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Equity and Time to Sale in the Real Estate Market

By DAVID GENESOVE AND CHRISTOPHER J. MAYER*

Evidence from the Boston condominium market of the early 1990's reveals that an owner's equity position determines his experience as a seller. An owner of a property with a high loan-to-value ratio sets a higher asking price, has a higher expected time on the market and, if he sells, receives a higher price than an owner with proportionately less debt. The down payment requirement for purchasers, but not incumbent owners, provides a simple explanation for this phenomenon among owner-occupants. The results provide supporting evidence for equity-based aggregate theories of price-volume movements in the housing market. (*JEL* R31, D83)

Evidence from the Boston condominium market of the early 1990's reveals that an owner's equity position determines his experience as a seller. An owner of a property with a high loan-to-value (LTV) ratio sets a higher asking price, has a longer time on the market and, if he sells, receives a higher price than an owner with proportionately less debt. The effects are large. A unit with an LTV of 100 percent has a list price that is 4 percent higher than a unit with an LTV of 80 percent and, if sold, obtains a price 4 percent greater than the second one. On average, it will remain on the market 15 percent longer than the second unit. This is true both for owner-occupants and investors.

These regularities are difficult to reconcile with perfect asset markets in which different sellers with identical units face an identical offer distribution for their properties. However, the combination of a down payment requirement, which is common in most new mortgages, and falling house prices provides a possible explanation for the behavior of owner-occupants. The typical seller relies on the proceeds from the sale of his existing home to purchase the next home.[1] Consider a seller who must move for exogenous reasons. If housing prices have fallen (as in Boston in the early 1990's), the seller will have incurred an equity loss on the current home. If the price decline is great enough, the remaining equity will not suffice for a down payment on a home of equivalent value. If one assumes that the unit could be sold at a single "market" price, the owner would either have to move to a home of much lesser value (because minimum down payments are proportional to housing values), or forgo moving altogether. If the owner chooses the latter course, he is, in effect, "locked in" to his home because of the asymmetric treatment of housing purchasers (who are required to contribute some equity) and incumbent owners (whose equity positions may deteriorate without their being evicted from their homes).[2]

Our sample contains only condominium owners who put their homes on the market, and so the key to understanding the empirical evidence lies not along the extensive margin

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[1] Surveys from the Chicago Title and Trust Company show that for the average repeat buyer, more than one-half of the down payment for the new home comes from equity obtained from the sale of the previous property.

[2] See Jeremy C. Stein (1995).

of "move" or "do not move," but in the choice of reservation price. Along this intensive margin the seller faces the trade-off between the expected transaction price and the expected time to sale, both of which are increasing in the reservation price.

A financially constrained seller will choose a higher reservation price for two reasons. If insistent upon moving only to a comparable unit, the owner must set the reservation price at no less than the sum of the minimum down payment required on such a home and the balance outstanding on the existing home plus transaction costs (real estate agents' fees, moving costs, etc.). If the owner is prepared to move to a lesser unit, he still would set a higher reservation price than if he were not equity constrained, for every extra dollar received from the sale of the existing home will give him more than a dollar's worth of additional housing value (five dollars more if the down payment required is 20 percent of the purchase price). Furthermore, the optimal reservation price will be decreasing in the owner's equity so long as the disutility in moving to a lesser home is convex in the quality difference between that and the preferred home.

Because both time to sale and transaction prices are increasing in the reservation price and should not be otherwise determined by equity, and to the extent that asking prices reflect reservation prices, this argument rationalizes the empirical results. Note that it also predicts a threshold effect. Owners whose equity stake is sufficiently high that they are unconstrained should be insensitive to small changes in their LTV; only among the constrained owners should we expect to find any responsiveness to equity. Thus both time to sale and the transaction price should be sensitive to LTV only above the maximum share of the sale price that can be borrowed upon purchase. We find such a threshold effect at an LTV of 80 percent for both the log-duration (time to sale) and transaction prices. Housing equity has little effect on the behavior of sellers who have an LTV below 80 percent.

The argument outlined above is a story about trading homes; there is no reason why it also should apply to investors. But our evidence shows that investors with high debt levels also are sensitive to equity. We offer a simple explanation of why this is so.

