were based on median sales prices. The RPI is created by taking

likely to use auctions because reduced costs due to economies of scale.

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 X's). The resulting equation (2) has only dummy variables on the right hand side.

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

$A'_{i,t}$ = a 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.[55] 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/disadvantage is that the resale price index does not net out depreciation due 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 than those units that sell only once in the sample period. This might pose a potential

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

problem if all units in the sample do not have the same expected rate of appreciation. In subsequent empirical work this bias becomes apparent in the 1982 downturn, although it does not appear to seriously affect the results.

In estimating the RPI, we will correct 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 sale. Following Case and Shiller, we will calculate a weighted resale index (WRS) 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 form the second stage, we can calculate a predicted variance and weight the original observations by the inverse of the predicted variance. These weighted observations are then used in the original equation. We will find, 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, we will assume that the coefficient on the auction dummy (θ) does not vary over time, or with any other factor (i.e., there is a constant auction premium/discount). To some extent we will be able to test this assumption by adding separate dummies for different types of auctions, or for sales at different intervals within a given auction. In this way we will be able to test whether Ashenfelter's observation of price declines over the course of art and wine auctions also applies to real estate auctions.

The hedonic equation also assumes that the vector of coefficients (β) on the X's 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, we will use the following model to control for changes due to depreciation[56]:

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

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, *v* can be interpreted as the premium for new properties in the sample.

V. Data

This study will focus on the condominium market in Los Angeles County between 1970 and the third quarter of 1991. Extensive information about condominium sales in the county were obtained from the Damar Corporation in Los Angeles. This data contains

[56] 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.

observations on the sales price and date as well as various property characteristics for properties sold during the sample period. It includes information on a property's condition and quality. The Damar data was gathered mostly from the California Market Data Cooperative (CMDC), which gets its information from county records, as well as members of the Society of Real Estate Appraisers who fill out detailed information on all sales. Although the data is quite extensive, it does not contain information on all sales and is frequently 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.

Information on auctions was obtained in visits to one or more firms that conducted auctions in Los Angeles County in the 1980's. The sample contains information on 21 English-style auctions between 1981 and 1986, with all auctions conducted as absolute sales above previously published minimum prices that varied by property. Ten of these sales were scattered site auctions in which large portfolios of different types of properties were sold off in one place. The typical scattered site auction was commissioned by an institution such as a bank or government agency and contained properties in as many as many as five or six counties and three states. Commercial land and structures were auctioned alongside single family homes and condominiums. The remaining 11 sales were single site auctions involving a large number of condominiums from a development. The seller in these cases was a developer or bank wishing to sell all remaining units at one time.[57]

[57] 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.

These data sets were merged together by hand using the property's address to identify matched resales. To increase the number of observed resales of auction properties, these units were further matched with a more extensive on-line data set from Damar that included additional sources of information beyond the CMDC. In the combined data set, condominiums were matched on house number, street name and unit number, since many units were missing data on city and zip code. Given the potential of severe mismatches or changes in a property's condition, the resale price data was 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.[58] Finally, observations were deleted that showed appreciation/depreciation of more than 500% over 5 years, on the grounds that these observations were either mismatches or coding errors.[59]

Table 1 gives 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 set of properties that are auctioned are very different from the average properties sold over the sample period. Auction properties tended to be smaller, both in terms of square feet, as well as the number of bedrooms and bathrooms, and to sell for lower prices.[60]

The evidence here supports the notion that even in California, where auctions are

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[58] 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 due to unobserved depreciation/appreciation in the base properties.

[59] Although not reported here, the deletions on the basis of excess appreciation/depreciation had no affect on the reported results.

[60] For purposes of comparison, the sales prices were deflated to $1990 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.

Table 1
Sample Means, Los Angeles

(Standard Errors)

All Units	Full Sample	Auction Sample
Number of observations	124,420	285
Sale Price[1]	$174,605 (116,078)	$138,516 (57,488)
Bedrooms	2.19 (.81)	1.75 (.67)
Full Baths	1.80 (.60)	1.79 (.69)
Half Baths	.37 (.49)	.03 (.17)
New Units	.53 (.50)	.35 (.48)
Age	7.00 (7.96)	9.40 (6.86)
Square Footage	1277 (614)	1039 (331)
Resale Units	**Full Sample**	**Auction Sample**
Number of Observations	29,456	112
Sale Price[1]	$163,198 (87,261)	$131,029 (52,677)
Bedrooms	2.15 (.80)	1.60 (.68)
Full Baths	1.71 (.58)	1.65 (.66)
Half Baths	.29 (.46)	.05 (.22)
New Units	.43 (.50)	.30 (.46)
Age	8.76 (8.43)	10.2 (7.2)
Square Footage	1198 (430)	955 (278)

[1] Sales prices are deflated by the weighted repeat sale index described in section V. to provide a constant means of comparing prices.

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. Auctioned condominiums are smaller, less expensive and have fewer bedrooms, although they have more bathrooms per bedroom than does the larger sample. Table 1 also shows that resale properties differ from the average property sold, both at auction as well as in the whole sample. Given that there is evidence that different segments of the market may have distinct appreciation rates, the variation in the types of units that resell could potentially cause biases in the RPI. (Poterba, 1991) Further evidence of selection in terms of the scattered site versus single site auctions is given in Table 2, which provides sample means for these two types of auctions.

VI. Empirical Evidence

Although the auction sample clearly differs from the average condominium in Los Angeles County, the sample selection bias is probably not as severe as in previous U.S. studies of real estate auctions, particularly that of Wright (1989). As expected, regression results from the hedonic model (Table 3) show an auction discount of 6%, not nearly as large as previous US estimates. This estimate is significant at the 1 percent level. The coefficients on the other hedonic variables, with the exception of half baths, are significant and of expected sign and magnitude. A 10 percent increase in square footage suggests an 11 percent increase in price, with new units getting a four percent higher price. The coefficient on bedrooms 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 surprising, although it is not statistically significant at the five percent level despite a sample size of over 124,000. This variable may also be measured with error, as some property listings show all bathrooms as full baths.

Table 2

Sample Means, Auction Sample

(Standard Errors)

Variable	Scattered Site	Single Site
Number of observations	78	207
Sale Price[1]	$126,379 (47,992)	$143,090 (60,153)
Bedrooms	1.94 (.67)	1.69 (.66)
Full Baths	1.94 (.69)	1.73 (.68)
Half Baths	.05 (.22)	.02 (.14)
New Units	.57 (.50)	.26 (.44)
Age	8.00 (7.09)	9.93 (6.70)
Square Footage	1136 (364)	1002 (311)

1 Sales prices are deflated by the weighted repeat sale index described in section V. to provide a constant means of comparing prices.

Table 3

Regression Results, Hedonic Equation, Whole Sample

(Standard Errors)

Dependent Variable	Sales Price* (1)	Sales Price* (2)	Sales Price* (3)
Methodology	Hedonic	Hedonic	Hedonic
Intercept	2.611 (.047)	2.611 (.046)	2.613 (.046)
Bedroom	-.1668 (.0016)	-.1668 (.0016)	-.1668 (.0016)
Full Bath	.0491 (.0026)	.0491 (.0025)	.0492 (.0025)
Half Bath	-.0051 (.0026)	-.0051 (.0026)	-.0052 (.0026)
New	.0394 (.0024)	.0396 (.0024)	.0394 (.0024)
Square Feet*	1.100 (.005)	1.100 (.005)	1.099 (.005)
Auction	-.0623 (.0212)		
Scattered Site		-.2415 (.0404)	
Single Site		.0054 (.0249)	
Top 1/3			-.1136 (.0445)
Middle 1/3			-.0829 (.0417)
Bottom 1/3			-.1493 (.0376)
N	124,419	124,419	124,419
R^2	.6632	.6632	.6632

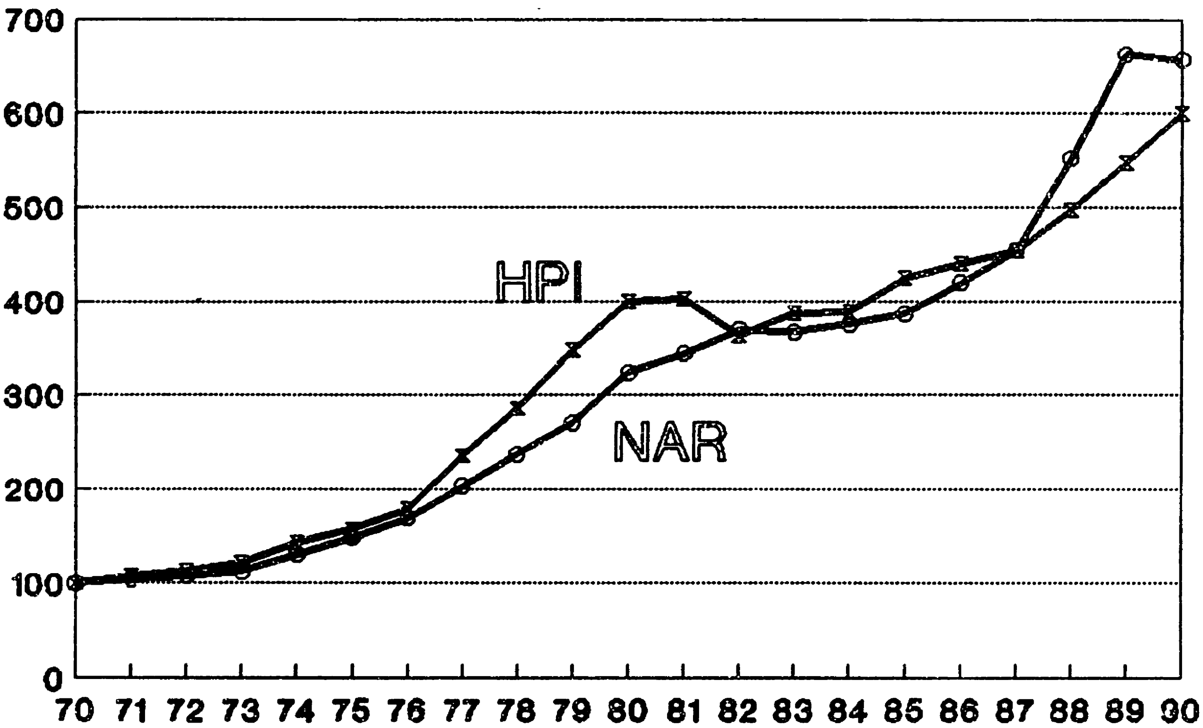
* Variable is in logs

Regression 1 (Table 3) also contains quarterly dummy variables, which are graphed in Figure 2. The results are compared and index of median sales prices for single family homes calculated by the National Association of Realtors. Although these series move generally together, there are also significant divergences, particularly from 1976-1982 and again after 1987. These relative movements may be explained by the use of different methodologies, or may be a result of varying price movements in the market for single family home versus the market for condominiums.