When the offered price to a seller falls short of the difference between the value of an owner's other assets and the outstanding loan balance, selling the unit will cause the owner to default on the loan. Thus, so long as rent and tax depreciation are sufficient to cover the scheduled mortgage payments, the owner is better off continuing to hold the property and waiting for it to appreciate.[3] In essence, he holds a put option. The value of the option is positive if prices follow a random walk (as in an asset model), and greater still if the long-run returns to holding real estate in a down market are positive, as suggested by Karl E. Case and Robert J. Shiller (1989) and Richard Meese and Nancy Wallace (1993). For this reason, we expect investors who own units with high LTVs to attempt to avoid default by setting high reservation prices. Consequently, investor-owned units with little equity will take longer to sell and obtain higher prices.[4]

These results may help explain one of the most distinctive and puzzling macro features of the market for existing homes. Falling real estate prices typically bring in their wake a large increase in the inventory of unsold homes on the market, and an accompanying decline in sales volume. This positive price-volume correlation, an anomaly from the perspective of a perfect asset market, often is attributed to a presumed reluctance of home owners to sell after experiencing a drop in the market value of their homes. Stein (1995) provides a rational explanation for this reluctance to sell in a formal

[3] If the rent falls below the mortgage payments, holding the property remains the optimal policy so long as the option value exceeds the cash outflow.

[4] Although the argument applies to owner-occupants as well as investors, it is less relevant for owner-occupants because they face a higher cost of default. Home owners who default will find it almost impossible to purchase another home for seven to ten years, and they face the possible seizure of other assets. Because investors can more easily shield their assets—including their personal residences—through incorporation or the "homestead" exemption, they face a lower cost of default. Consequently, an owner-occupant with the same equity position is more likely to accept any given offer, possibly putting up other assets to pay off the mortgage, when an investor would choose to wait for a higher price, even if waiting carries a greater risk of default. For this reason, lenders generally require greater initial equity from investors, and investors still have default rates that are two–three times higher than owner-occupants.

model which shows how down payments and other borrowing constraints can add a self-reinforcing mechanism to demand shocks, and so generate a positive price-volume correlation at the aggregate level.[5]

The remainder of the paper is organized as follows. Section I describes the data. Section II presents estimates of a duration model of sale, and Section III, estimates of the regression of price on LTV. The next section explores the extent to which a higher reservation price is reflected in a higher asking price for a property. Section V, which concludes the paper, discusses implications of the equity hypothesis and future directions for research.

I. Data

This paper uses data from the Boston condominium market between May 1, 1990 and December 31, 1992, a period of substantial decline in the market. In May 1990, prices were nearly triple those of eight years previous but had just started to decline. Sales had already declined by over one-third from two years previous. Subsequently, prices would fall by almost 20 percent in 1990 alone, to be followed by a 10-percent drop over the next two years. Sales would rise slightly between 1990 and 1992. These years form an appropriate time period for testing the equity hypothesis, which presupposes an unanticipated price decline.

Listing data were obtained from Listing Information Network, Inc. (LINK), a privately owned listing service not associated with broker groups like the National Association of Realtors. Over this time period, LINK claims to have had a 90- to 95-percent market share in its coverage area, which includes Central Boston (Back Bay and Beacon Hill), Charlestown, and South Boston.[6] LINK has weekly records of all properties listed, including the asking price, the realtor's name, and the property's street address. (Although LINK allows properties to be listed concurrently by up to three brokers, listings were combined to a single record for each property in a week, regardless of the number of brokers involved.)

To supplement LINK, information on property characteristics and assessed tax valuations was obtained from the City of Boston Assessor's Office for all units in the three neighborhoods. The assessor's data indicate for each year whether the owner applied for a residential tax exemption.[7] We classify all units that an exemption was applied for as owner-occupied, though clearly there is room for misclassification. Finally, Banker & Tradesman, a private firm, supplied sales prices and mortgage amounts for all property transactions between 1982 and 1992, including sales and refinancings, but not foreclosures.

LINK properties were included in the sample if they could be matched into the assessor's data.[8] Some listings correspond to the same property being listed more than once (multiple spells). Because of the possibility of an address mismatch in a given week, or brokers gaming to get a property designated as a "new listing," a listing was considered new only if there was at least a four-week window since it last appeared in LINK. When a property exited from LINK, its destination was labeled either "sale" or "off-market," according to whether a sale transaction record was found in LINK.

The mortgage balance was calculated for all properties that sold or refinanced at least once after 1982, using the latest transaction available from Banker & Tradesman, and under the assumption that the owner used a 30-year fixed mortgage at the prevailing mortgage interest rate. Some transactions could not be matched with the assessor's data and were discarded.

We normalized the mortgage balance by dividing through by an estimate of the market value of the home to obtain the LTV. Two different estimated values were used—the

[5] Alternatively, William Wheaton (1991) uses a search model to generate a positive price-volume correlation in the market for existing homes. In that model, increases in the probability of an exogenous need to move leads to both higher prices and greater trade in the steady state.

[6] LINK lists some condominiums in East Cambridge as well as some one- to four-family properties in the city of Boston, but that information was eliminated to maintain a well-defined market.

[7] In Boston, owners can obtain a tax exemption equal to 10 percent of the city's average property tax bill by certifying that the owner lived in his/her unit on January 1 of a given tax year.

[8] A listing that failed to match had an address that was too vague for exact matching or was different from the property's legal address. The initial matching by computer was followed by a round of matching by hand.

property's official assessed value and the previous sale price, adjusted by a resale price index. The Boston assessor's office computes a value based on both a hedonic method and the median price of five comparable units from recent sales.[9] Where the two methods differ significantly, the property's valuation is investigated further by the assessor's office. Only sales that occur prior to the assessment date are used to determine the official value. The resale price index is calculated on a quarterly basis using the value-weighted arithmetic method as in Shiller (1991) on matched sale pairs in the LINK coverage area.

We chose to focus on assessed values. Although the previous sale price captures the idiosyncracies of individual properties, it also reflects the vagaries of the previous transaction itself, such as below-market transfers of properties and distressed sales. Also, because of the relatively small size, the resale price index is a very noisy estimate of the general market level of prices. As will be seen in the next section, however, it makes little qualitative difference which estimated value is used. Out of a total of 8,041 listings in LINK, 5,838 were successfully matched to the assessor's office data. We dropped properties that lacked information on a previous sale, or that had an observed LTV greater than 2. This shrank the sample to 2,381 observations (if LTV is calculated from the assessed value) or to 2,354 observations (if LTV is calculated from the previous sale price).

Table 1 presents the means of various property characteristics for the whole sample, as well as various subsamples. The sample is restricted to condominiums in the LINK coverage area, broadly defined. Because Boston does not delineate neighborhoods in the same way that LINK does, the whole sample includes some properties that are unlikely to have been listed in LINK even if they were for sale.

The average condominium has a tax assessment of almost $200,000, but contains less than 1,000 square feet of finished space. Over one-half of all owners did not claim the residential tax exemption, suggesting that a large number of units are owned by investors and rented as apartments. LINK units are slightly larger and more expensive than the average for their area, and contain a higher proportion of owner-occupants. Investor units are on average smaller and more highly leveraged than condominiums possessed by owner-occupants. The average condominium owner has a significant amount of debt, with the mean LTV of the sample as a whole at 61 percent. Figure 1 shows the distribution of LTV, and it is clear that the degree of dispersion in LTV is quite large. Furthermore, almost 40 percent of all owners have a ratio that exceeds the threshold level of 80 percent.

[9] There is some adjustment of prices for small differences in attributes in this method as well.

II. Duration on the Market

This section estimates the effect of equity on the expected number of weeks that it takes a property to sell. Not all properties in the sample are observed to sell, however. Some units remain listed but unsold at the end of our sample period, December 1992, and so are right censored. Others are de-listed without sale (go "off-market"), and so are considered to be censored at their time of exit. Although some properties go "off-market" because of exogenous changes in the conditions of the household, others exit when the owners become discouraged. A few properties are foreclosed upon, and their exits, too, are regarded as "off-market."