More surprising is the change in the auction effect when auction properties are split into separate groups for scattered site and single site auctions. (Regression 2) Scattered site auctions sell at almost a 25 percent discount, a result much more in line with previous studies, while single site auctions sell at close to the same predicted price as the rest of the sample. This result suggests that either these auctions are very different in terms of their marketing success or that the average quality of units sold at these different types of auctions varies widely.

Previous literature suggests that there are price declines during an auction. Regression 3 shows the results of separating auction units into 3 groups representing the first, second and last third of the auction. The difference between the coefficients for the first 1/3, middle 1/3 and bottom 1/3 sales provides only very weak evidence of a price decline during the auction. Although all coefficients are significant, it is impossible using conventional significance levels to reject that the coefficients are the same. This result contradicts other studies of real estate auctions by Gau, Quan and Sternberg (1990) and Vanderporten (1990) that find strong evidence of a price decline over the course of an auction.

FIGURE 2
COMPARISON OF PRICE INDICES



1970=100

As noted in the methodology section, the hedonic regression probably suffers from a selection problem which would affect the auction coefficients. Estimates from resale price equations (Tables 4 and 5) provide strong evidence of such a bias. Table 4 lists results from the RPI, while Table 5 shows quite similar results for the WRS, which corrects for possible heteroskedasticity. Although the correction does not significantly affect the auction results, a graph of the quarterly dummy coefficients (Figure 3) shows there is a small change in the price index, particularly later in the sample when some observations with a long time between sales received heavier weight in the RPI.

Figure 4 plots the compares plots of the quarterly dummy coefficients from the WRS and HPI equations. These indices appear to move together quite closely except for 1982, when the WRS takes a much sharper drop than the HPI. Both of these series, however, show a runup in condominium prices that is much faster than the increase in median single family home prices in the late 1970's and then a much sharper fall in prices in 1982. Later in this section we will explore whether these series differ because of methodological reasons or because they cover different sets of properties.

Using the WRS, the auction discount falls from 6.1 percent to 1.3 percent and is no longer significant. Breaking apart the data by sales type provides an even more striking contrast between the methodologies. Scattered site auctions (Equation 5) now show a discount of 9.5 percent (significant at the 2% level), compared with 24 percent in the hedonic equation. Measurement error is particularly pronounced in these auctions because properties come from the portfolios of large institutions and are usually of lower quality. In fact, many

Table 4

Regression Results, Resale Price Equation

(Standard Errors)

Dependent Variable	[illegible]	[illegible]	[illegible]
Methodology	Resale	Resale	Resale
Auction	-.0104 (.0288)		
Scattered Site		-.1090 (.0442)	
Single Site		.0459 (.0335)	
Top 1/3			.0049 (.0608)
Middle 1/3			.0007 (.0569)
Bottom 1/3			-.0287 (.0417)
N	17,891	17,891	17,891
R^2	.6697	.6698	.6697

* Difference of Log Prices.

<u>Table 5</u>

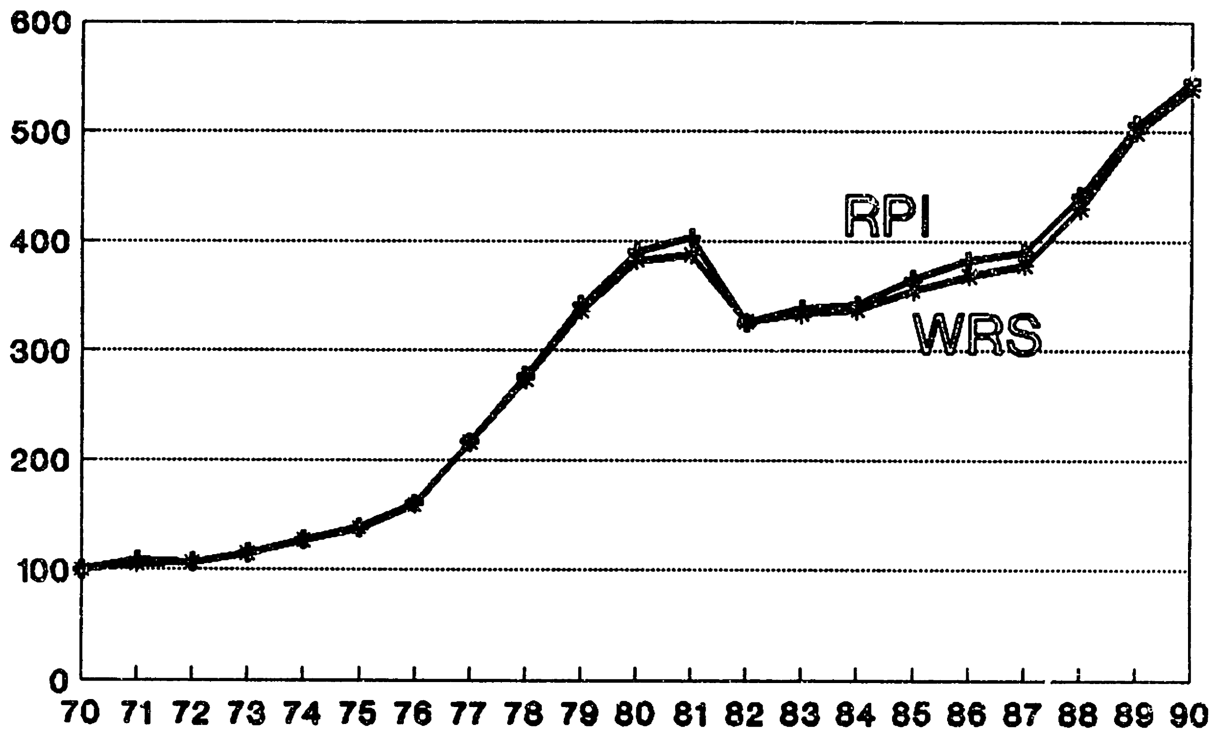
Regression Results, Weighted Resale Price Equation

(Standard Errors)

Dependent Variable	Price Diff.* (7)	Price Diff.* (8)	Price Diff.* (9)
Methodology	Resale (W)	Resale (W)	Resale (W)
Auction	-.0134 (.0234)		
Scattered Site		-.0951 (.0383)	
Single Site		.0351 (.0295)	
Top 1/3			-.0024 (.0509)
Middle 1/3			.0020 (.0491)
Bottom 1/3			-.0293 (.0363)
N	17,891	17,891	17,891
R^2	.6378	.6379	.6378

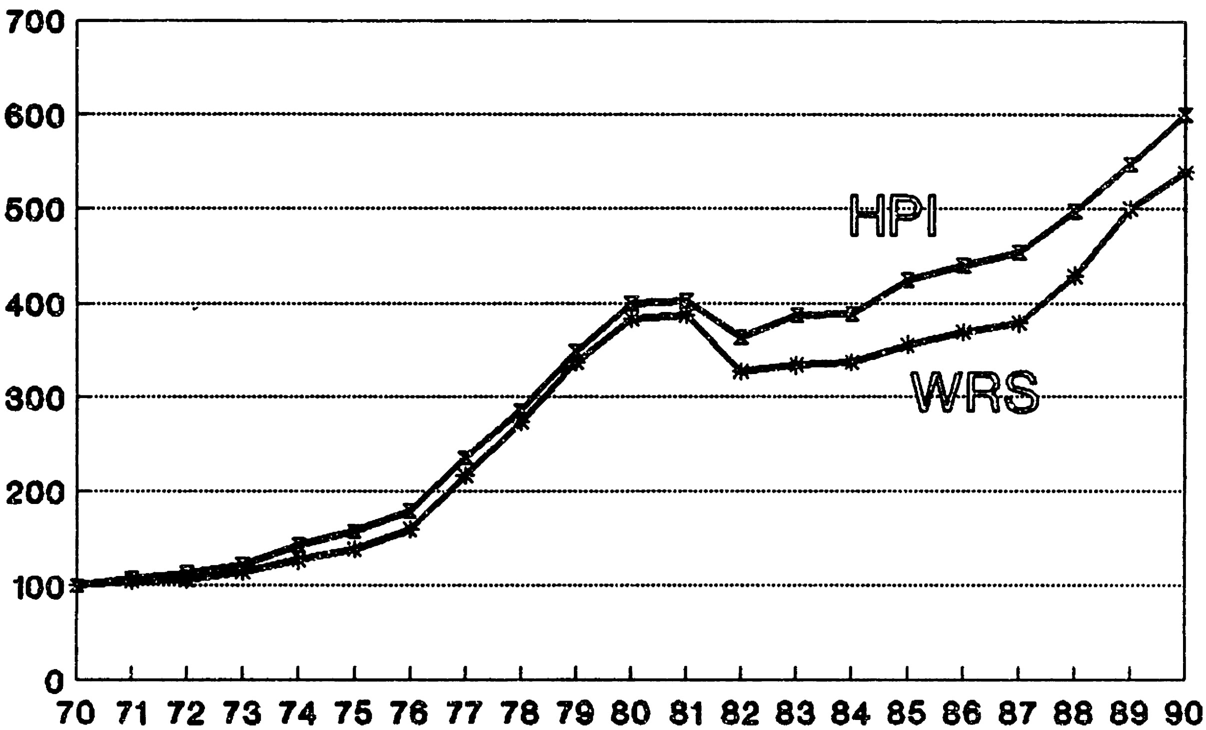
* Difference of Log Prices.