As a preliminary step, Table 2 shows the percentage of sold, "off-market," and right-censored observations, by level of LTV, in the LINK sample. Consistent with the equity hypothesis, high LTV properties (above 80 percent) are both less likely to sell and more likely to be withdrawn from the market than low LTV properties. This is true for the sample as a whole, though it is more evident when the data are categorized by year.

Because of the likelihood that LTV is correlated with other property attributes or differences in entry conditions, we model the time that a property is on the market as a function of attributes of the property and the owner, as well as the date the property first entered the market. Table 3 presents estimates of several different duration models. The dependent variable in all of the columns is the number of weeks a property is on the market, and is measured in logs.

TABLE 1—SAMPLE MEANS (STANDARD DEVIATIONS)

Variable	(1) All units	(2) LINK listings	(3) Owner-occupants	(4) Investors
Number of observations	21,446	2,381	1,320	1,061
1991 assessed value[a]	197,240	213,693	227,729	196,232
	(140,540)	(134,323)	(126,520)	(141,569)
Computed loan balance as of 5/1/90	101,814	181,195	193,493	165,894
	(152,085)	(122,153)	(119,154)	(124,149)
Loan/value[b] calculated using resale price index	0.53	0.65	0.67	0.62
	(0.35)	(0.55)	(0.48)	(0.63)
Loan/value[b] using assessed value	0.48	0.61	0.64	0.57
	(0.34)	(0.42)	(0.40)	(0.44)
Square footage	908	973	1,002	856
	(480)	(460)	(477)	(424)
Total rooms	3.7	3.8	4.0	3.6
	(1.3)	(1.3)	(1.3)	(1.3)
Bedrooms	1.5	1.5	1.6	1.5
	(0.7)	(0.7)	(0.7)	(0.6)
Full baths	1.2	1.2	1.2	1.1
	(0.5)	(0.4)	(0.5)	(0.4)
Half baths	0.12	0.14	0.17	0.11
	(0.33)	(0.35)	(0.38)	(0.32)
Floor of unit	4.0	3.5	3.4	3.5
	(5.1)	(4.4)	(4.3)	(4.4)
Parking spaces	0.20	0.19	0.19	0.18
	(0.44)	(0.45)	(0.49)	(0.41)
Owner-occupant	0.43	0.55	1.0	0.00
Year built		1903	1898	1909

[a] Boston assessor's office prediction of January 1, 1990 value, using information prior to that date only.
[b] Calculated for all properties with a previous sale and an estimated loan/value < 2.

The first column shows the results from ordinary least-squares (OLS) analysis. The coefficient on LTV is positive and significant. But the presence of censoring, of whatever source, causes OLS estimates to be biased and inconsistent (see Nicholas M. Kiefer [1988], for example). The next two columns show the results of using maximum-likelihood censored regression techniques. The estimates in column (2) assume the residuals from the duration equation are distributed normally, while the estimates in the next column assume the extreme value distribution for these residuals, equivalent to a Weibull regression, and of which the exponential distribution is a special case. Because of the possible dependence of the results on distributional assumptions, the final column incorporates the nonparametric technique for censored data proposed in Jonathan Buckley and Ian James (1979).[10]

[10] The Buckley-James estimator is defined by the solution to a modification of the least-squares normal equations, in which, for the censored observations, the dependent variable is replaced by its expected value