FIGURE 3
COMPARISON OF PRICE INDICES



1970=100

FIGURE 4
COMPARISON OF PRICE INDICES



1970=100

institutions auction units _because_ they are less desirable and harder to sell.

The changes for single site auctions are less dramatic, showing that properties at these 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. A likely explanation is that most of the single site auctions in the sample occurred between 1981 and 1984 and were still among the early auctions in Southern California. It is possible that these auctions received a lot of attention, both in the media as well as with potential buyers. Consequently, bids might have been higher than anticipated.[61]

The difference in premia between the single site and scattered site is quite pronounced, even in the WRS results. There are several reasons to expect these auctions to get different results. Some of the units in the scattered site auctions may have been in poor shape after having been previously occupied by owners that were evicted. Although deterioration is less of a problem for this sample than for other studies that include single family homes, it is still likely that the scattered site units were in worse average condition than the single site units. Because the included condition variable is an imperfect measure of changes in condition, some bias may still have occurred. 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

[61] The WRS was also run with separate dummies for the four largest single site auctions and alternatively with different auction dummies for each year to see if one particular auction or time period 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% level. The coefficients on the time dummies were less stable, mostly because there were few resales from auctions in some years.

a particular type of condominium in one location.

Evidence of price declines over the course of the auction is even less pronounced in the WRS results. Although neither methodology finds strong evidence in favor of a price decline, the point estimates in both cases show that there are some price declines in the last third of the auction.[62] The reduced difference between the WRS and HPI order coefficients, although not statistically significant, was expected due to the errors in variables problem mentioned earlier. 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.

Another reason the WRS and HPI result may differ is because they are estimated on a different set of properties. As was apparent in Table 1, resale properties are older, smaller and less expensive than properties that sell only once. Table 6 shows the results of running the hedonic model on the subsample of units that sold more than once, subsequently referred to as the HRPI estimates. This table makes clear that the differences between the repeat sale and hedonic estimates of the auction coefficients are due to methodology rather than different samples of data. Although some of the coefficients on the property characteristics move slightly between the WRS and the HRPI estimates, the HRPI equation still shows a much more significant auction discount than the WRS, both for all auctions as well as for scattered site

[62] In further tests, we divided the auction sales into the top 2/3 and bottom 1/3 and were still unable to reject the hypothesis that the coefficients for the two groups were the same.

auctions. One interesting point, however, is that the single site coefficient is closer to the WRS estimate than the HPI numbers, although all of these numbers are very close together.

A graph of the quarterly dummy estimates (Figure 5) provides evidence that not all of the differences between the WRS and HPI are due to discrepancies in properties being sold. Most often the HRPI appears to more closely track the HPI estimates.[63] However, there are some times, especially around 1982, that the HRPI seems to move closer to the WRS. It is interesting that during the 1982 recession, resold properties seemed to suffer a bigger price decline than other properties. A possible explanation is that owners that had purchased a unit in preceding years were more likely to be hit hard by the recession and forced to sell quickly, at a larger discount. Figure 5 also shows that resale price indices seem to have a lower rate of appreciation than indices measured with hedonic equations, probably because the former include the effect of depreciation on individual units, while the latter do not.

As discussed in the methodology section, depreciation also has the potential to bias the comparison between hedonic and resale price indices. Table 7 shows the results of including a control for sales of new properties (less than 5 years old) in the earlier WRS model. (WRSD) In all cases the coefficient on new houses suggests that they sell for a (significant) premium of approximately 3.4%. The coefficients on the auctioned properties show little change from the WRS results in Table 5, suggesting that depreciation is not driving the differences in auction coefficients between the methodologies. Figure 6 provides evidence that depreciation does affect the quarterly coefficients, biasing down the WRS results.

[63] Due to the large sample, the standard errors of the quarterly estimates are quite small. In 1982, the standard error was approximately 2% of the quarterly coefficient from the HPI regression and 5% of the coefficients from the HRPI and WRS equations.

Table 6

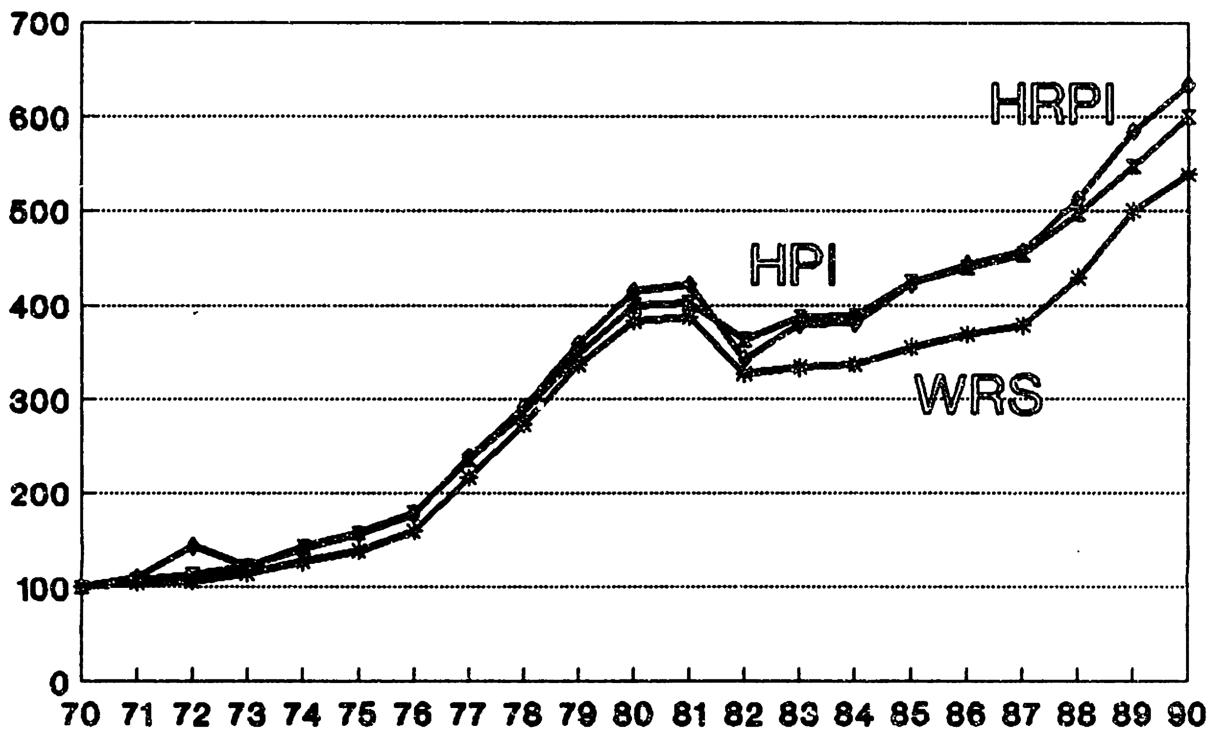
Regression Results, Hedonic Equation, Resale Sample

(Standard Errors)

Dependent Variable	Sales Price* (10)	Sales Price* (11)	Sales Price* (12)
Methodology	Hedonic	Hedonic	Hedonic
Intercept	2.940 (.100)	2.937 (.100)	2.942 (.100)
Bedroom	-.1952 (.0035)	-.1951 (.0035)	-.1953 (.0035)
Full Bath	.0888 (.0054)	.0887 (.0054)	.0890 (.0054)
Half Bath	-.0065 (.0056)	-.0066 (.0056)	-.0066 (.0056)
New	.0708 (.0050)	.0712 (.0050)	.0708 (.0050)
Square Feet*	1.057 (.011)	1.057 (.011)	1.057 (.011)
Auction	-.0557 (.0307)		
Scattered Site		-.2321 (.0522)	
Single Site		.0367 (.0378)	
Top 1/3			-.0884 (.0692)
Middle 1/3			-.0492 (.0656)
Bottom 1/3			-.1435 (.0484)
N	29,455	29,455	29,455
R^2	.6577	.6579	.6578