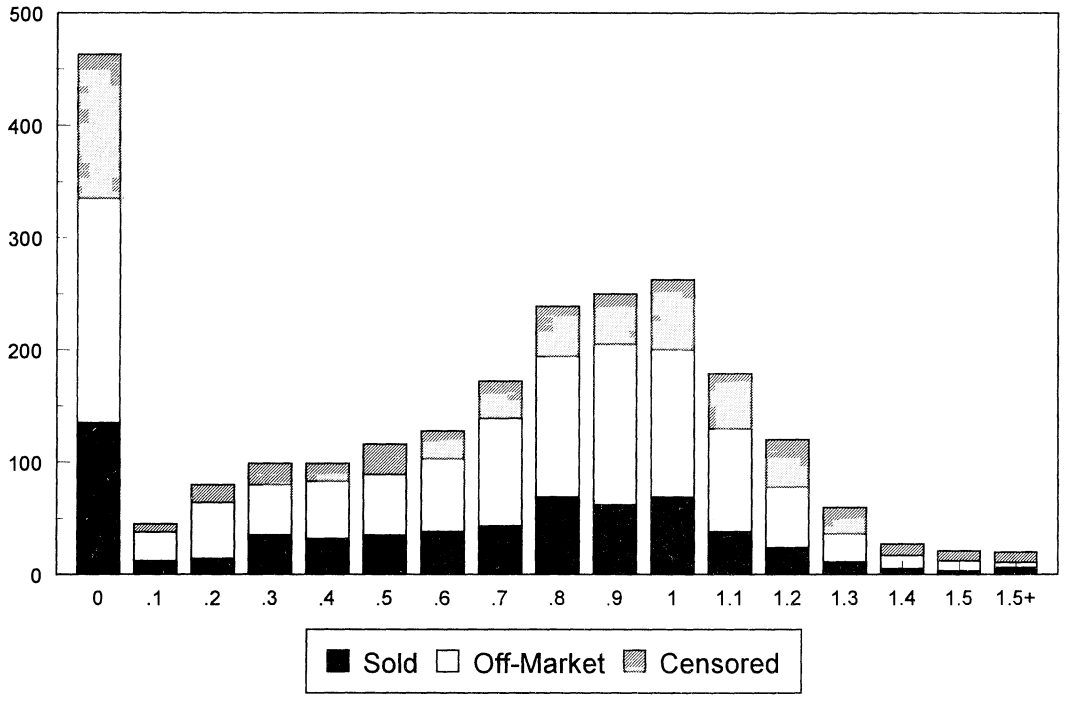

FIGURE 1. LOAN-TO-VALUE CATEGORIES

The evidence strongly favors the conclusion that higher LTVs decrease the log-duration.

As the first row indicates, the coefficient on LTV is positive and highly significant in all of the estimation procedures. The OLS estimate is much smaller than the rest, which, except for the confounding effects of the correlation of LTV with the other independent variables, is to be expected. The LTV coefficients for all three censored regression techniques are quite similar. Even more striking is the quite close relationship between the nonparametric estimates and the censored regression with normally distributed errors. The coefficients in the second and fourth columns, for example, suggest that a property with an outstanding mortgage balance equal to its assessed value would be on the market for about 25 percent longer ($e^{0.22}$) than an identical property with no mortgage. The extreme value estimates suggest a slightly more modest increase in duration of about 17 percent for the highly leveraged property.

All specifications include year-of-entry dummies. Because prices and assessed values declined substantially over the sample period, LTVs are much higher in 1991 and 1992 than in 1990. The dummies are included to avoid confusing any aggregate time effects with the equity effect. In fact, the 1991 and 1992 dummy variables are negative and significantly different from zero at the 1-percent level. We suspect that the much higher sales time in 1990 (an increase of more than 100 percent from 1992 and 80 percent from 1991)

according to the Kaplan-Meier product limit estimator of the residual distribution. It permits the censoring points, and so the time to "off-market," to depend on the regressors, but requires the errors from the time-to-sale equation to be independent of the regressors. Tze Leung Lai and Zhiliang Ying (1991) have shown it to be consistent and asymptotically normal, and it has performed well in Monte Carlo studies, such as Helmut Schneider and Lisa Weissfeld (1986) and Glenn Heller and Jeffrey S. Simonoff (1990). We calculate the variance-covariance matrix of the coefficients by bootstrapping with 1,500 iterations.

TABLE 2—OUTCOME OF NEW LISTINGS IN LINK BY YEAR OF LISTING AND LOAN-TO-VALUE RATIO (LTV)