* Variable is in Logs

FIGURE 5
COMPARISON OF PRICE INDICES



1970=100

Table 7

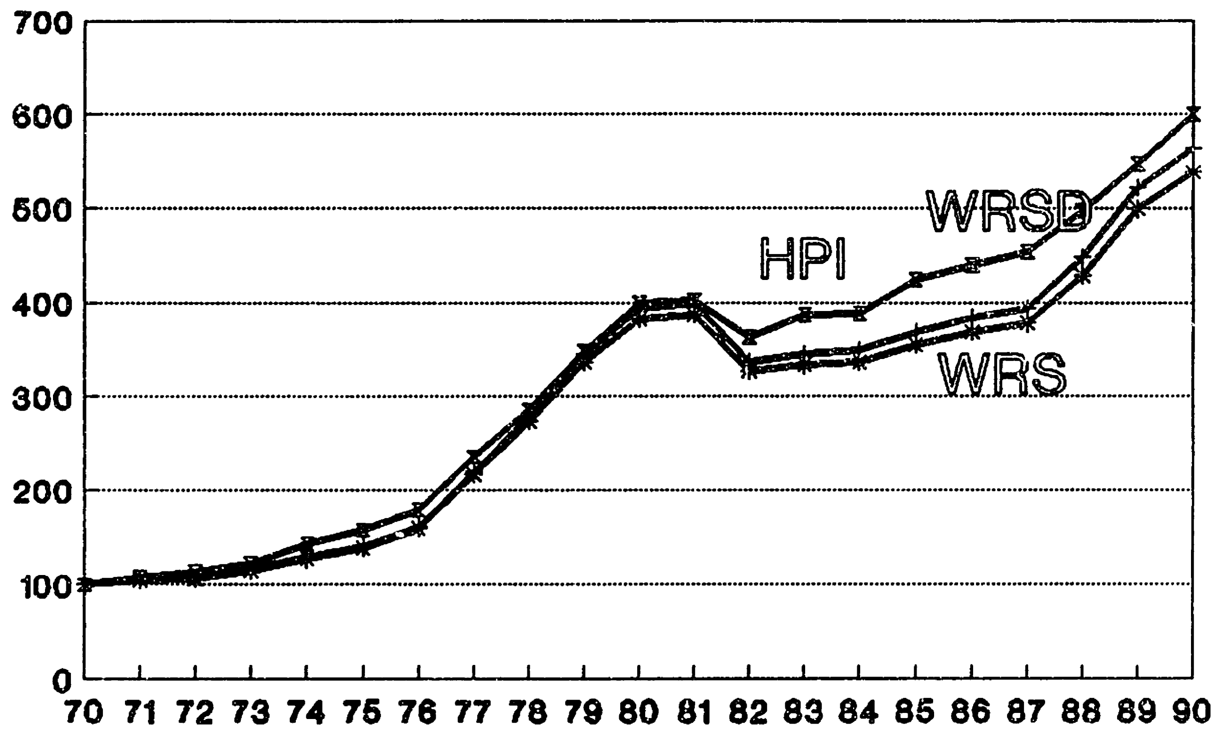
Regression Results, Weighted Resale Price Equation, includes New

(Standard Errors)

Dependent Variable	Price Diff.* (7)	Price Diff.* (8)	Price Diff.* (9)
Methodology	Resale (W)	Resale (W)	Resale (W)
New	.0342 (.0056)	.0347 (.0056)	.0343 (.0056)
Auction	-.0144 (.0234)		
Scattered Site		-.1015 (.0383)	
Single Site		.0371 (.0295)	
Top 1/3			-.0023 (.0509)
Middle 1/3			.0009 (.0491)
Bottom 1/3			-.0319 (.0363)
N	17,891	17,891	17,891
R^2	.6386	.6388	.6386

* Difference of Log Prices.

FIGURE 6
COMPARISON OF PRICE INDICES



1970=100

VII. Conclusion

The results from this paper clearly indicate that auctions are a viable method of selling real estate for large institutions able to take advantage of the economies of scale in running large sales. Estimates suggest that, overall, auctioned properties sell at little discount. When auctions are broken apart by sale type, scattered site auctions sell units at a 10 percent discount, while single site auctions actually get a small premium, although that premium is not significantly different from 0 at reasonable confidence intervals. Although these results differ from previous studies of US auctions that find much larger discounts, a comparison of methodologies suggest that previous work suffers from a selection bias problem, pushing auction coefficients towards finding larger discounts. This paper also finds marginal evidence supporting previous research that found price declines at auctions of various different types of goods.

These findings could have a significant impact on the disposition of large amounts of foreclosed properties and REO currently held by the RTC, FDIC and many remaining banks and savings and loans in the Northeast and the South. Current RTC policy is to auction the least expensive residential properties, while reserving many other properties to be sold through brokered sales. This research suggests that with holding costs averaging as much as 2 percent per month, the RTC and FDIC could lose hundreds of millions of dollars by not selling the bulk of their properties quickly at auction. In addition, the revenue gained from these sales would allow these agencies to act more quickly in taking over other insolvent institutions, further cutting the cost of the S&L bailout to taxpayers.

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. Also, can these results be replicated for commercial property? If a resale price index is impossible because of the lack of turnover, a case study approach may be productive for this question.

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Assessing the Performance of Real Estate Auctions

Chapter 3:

Evidence From Dallas

During the Late 1980's

I. Introduction

Real estate auctions in the US have followed downturns. This contrasts with the evidence in other countries, including Australia and New Zealand. Theory, presented in Chapter One of this dissertation, suggests that real estate auctions sell property at a discount, and that the discount increases as a market deteriorates. Subsequent empirical work in the Second Chapter looked at a sample of auctions in Los Angeles, finding that prices ranged from a 3% premium to a 10% discount, depending on the type of auction and the time of the sale. During the 1980's, the California real estate market was booming, although it slowed down a bit around the 1982 recession. This paper will follow up on the Los Angeles study by looking at a sample of real estate auctions in Dallas from 1985-1991. During that period, the Dallas housing market suffered a large, negative shock due to falling oil prices and the loss of jobs in the support industries of finance and exploration. The demand shock hit as supply had been growing rapidly. This provides a good test of the hypothesis that auction discounts should increase with higher vacancies and lower demand for housing.

The oil-price shock that hit Texas was both severe and unexpected. West Texas Crude fell from a high of $39 per barrel in 1980 to $28 late 1985. By the beginning of 1986, the bottom fell out and crude sold for $13 per barrel. The number of working rigs in Texas fell from a high of 4,520 in 1981 to about 700 in June, 1986.[64] This change hit as the national economy was experiencing strong growth, shaking real estate markets from Louisiana to Texas to Colorado. Because Dallas had a diversified local economy, it suffered less than most other oil-belt cities. For example, only 10.5% of Dallas' office space was occupied by energy

[64] See Melody and Wagley (1989), P. 162.

firms, compared to 45% in Houston.[65] Even with oil problems, employment and immigration growth in Dallas was positive for most of the 1980's, except 1987.

Many of the problems in Dallas real estate were much more attributable to overbuilding than changes in demand. The supply of real estate in Texas had grown substantially in the early 1980's due to tax and banking law changes. The 1981 tax reform made investments in commercial real estate much more attractive by liberalizing the treatment of depreciation and tax losses and allowing the creation of syndicates to pass along these benefits to individual investors. This resulted in a flood of new investments in commercial real estate across the country.

Further supply was added as Texas thrifts actively invested in local real estate markets, using funds gained by raising interest rates on savings accounts when these rates were decontrolled. As real estate markets began to fall, savings and loans began to invest in even riskier projects, adding to supply and hoping the market would improve. By 1985 there was a glut of 50 million square feet vacant in Dallas.[66] Residential property was also over built, condominiums more than single family homes, but the overbuilding was less severe. Prices of homes fell sharply, with condo prices down about 60% from peak and single family homes declining in value by 20%. This glut in supply and falling prices hit the banking industry hard. The number of Texas commercial banking organizations fell by 16% from a high of 1261 in 1986 to a low of 1019 in 1990. S&L's fell even further, declining by over 60%. Total banking

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[65] Brown (1986), P. 180.

[66] See Brown (1985), P. 179.

assets declined by 16% over that period, despite the turnaround in the economy after 1987.[67]

This paper explores the performance of real estate auctions in such a down market. It will confirm some of the basic conclusions of the Los Angeles chapter, including the finding that hedonic methodologies overestimate auction discounts. We find little evidence of price declines over the course of the auction. The paper will also test some of the predictions made in the first chapter, including the hypothesis that the auction discount decreases in larger markets and for properties with smaller differences in mismatch costs among buyers. Both of those conditions hold for new condominiums built to appeal to a wider audience of buyers, suggesting that these properties should sell at a smaller discount than the typical, older auction properties whose prices depend on a buyer arriving with a strong match to the individual property.

Theory also predicts that auction discounts should increase in a "down" market, with high vacancies and falling prices. Given the conditions in Dallas from 1985-1990, the auction discount should be larger than in Los Angeles. We look to see if the discount in Dallas increases as the market declines, but are able to find no conclusive evidence. Because the auction data in Texas is more varied than in Los Angeles, we will also be able to explore the price effect of absolute versus reserve auctions. Section 2 explores the data and creates price indices. Auction results are presented in Section 3, while Section 4 looks at negotiated sale prices of properties that "fell through" at reserve auctions. We conclude by putting these results in perspective and looking at future research topics.

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[67] See Clair (1991).

II. Data and Methodology

This study will use repeat sales indices to study the performance real estate auctions, as described in Chapter 2. In estimating the RPI, we will account for heteroskedasticity in the errors, as suggested by Case and Shiller (1987), using a weighted resale index (WRS). Heteroskedasticity occurs because the variance of ϵ increases with the time between sale. We correct for this problem by calculating a predicted variance and reweighting the original observations by the inverse of the predicted variance.