	"Off-market"	Sold	Right-censored	Total
1990				
LTV <= 0.8	310	140	13	463
	(67.0)	(30.2)	(2.8)	
LTV > 0.8	128	36	10	174
	(73.6)	(20.7)	(5.7)	
Total	438	176	23	637
	(68.8)	(27.6)	(3.6)	
1991				
LTV <= 0.8	256	182	76	514
	(49.8)	(35.4)	(14.8)	
LTV > 0.8	198	111	36	345
	(57.4)	(32.2)	(10.4)	
Total	454	293	112	859
	(52.9)	(34.1)	(13.0)	
1992				
LTV <= 0.8	146	91	227	464
	(31.5)	(19.6)	(48.9)	
LTV > 0.8	145	71	205	421
	(34.4)	(16.9)	(48.7)	
Total	291	162	432	885
	(32.9)	(18.3)	(48.8)	
1990–1992				
LTV <= 0.8	712	413	316	1441
	(49.4)	(28.7)	(21.9)	
LTV > 0.8	471	218	251	940
	(50.1)	(23.2)	(26.7)	
Total	1183	631	567	2381
	(49.7)	(26.5)	(23.8)	

Notes: Percentages are in parentheses. All rows total 100 percent.

is due to the more rapid decline in prices in that year, and to the fact that owners are slow to adjust their reservation prices in the face of price shocks. Future work will examine this conjecture.

Years since last sale (at time of entry) is included in all columns since, by construction of the mortgage balance, it, too, is highly correlated with LTV and, because of the dependence of mobility on length of tenure, may have an independent effect on the log-duration. The loan-to-value ratio is equal to the product of two terms: the ratio of the mortgage balance at the time of (re)financing to value, and a function that is declining in the elapsed time since (re)financing. Two sellers of identical units with the same length of residence will exhibit different LTVs if at least one factor among the initial mortgage balance, the prevailing interest rate, and the time since last

TABLE 3—DURATION EQUATIONS—DURATION VARIABLE IS THE LOG OF THE NUMBER OF WEEKS THE PROPERTY IS LISTED ON THE MARKET BEFORE EXITING (STANDARD ERRORS)

Variable	(1) OLS	(2) Normal	(3) Extreme value	(4) Buckley-James
Loan/value	0.09	0.22	0.16	0.22
	(0.05)	(0.10)	(0.08)	(0.10)
$(VALUE)^{-1}$	29	128	152	121
(000s)	(11)	(24)	(24)	(28)
Years since last sale	0.03	0.09	0.08	0.09
	(0.01)	(0.02)	(0.02)	(0.02)
1991 entry	−0.19	−0.60	−0.59	−0.59
	(0.05)	(0.10)	(0.09)	(0.10)
1992 entry	−0.67	−0.77	−0.84	−0.77
	(0.06)	(0.11)	(0.10)	(0.11)
Standard error of regression	0.962	1.44	1.495	1.036
χ^2 (17 degrees of freedom)	189.0	131.8	152.6	112.0

Notes: Value is obtained from the Boston assessor's office for the year of entry into LINK. All equations contain additional control variables for property attributes. Number of observations = 2,381.

refinancing differs between them. As the table shows, this variable always is positive and significant. Excluding it from the list of regressors, however, has no effect on the estimates of the remaining coefficients.

Given the threshold effect in the hypothesized relationship between equity and time to sale, Table 4 introduces a spline function, so that the log-duration is piecewise linear and continuous in LTV.[11] This allows the sensitivity of log-duration to LTV to differ on either side of a threshold of 0.8, which corresponds to a 20-percent cash outlay for the down payment and closing costs, and so is consistent with the theoretical prediction that only high LTV units—those of "constrained" households—are sensitive to equity.

Consistent with the equity hypothesis, the log-duration is much more sensitive to LTV above than below the cutoff. In fact, the coefficient on LTV is close to zero, and no longer significant, while the spline term is positive and significant at the 5-percent level in the last three columns. In column (4), for example, the estimates suggest that a property with an LTV of 1 would remain on the market 15 percent longer than a unit with an LTV of 0.8 ($e^{(0.67+0.05)*(1-0.8)}$); at an LTV of 1.1, the duration increases by 25 percent. As a check on our specification and to determine if all-cash purchasers behaved differently than other owners, other estimates (not shown here) include a dummy variable for the absence of any mortgage. The LTV and spline coefficients change little, while the coefficient on the new variable is not significantly different from zero.