This paper looks at the Dallas housing market from 1979-1991. The 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. For residential properties, the DCAD collects many characteristics, including a unit's square footage, the number of bathrooms, the type of construction, age, a neighborhood cost factor for houses, amenities such as a pool or hottub and even an estimate of the property's condition. Because properties are not inspected every year, some variables are not filled in for all units, including the condition variable which only exists for a subset of properties.

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 appraiser's society, 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 in this data to use it for tax appraisal purposes. To the extent that biases exist, it is likely due to the underreporting of private transactions that do not involve a realtor or a bank appraisal.

Table 1 gives sample means of various characteristics for houses and condominiums in Dallas County that sold at least once between 1979 and 1991. Clearly this is a different market than Los Angeles. The average house is reasonably large, with almost 1800 square feet and 2 full bathrooms, yet sold for only $105,000. In reading the table, notice that sales prices were deflated to 1990 levels using the price indices calculated later in the paper and the age variable represents the age at the time of the sale. In Dallas, condominiums represent a small share of the total housing market and are much newer than the typical single family home, but are also smaller and less expensive. It is also striking to compare the means in Table 1 to those in Los Angeles County, where the average condominium is 1277 square feet, but costs almost $175,000 (1990$).

Auction information was obtained in visits to several firms that conducted auctions in Dallas County in from 1985 to 1990. The sample contains data on 21 English-style auctions, most of which were scattered site auctions in which large portfolios of different types of properties were sold off in one auction. The typical scattered site auction was commissioned by an institution such as a bank or government agency, took over a week to conduct in several different locations and contained as many as 3000 properties across Texas and possibly other states. Commercial land and structures were auctioned alongside single family homes and condominiums. One auction was a single site sale of 185 units in a condominium complex, with a published minimum price.

TABLE 1

Sample Means, Dallas

(Standard Errors)

	Single Family, Full Sample	Single Family, Auction Sample
Number of observations	139,480	234
Sale Price*	$104,316 (104,932)	$66,332 (75,431)
Square Footage	1799 (771)	1645 (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, Full Sample	**Condominiums, Auction Sample**
Number of Observations	10,423	235
Sale Price*	$47,051 (52,949)	$23,932 (21,860)
Square Footage	1062 (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)

* Sales prices are deflated by the weighted repeat sale index described in section V. to provide a constant means of comparing prices.

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 reserves.

The auction information was merged into the DCAD database using addresses to identify matched resales. Given the potential of mismatches or changes in a property's condition, the resale price data was filtered to ensure that for all matched auction sales, the unit in both sales contained the same reported number of bathrooms and square footage. We also looked for evidence of a change in condition, especially in auction properties.[68] Using recent appraisal forms, we removed all auction properties from the sample that were in poor condition on the grounds that these properties were likely to be fixed-up before a subsequent resale and/or had been allowed to deteriorate substantially from a previous sale. Either of these two 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

[68] Regressions were run with controls for properties that were either in excellent condition or poor condition, with little effect on the final results. These are not reported because of the severe drop in the number of observations with this information present, particularly among auction units.

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 properties, the improvement bias may still cause the WRS to overestimate the discount associated with auctions. The appraisal reports suggests that most auction properties are in worse than average condition due to their 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 preventative maintenance when they realized they would lose their home. Some previous owners even stripped their homes of all appliances.

The sample means from the auction properties (Table 1), show that these units are not typical for the market and that selection bias may be a large problem. As in Los Angeles, auction properties are a bit smaller and are in poorer neighborhoods than the average property and also sell for considerably less money. These tables suggest that either auctions sell at a big discount, or that there are other (unobserved) variables that affect the price.

IV. Empirical Evidence

Given the sample means for the auction properties in Table 2, it is not surprising that hedonic equations (Tables 2 and 3) show that auctions sell property at a large discount. Given that the left hand side of the hedonic model is ln(price), the coefficient of -.3851 is equal to a discount of 32% for single family homes, similar to other studies including Gau, Quan and Sternberg (1990) who look at land sales near Austin Texas, but larger than the discount found in the Los Angeles paper. Other coefficients in the hedonic equation seem quite reasonable.[69] Square footage has a price elasticity of over 1, probably because larger units are associated with higher quality, which is not included in the regression. The neighborhood cost factor estimated by the DCAD has a moderate effect on price, with a doubling of the cost index leading to a 29% increase in the house price. This may be due to the fact that more expensive areas have nicer houses and the DCAD index attributes "too much" of the price to the neighborhood as opposed to individual houses.

The condominium equation does not work as well, possibly because the DCAD does not produce a neighborhood cost factor for these units. The price elasticity of square footage is quite large and the coefficients on full and half bathrooms are even negative. The latter result may be due to half baths being associated with lower quality units. The coefficient on full bathrooms is marginally significant given the sample size, and may suggest that Dallas condominiums have little variation in the number of full bathrooms. As with single family homes, square footage seems to proxy for unobserved quality. The auction results here suggest a discount of about 19%, smaller than for single family homes, but much larger than found in Los Angeles.

The hedonic condominium and SF home equations give different interpretations of the performance of the various auction types. In these equations, three types of minimum price sales are grouped together: single site, minimum price sales; scattered site, minimum price sales; and scattered site, absolute auctions. Later equations will separate these auction types

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[69] The equations in Tables 5 and 6 also contained detailed controls for a property's age, with those variables being highly significant.

Table 2

Regression Results, Hedonic Equation[*]
Single Family Homes

(Standard Errors)

Dependent Variable	Sales Price[*] (1)	Sales Price[*] (2)	Sales Price[*] (3)
Methodology	Hedonic	Hedonic	Hedonic
Intercept	1.737 (.026)	1.737 (.026)	1.737 (.026)
Square Feet[*]	1.147 (.004)	1.147 (.004)	1.147 (.004)
Full Bath	.1590 (.0020)	.1590 (.0020)	.1590 (.0020)
Half Bath	.0948 (.0022)	.0948 (.0022)	.0948 (.0022)
Garage	.1156 (.0030)	.1156 (.0030)	.1156 (.0030)
Neighborhood Cost Factor	.2520 (.0039)	.2520 (.0039)	.2520 (.0039)
Auction	-.3851 (.0210)		
Minimum Price		-.3629 (.0390)	
Unpublished Reserve		-.3942 (.0250)	
Top 1/3			-.4131 (.0350)
Middle 1/3			-.4118 (.0380)
Bottom 1/3			-.3310 (.0362)
N	139,479	139,479	139,479
R^2	.7780	.7780	.7780

[*] Variable is in logs
[*] All equations also contain 60 dummy variables to control for the age of the property at the sale date.

Table 3

Regression Results, Hedonic Equation[a]
Condominiums

(Standard Errors)

Dependent Variable	Sales Price* (4)	Sales Price* (5)	Sales Price* (6)
Methodology	Hedonic	Hedonic	Hedonic
Intercept	1.255 (.106)	1.234 (.106)	1.247 (.106)
Square Feet*	1.408 (.014)	1.410 (.014)	1.409 (.014)
Full Bath	-.0247 (.0078)	-.0239 (.0078)	-.0243 (.0078)
Half Bath	-.1212 (.0094)	-.1203 (.0094)	-.1208 (.0094)
Garage	.0421 (.0142)	.0407 (.0142)	.0414 (.0142)
Auction	-.2134 (.0289)		
Minimum Price		-.0212 (.0452)	
Unpublished Reserve		-.3308 (.0358)	
Top 1/3			-.1183 (.0411)
Middle 1/3			-.2391 (.0415)
Bottom 1/3			-.3803 (.0662)
N	10,422	10,422	10,422
R^2	.7366	.7373	.7369

* Variable is in logs

a All equations also contain 30 dummy variables to control for the age of the property at the sale date.

and find they have different estimated discounts. Consistent with the LA study, single site auctions sell at a smaller discount than scattered site sales. Absolute auctions also seem to sell at a smaller discount. Because of the large number of single site sales, the estimated discount associated with minimum price auctions is much lower for condominiums. (Unpublished) Reserve auctions seem to get a large discount in both markets.

Tables 2 and 3 also give conflicting indications regarding a price decline over the course of the auction, as suggested by Ashenfelter and Genesove (1991), Vanderporten (1990) and Gau, Quan and Sternberg (1990). All of those studies looked at single site condominium auctions, which also explains the conflict between the results in the two markets. The condominium equation includes many sales from a large single site auction. As with the Los Angeles paper, the price decline goes away when estimated using a resale price equation. It should be surprising to find a price decline in scattered site auctions (e.g., single family homes), because these auctions involve very different types of goods. A house could be sold immediately following a commercial lot in another county or state.

Figures 1 and 2 graph the coefficients from the quarterly time dummy variables, showing the movements of nominal housing prices. Single family home prices rise steadily until 1985, when they begin to fall, suffering a decline of over 18% from peak, until they level off in 1990. Up to the peak, the various price indices seem to move together. The National Association of Realtors (NAR) index does not fully reflect the downturn, probably because the index is based upon median sales prices. That is consistent with results from Case and Shiller (1987) indicting that the NAR index is biased because of its dependence on the mix of houses sold at a given time. The hedonic (HPI) and resale (WRS) price indices seem to track each other quite closely during the whole period.

Nominal condominium prices suffer a much steeper decline after 1984, falling almost 60% over a five year period. The real decline was over 65%. This trend shows up in both the HPI and WRS indices, although there is much more noise than in the graph of SF home prices, which is based on a sample that is almost 25 times larger. Although condominiums may have been overbuilt because of tax law changes in 1981 and the Dallas economy did slow down after 1985, neither of these reasons is completely satisfactory. Another possibility is that banks responded to problems with commercial property by cutting back on loans to purchase condominiums, which became viewed as "too risky."[70]

Looking at the results of the WRS equations makes it clear, as in the Los Angeles paper, that hedonic price models significantly overstate the discount associated with real estate auctions. Tables 4 and 5 show that the estimated discount falls from 32% to 22% for SF homes and from 19% to 16% for condominiums. As with the hedonic model, the difference between the two types of homes is due to the inclusion of single site auction results in the minimum price sample for condominiums. Estimates for reserve auctions suggest discounts around 21% in both markets. These equations also show no evidence of price declines during the course of the auction. Hypothesis tests do not reject that the prices are the same during all phases of the auction.

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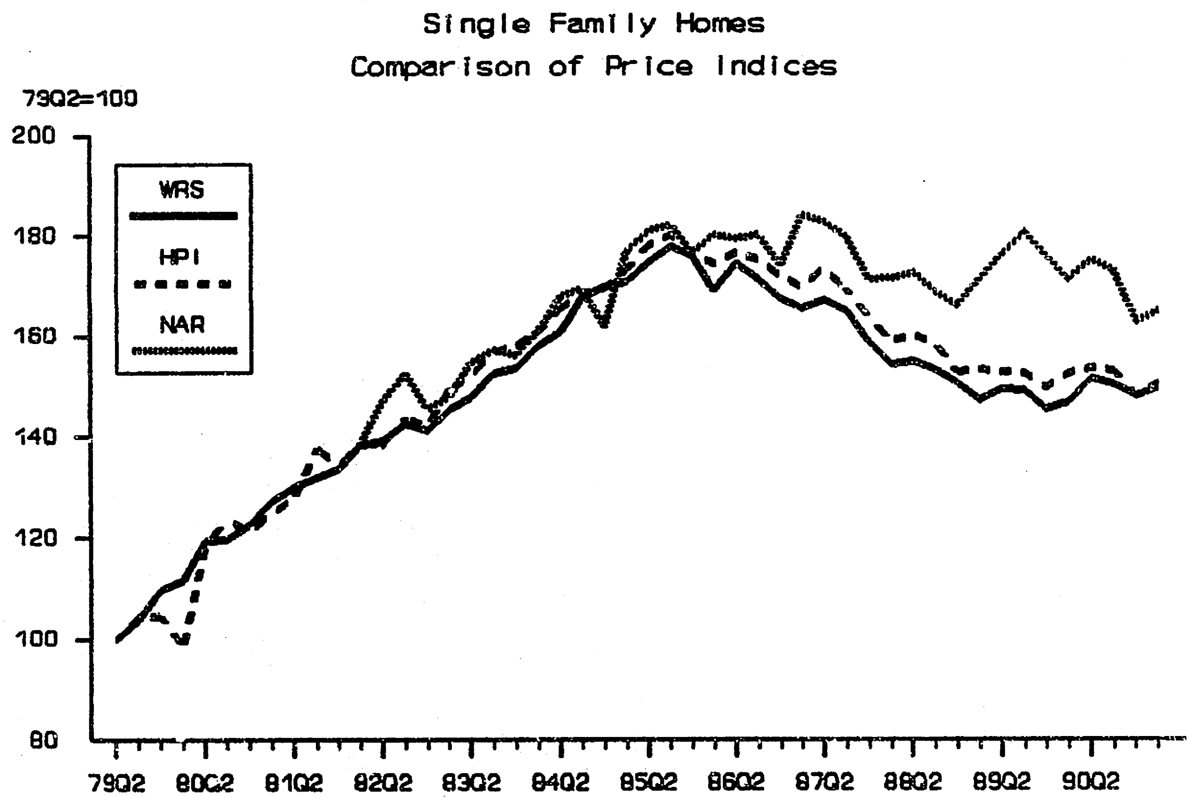
[70] Under this scenario, reduced liquidity made it difficult for owners to sell their condo's. In response, some owners decided to rent their units. The increase in rentals made many loans in many complexes ineligible for sale in the secondary market. Fannie Mae will only purchase loans in developments that have a minimum percentage of owner occupants. The lack of liquidity for condo sales might explain why their prices fell so much faster than SF home prices. A similar situation may have occurred in Boston during the boom of the mid 1980's. Many condo's were purchased by investors hoping for a quick profit. As the market fell, condos became difficult to sell with the result that over two-thirds of all condos were owned by investors. Condo prices fell over 35%, compared to a 20% decline in the value of SF homes. This is an area that is ripe for future research.

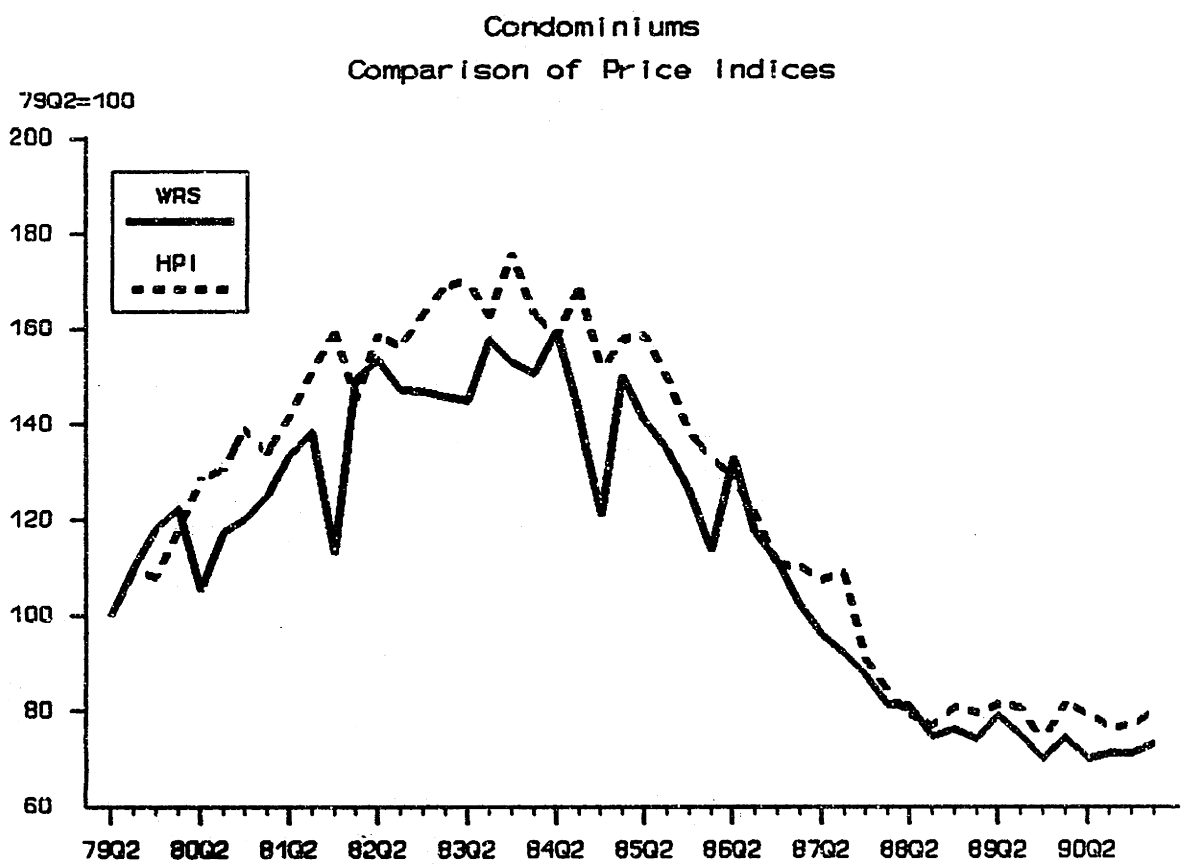
Figure 1



NAR Index available after 1982

NAR=WRS in 82Q1

Figure 2



Condominiums
Comparison of Price Indices
79Q2=100
200
180
160
140
120
100
80
60
WRS
HPI
79Q2
80Q2
81Q2
82Q2
83Q2
84Q2
85Q2
86Q2
87Q2
88Q2
89Q2
90Q2

Table 4

Regression Results, Weighted Repeat Sale Equation
Single Family Homes

(Standard Errors)

Dependent Variable	Sales Price* (7)	Sales Price* (8)	Sales Price* (9)	Sales Price* (10)
Methodology	Resale(W)	Resale(W)	Resale(W)	Resale(W)
New	.0416 (.0034)	.0416 (.0034)	.0416 (.0034)	.0416 (.0034)
Auction	-.2485 (.0299)			
Resale Before		-.2124 (.0651)		
Resale After		-.2581 (.0337)		
Minimum Price			-.2578 (.0564)	
Unpublished Reserve			-.2448 (.0353)	
Top 1/3				-.2270 (.0451)
Middle 1/3				-.2721 (.0620)
Bottom 1/3				-.2388 (.0512)
N	26,344	26,344	26,344	26,344
R^2	.3536	.3536	.3536	.3536

* Difference of Log Prices.