To ensure that the calculation of LTV was not affected by any possible biases in the unit's assessed value, Table 5 repeats several of the specifications in the first two tables with the indexed previous sale price replacing the official assessed value.[12] The two sets of estimates are remarkably similar. For example,

[11] The additional variable is defined as the product of loan-to-value minus 0.8 and a dummy variable that equals 1 when loan-to-value is above 0.8 and 0 otherwise.

[12] The calculations in Table 4 use a repeat sale price index that is computed with matched sales of the same property in the Boston condominium market. The number observations differ between Table 4 and the previous two tables because of the requirement that the estimated loan-to-value ratio be below 2 for all observations.

TABLE 4—DURATION EQUATIONS—DURATION VARIABLE IS THE LOG OF THE NUMBER OF WEEKS THE PROPERTY IS LISTED ON THE MARKET BEFORE EXITING (STANDARD ERRORS)

Variable	(1) OLS	(2) Normal	(3) Extreme value	(4) Buckley-James
Loan/value (LTV)	0.04	0.04	−0.03	0.05
	(0.07)	(0.14)	(0.12)	(0.14)
(LTV − 0.8) * (LTV > 0.8)	0.18	0.71	0.79	0.67
	(0.20)	(0.40)	(0.37)	(0.40)
$(\text{VALUE})^{-1}$ (000s)	28	125	148	119
	(11)	(24)	(24)	(28)
Years since last sale	0.03	0.09	0.08	0.09
	(0.01)	(0.02)	(0.02)	(0.02)
1991 entry	−0.20	−0.62	−0.61	−0.61
	(0.05)	(0.10)	(0.09)	(0.10)
1992 entry	−0.68	−0.81	−0.88	−0.81
	(0.06)	(0.11)	(0.11)	(0.12)
Standard error of regression	0.962	1.438	1.498	1.036
χ^2 (18 degrees of freedom)	189.9	134.9	142.9	111.7
P-value[a]	0.135	0.017	0.023	0.006

Notes: Value is obtained from the Boston assessor's office for the year of entry into LINK. All equations contain additional control variables for property attributes. Number of observations = 2,381.

[a] For the joint test of the hypothesis that all of the loan/value coefficients equal zero.

increasing LTV from 0.8 to 1 now increases the time on the market by 20 percent [column (6)], slightly larger than the 15-percent estimate from Table 4, column (4). Notice also that the estimated coefficient on the spline term in column (6) is nearly identical using either estimate of value.

Table 6 compares log-duration for owner-occupants and investors. When the coefficients on variables other than LTV are constrained to be the same for both groups, whether with the spline function, as in column (2), or without [column (1)], it is impossible to reject the null that the LTV coefficients are the same for both types of sellers. A chi-squared test rejects the hypothesis that both spline terms in column (2) equal zero at the 5-percent level. When all coefficients are allowed to differ by occupancy status, the magnitude of the coefficient on the spline term for investors [column (4)] exceeds that for owner-occupants [column (3)], though not significantly so.

Although the two types of sellers are similar in their responsiveness to LTV, the estimates from columns (1) and (2) indicate that owner-occupants' time on the market is about 20 percent lower than investors. This is not surprising. Owner-occupants have higher search costs: it is *their* homes that potential buyers will traipse through. And without a new home to live in and bridge financing, the opportunity to rent the property while waiting for a high price is limited.

III. Prices

Table 7 presents the regression of the (log) transaction price on the loan-to-value ratio.[13] Property attributes, the (log) assessed value at the beginning of the period, and dummies for the quarter of sale also are included. The coefficient on the assessed value is approximately equal to 1 in the first three columns,

[13] The regressions in Table 6 omit two observations for sold units, the recorded sale prices of which were below $25,000—an unrealistic amount in this market.