Table 5

Regression Results, Weighted Repeat Sale Equation
Condominiums

(Standard Errors)

Dependent Variable	Price Diff.* (11)	Price Diff.* (12)	Price Diff.* (13)	Price Diff.* (14)
Methodology	Resale(W)	Resale(W)	Resale(W)	Resale(W)
New	.0515 (.0201)	.0515 (.0201)	.0496 (.0202)	.0520 (.0202)
Auction	-.1729 (.0617)			
Resale Before		-.1681 (.0778)		
Resale After		-.1805 (.0977)		
Minimum Price			-.0386 (.0554)	
Unpublished Reserve			-.2379 (.0757)	
Top 1/3				-.2250 (.0814;
Middle 1/3				-.1096 (.0926)
Bottom 1/3				-.1150 (.3129)
N	1,292	1,292	1,292	1,292
R^2	.7141	.7142	.7145	.7143

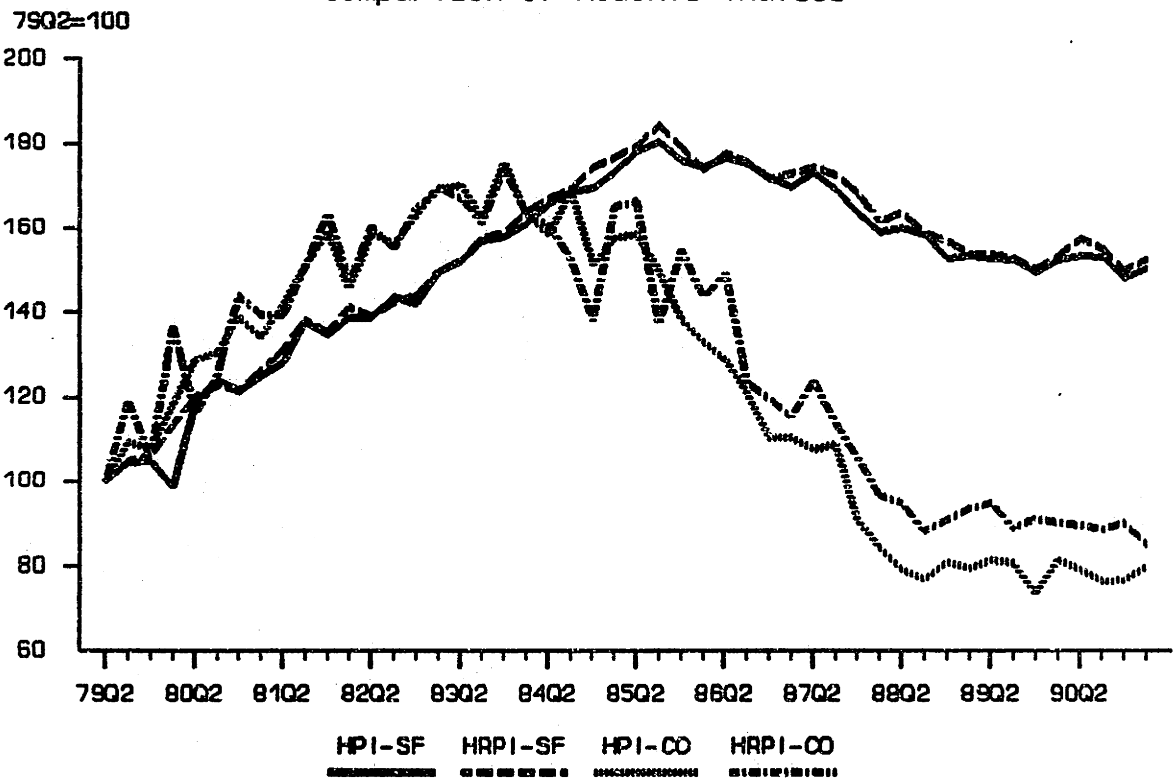
* Difference of Log Prices.

These tables also explore whether the discount is different if measured using sales before or after the auction. Most of the auctions are run by banks or government agencies, who obtained the properties through the foreclosure process. It is possible that the foreclosure is evidence that the previous buyer "overpaid" for the property, making the buyer more likely to face financial troubles or to just "walk away" given the loss of equity. If this scenario were true, it would suggest that (re)sales before an auction would result in a higher estimated discount than resales after the auction. Given the regression results, however, it is impossible to reject that the estimated discount is the same whether measured against pre-auction sales or post-auction sales.

Another potential bias in comparing results from the WRS and HPI equations is that these models use different data. If the mix of houses sold changes over time, it may bias the WRS estimates. For example, Poterba (1991) suggests that the 1986 tax reform caused high priced property to appreciate less quickly than lower priced units. To explore this question, we run the hedonic model only using houses that sell more than once in the sample. (HRPI-Hedonic Resale Price Index) The coefficients of the time dummies are graphed in Figure 3, which shows that, for the most part, the HPI and HRPI move in a similar pattern. Once again, the condo estimates show a lot of noise, but a similar pattern between the two indices. The regression results, which are not reported here, show that differences between the two estimates of the auction discount are within standard error bounds. The HRPI equation estimates an overall discount of 30% for SF homes and 16% for condos, compared with HPI coefficients of 32% and 19%, respectively.

Figure 3

Condos and SF Homes
Comparison of Hedonic Indices



So far, the results from real estate auctions in Dallas support the basic conclusions from the Los Angeles study: Hedonic indices overestimate auction discounts and repeat sales indices find little evidence of price declines during the course of an auction in the sample. The latter result was expected, given the predominance of scattered site auctions in this sample. We now look at two additional questions: Do auctions have larger discounts in "down " markets?; and How do auction discounts vary with the kind of auction and the type of reserve used?

In order to answer the latter question, we pool the data on SF homes and condos, running a single regression with the constraint that the auction discount be equal in both markets. All other (non-auction) variables are allowed to differ across the two housing types, including the quarterly time variables and the controls for housing characteristics. Hypothesis tests cannot reject that the auction coefficients are the same in both markets, once single site auctions are separated from other minimum price sales.

The results of the WRS equation using the combined sample are reported in Table 6. The weights for condominiums and SF homes were calculated separately, as the predicted variance for these two groups should be different given the differences in the price indices. Looking at equation 16, suggests that single site auctions do, in fact, get a smaller discount than scattered site auctions. A hypothesis test rejects equality of the single site and scattered site coefficients at the 13% level.[71] The confidence interval is low mostly because of the difficulty of estimating the single site coefficient with less than 10 resales. The difference here

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[71] The t value (equivalent to the F test for a single restriction) is 1.125 which is significant at the 13% level using the one-sided t distribution.

is consistent with the empirical results from Los Angeles, as well as the theory which predicts that units that are more homogeneous and appeal to a larger market will sell for a smaller discount. New condominiums are built for a broad based market, and require less of an individual match than the typical, older property.

It is also interesting to note that (published) minimum price and unpublished reserve auctions seem to get the same discount. As we discussed in Chapter 2, the difference between these two auction types is the information conveyed to buyers in the minimum price and the commitment to sell that is embodied in publishing the reserve. Because the scattered site auctions were run by banks with large real estate holdings and federal agencies, the commitment to sell might not have been an issue for buyers, regardless of the auction type. The literature on optimal auctions suggests setting the reserve based on the seller's valuation for a property, but most buyers knew, correctly, that these sellers had no independent (consumption) value above the opportunity cost of what they could get by selling in a future period. Because the institutions had little information that was not also observable about the properties, the minimum bid provided little help in determining a property's (market) value.

Using the WRS equation, we also attempt to separate out differences between absolute and (positive) minimum price auctions. Here the coefficients seem to be different, but large standard errors make it impossible to reject equality. Auctioneers claim that absolute auctions attract greater interest among buyers and consequently get higher prices. To further explore this issue, look at the combined results from the hedonic equation in Table 7. Although the hedonic equation continues to overestimate auction discounts, it is useful in comparing auction results within scattered site auctions where selection is not a large issue.

Table 6

Regression Results, Weighted Repeat Sale Equation
Combined Sample*

(Standard Errors)

Dependent Variable	Price Diff.* (15)	Price Diff.* (16)	Price Diff.* (17)	Price Diff.* (18)
Methodology	Resale(W)	Resale(W)	Resale(W)	Resale(W)
New (SF)	.0415 (.0033)	.0415 (.0033)	.0415 (.0033)	.0415 (.0033)
New (CO)	.0526 (.0198)	.0496 (.0199)	.0497 (.0199)	.0528 (.0197)
Unpublished Reserve	-.2407 (.0316)	-.2401 (.0316)	-.2401 (.0316)	
All Minimum Price	-.2083 (.0490)			
Single Site (Minimum Price)		-.0940 (.1128)	-.0940 (.1127)	
Scattered Site (Minimum Price)		-.2349 (.0544)		
Scattered Site (Absolute)			-.1802 (.1022)	
Scattered Site (Min. Price > 0)			-.2564 (.0642)	
Top 1/3				-.2245 (.0387)
Middle 1/3				-.2206 (.0511)
Bottom 1/3				-.2348 (.0505)
N	28,154	28,154	28,154	28,154
R^2	.4036	.4037	.4037	.4036

* Difference of Log Prices.

* SF homes and condominiums have separate dummy variables 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.

29

All of the scattered site auctions were conducted by large institutions from previously foreclosed properties, the only difference being whether or not the institution was taken over by a federal agency. Equation 21 clearly shows that absolute auctions get a smaller discount, with equality being rejected at the 2% level.[72] Although we are hesitant to use hedonic models to interpret the magnitude of the discount associated with different kinds of auctions, Tables 6 and 7 give similar rankings within scattered site auctions. The hedonic model is able to get more precise point estimates because it uses a larger sample.

Tables 6 and 7 also show the difference in the models in finding a decline over the course of the auction. Whereas the hedonic model shows a statistically significant (4% level) decline in prices over the course of the auction[73], the WRS equation estimates order coefficients that are virtually the same. Many auctioneers admit to putting better properties at the front of the auction to generate bidding interest and hedonic models have a difficult time controlling for this selection bias.

In addition to the results on auction types, there is evidence of increased discounts associated with "down" markets, as predicted by the previous model. Immediate evidence is that the auction discounts in a Dallas market that is declining during much of the late 1980's are much larger than in the Los Angeles market that is rapidly rising over the same period. As a further test, we looked within the Dallas market to see if discounts increased as the market fell. Table 8 reports the results of running the WRS model on the auction variables plus an

[72] The t value is 2.046 which is significant at the 2% level using a one-sided t distribution.

[73] 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% level with a one sided test.

Table 7

Regression Results, Hedonic Equation
Combined Sample*

(Standard Errors)

Dependent Variable	Sales Price* (19)	Sales Price* (20)	Sales Price* (21)	Sales Price* (22)
Methodology	Hedonic	Hedonic	Hedonic	Hedonic
Unpublished Reserve	-.3709 (.0194)	-.3673 (.0194)	-.3673 (.0194)	
All Minimum Price	-.1864 (.0274)			
Single Site (Minimum Price)		.0168 (.0448)	.0171 (.0448)	
Scattered Site (Minimum Price)		-.3074 (.0346)		
Scattered Site (Absolute)			-.2071 (.0600)	
Scattered Site (Min. Price > 0)			-.3573 (.0423)	
Top 1/3				-.2668 (.0247)
Middle 1/3				-.3288 (.0258)
Bottom 1/3				-.3484 (.0307)
N	149,903	149,903	149,903	149,903
R^2	.9992	.9992	.9992	.9992

* Variable is in logs.

* SF homes and condominiums have separate variables in the HPI equation. This is equivalent to stacking the regressions for the two groups with the restriction that the auction coefficients are equal.

term interacting the auction dummy with various measures of market performance. Unfortunately, none of these regressions are able to pick up significant evidence that auction discounts changed over the period. The coefficients are all the wrong sign and very close to zero.

The lack of evidence within Dallas may be a result of having most of the auctions in the sample in 1985-6 and 1990 periods when prices were more stable. A simple test of auctions before 1989 and after 1989 shows a marginally significant increase in the discount before 1989 when prices were falling faster. That result, however, does not control for the type of auction. Given the small number of auctions in the sample, it is difficult to find any trend within the Dallas market.

V. Post Auction Results

In looking at the seller's decision about whether or not to auction property, it is useful to explore what happens to properties whose sales fall through or do not have a bid that exceeds the seller's reserve. A recent article by Ashenfelter and Genesove (1991) looks at a condominium auction in New Jersey and finds that about a third of the units sell for almost 13% less than the auction bid price. Although the authors have found subsequent evidence modifying that result, another auction that had resales slight! ›bove the bid prices, this study can provide further evidence on this question. If units truly sell for lower prices following an auction, buyers should never bid at an auction, instead making offers afterward. A second argument made by some critics is that auctions sell at a discount because they "taint" a

Table 8

Regression Results, Weighted Repeat Sale Equation
Combined Sample[a]

(Standard Errors)

Dependent Variable	Price Diff.* (23)	Price Diff.* (24)	Price Diff.* (25)	Price Diff.* (26)
Methodology	Resale(W)	Resale(W)	Resale(W)	Resale(W)
Unpublished Reserve	-.2346 (.0312)	-.2371 (.0331)	-.0706 (.1692)	-.2059 (.0621)
Single Site (Minimum Price)	-.0876 (.1130)	-.0819 (.0932)	.0615 (.1751)	-.0808 (.0925)
Scattered Site (Absolute)	-.1438 (.1004)	-.1474 (.1002)	.0337 (.2048)	-.1221 (.1061)
Scattered Site (Min. Price > 0)	-.2561 (.0646)	-.2546 (.0648)	-.0947 (.1763)	-.2166 (.0990)
Change in Mkt. Price, 1 QTR	-.0171 (.4304)			
Change in Mkt. Price, 2 QTR		-.0884 (.3967)		
Price Level, Lagged 1 QTR			-.1090 (.1108)	
Pred. Sales Volume ($*10^3$)				-.0110 (.0209)
N	28,154	28,154	28,154	28,154
R^2	.4421	.4421	.4421	.4421

* Difference of Log Prices.

[a] SF homes and condominiums have separate dummy variables 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.

property as undesirable.[74] Those who make this argument, including many real estate brokers and developers, claim that auction properties will sell at a discount well into the future because they are assumed to be low quality.

Theory, however, predicts that subsequent resale prices should be higher than the auction prices, particularly for units that are sold through negotiated sales well after the auction. For the same reasons that auctions sell at a discount, subsequent negotiated sales should get a premium. The subsequent resale premium should be particularly large given that the seller presumably rejected bids in expectation of selling at a higher price.

Table 9 summarizes the outcome of all single family properties that were offered at auctions in the sample. One striking figure is the "fall through" rate for minimum price auctions. That rate was driven by a single-site auction of 178 units, of which 85 failed to sell at the posted minimum price. This auction shows what can happen if an extremely large number of properties are auctioned, given a limited market. By late 1986, the condominium market was in the middle of a huge decline. (See Figure 2 which graphs condominium price indices.) The posted minimum prices protected the seller from low prices, but left a large unsold inventory. At that point, given the possible lack of liquidity in the condominium market, the owner chose to rent the remaining units. Except for that extraordinary sale, which would have had the same problems no matter what type of auction was chosen, minimum price auctions have very low "fall through" rates. One auctioneer who uses mostly minimum price sales claimed rates of several percent, which is consistent with this data. Reserve auction properties fall through more often, mostly because auction bids are rejected by the seller.

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[74] For example, see Ginsburg (1991).

Table 9

Data Summary, Combined Sample

ALL PROPERTIES

	Total Properties	Fell Through
Reserve Auctions	416	87 (21%)
Minimum Price Auctions	244	88 (36%)
Total	660	175

PROPERTIES THAT FELL THROUGH

Minimum Price Auctions:

	3	No subsequent resale information was available.
	85	No bids exceeded the minimum price at the auction. These properties were part of a single site sale of 178 units. The unsold properties were placed in the rental market after the auction and there is no evidence of subsequent resales through 1991.
Total	88	

Reserve Auctions:

	33	Have information on auction bid that fell through, as well as the subsequent resale price.
	10	Have no information on the auction bid, but do know the subsequent resale price.
	44	Have no information on the subsequent resale price.
Total	87	

Table 10

Data Summary, Subsequent Resales of Auction Properties

I. Properties that are sold by the auction company at prices different than the winning bid.

Total Number:	19
Average % Discount:	17.2%
Total- Bid Amount:	$957,900
Total- Final Sale Price*:	$951,800
Average Discount:	.6%

II. Properties that resell less than a year after the auction, not by the auction company.

Total Number:	19
Average % Discount:	21.5%
Total- Bid Amount:	$1,250,750
Total- Final Sale Price*:	$1,441,800
Average Discount:	15.3%

Properties that resell more than a year after the auction, not by the auction company.

Total Number:	14
Average % Discount:	.98%
Total- Bid Amount:	$1,397,350
Total- Final Sale Price*:	$1,530,420
Average Discount:	13.0%

* All final sales prices were discounted to the auction date using the WRS price index calculated in Section IV.

Data in Table 10 provide strong support for the above theory. The first section shows resales of properties by the auction company, which collects a commission on sales that they arrange within a month of the auction date. These are usually units that fall through due to financing problems or confusion about the winning bid and are resold to losing bidders from the auction. The average discount of less than 1 percent is almost exactly equal to the discount found by one auction company that studied 2 years of its sales/resales.

Consistent with the search framework, negotiated sales well after the auction get a premium of 13-15%, depending on the length of time after the auction. These properties were sold well after the auction by a firm other than the original auction company and were likely purchased by buyers that did not attend the auction. Before concluding that these sales were a success, however, remember that the sellers faced substantial holding costs of 1-2% per month while waiting for a sale. It was these costs that caused the sellers to choose auctions to sell their property in the first place. The estimated discount from the auction bid for these sales was actually less than the 22% that would be predicted using the earlier regressions. This may provide evidence that the methodology used in this paper can overestimate the auction discount for the types of sellers used in this study, such as the government and bank sellers. Because these owners face high holding costs, they are more likely to accept a lower price, rather than holding out for more money. Thus a comparison with a market of mostly owner-occupants would overstate the discount for large institutions, although it would be correct for the typical seller.

VI. Conclusion

This paper verifies the basic conclusions of the Los Angeles study, including the fact that hedonic models overstate auction discounts and can provide misleading conclusions about the behavior of prices during an auction. Consistent with the theory, it finds evidence that scattered site auctions sell at a larger discount than the more homogeneous sales of single site condominiums. The larger discount found for Dallas auctions as opposed to Los Angeles sales support the prediction that "down" markets are associated with larger auction discounts, although there was very little evidence of a movement in the discount within the Dallas market as conditions changed.

Comparing various auction types, publishing a reserve price does not effect estimated auction prices, although there is some evidence that absolute auctions get slightly better prices than auctions with a positive reserve price. That result, which differs from theory, may be due to an endogenous number of bidders. In other words, an absolute auction signals a firm commitment to sell, giving potential buyers an additional incentive to inspect auction properties and attend the auction. That may result in more bidders and higher prices, although there is also an increased risk that the property will sell for a low price if few buyers turn out at the auction. The lack of an effect of a published reserve price may be because 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.

Future research can focus on several empirical questions. 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, how much? This paper provides a baseline that can be used to do simulations of the decision faced by a large owner 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, although it might be difficult to establish a control using a resale price index. Finally, the radically different movements of prices in the condominium and single family home markets is suggestive of some underlying problems in the way condominiums are financed. Although those problems have little to do with auctions, they seem to have very large effect on prices within a given market.

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