TABLE 5—DURATION EQUATIONS—DURATION VARIABLE IS THE LOG OF THE NUMBER OF WEEKS THE PROPERTY IS LISTED ON THE MARKET BEFORE EXITING (STANDARD ERRORS)

Variable	(1) OLS	(2) Normal	(3) Buckley-James	(4) OLS	(5) Normal	(6) Buckley-James
Loan/value (LTV)	0.12	0.30	0.31	0.10	0.11	0.12
	(0.05)	(0.10)	(0.09)	(0.07)	(0.15)	(0.14)
(LTV − 0.8) * (LTV > 0.8)				0.09	0.80	0.77
				(0.23)	(0.46)	(0.43)
$(VALUE)^{-1}$	32	131	125	32	131	125
(000s)	(11)	(24)	(27)	(11)	(24)	(27)
Years since last sale	0.03	0.10	0.10	0.03	0.10	0.10
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
1991 entry	−0.19	−0.60	−0.59	−0.19	−0.62	−0.61
	(0.05)	(0.10)	(0.10)	(0.05)	(0.10)	(0.10)
1992 entry	−0.67	−0.79	−0.79	−0.68	−0.83	−0.83
	(0.06)	(0.11)	(0.11)	(0.06)	(0.12)	(0.11)
Standard error of regression	0.963	1.441	1.049	0.963	1.440	1.046
χ^{2} [a]	187.2	137.8	148.2	187.4	140.8	165.5
P-value[b]				0.047	0.002	0.001

Notes: Value is calculated by indexing the previous sale price to the quarter of listing using repeat-sale price index. All equations contain additional control variables for property attributes. Number of observations = 2,354.

[a] The degrees of freedom are 17 for columns (1)–(3), and 18 for columns (4)–(6).

[b] For the joint test of the hypothesis that all of the loan/value coefficients equal zero.

even after separately controlling for a large number of hedonic attributes (see Table 1), suggesting that the assessed value is a very good proxy for current value.

Table 7 gives further evidence in favor of the search version of the equity hypothesis. At 0.08, the coefficient on LTV in column (1) is positive, and significant at the 1-percent level, indicating that owners with high LTV levels hold out for a higher price. Owners with higher reservation prices achieve higher selling prices, at the cost of a greater expected time on the market.

In addition, as with log-duration, price shows evidence of the expected threshold effect. When a spline is added in column (2), the coefficient on the spline term is positive and significant, while the coefficient on LTV variable becomes small and insignificantly different from zero. The coefficients in column (2) suggest that an owner with an LTV of 1 will sell his unit for a 4.3-percent higher price than an owner with an LTV of 0.8.[14]

IV. The Asking Price as a Proxy for the Reservation Price

As a final issue, we turn to the original asking price and consider the degree to which it acts as a proxy for the reservation price. Search models have the characteristic that seller attributes, such as LTV, affect the transaction price and duration only through their effect on the reservation price. To the extent that the asking price reflects the seller's reservation price, this will be true of the asking

[14] This figure is obtained by multiplying the sum of loan-to-value coefficients by the difference in loan-to-value between 0.8 and 1. [i.e., (0.185 + 0.031)*(1 − 0.8) = 0.043, or 4.3 percent.]

TABLE 6—DURATION EQUATIONS—DURATION VARIABLE IS THE LOG OF THE NUMBER OF WEEKS THE PROPERTY IS LISTED ON THE MARKET BEFORE EXITING (STANDARD ERRORS)

Variable	(1) Buckley-James	(2) Buckley-James	(3) Buckley-James (Owner-occupied)	(4) Buckley-James (Investors)
Owner-occupied	−0.21	−0.18		
	(0.14)	(0.16)		
Loan/value (LTV)			−0.09	0.17
			(0.21)	(0.20)
(LTV − 0.8) * (LTV > 0.8)			0.64	0.60
			(0.55)	(0.58)
LTV* (owner-occupied = 1)	0.21	−0.01		
	(0.14)	(0.18)		
LTV* (owner-occupied = 0)	0.32	0.21		
	(0.14)	(0.21)		
(LTV − 0.8) * (LTV > 0.8) (owner-occupied = 1)		0.81		
		(0.55)		
(LTV − 0.8) * (LTV > 0.8) (owner-occupied = 0)		0.44		
		(0.59)		
$(VALUE)^{-1}$ (000s)	112	110	142	97
	(28)	(28)	(40)	(37)
Years since last sale	0.10	0.10	0.06	0.15
	(0.02)	(0.02)	(0.03)	(0.03)
1991 entry	−0.58	−0.60	−0.56	−0.65
	(0.10)	(0.10)	(0.13)	(0.16)
1992 entry	−0.76	−0.79	−0.72	−0.92
	(0.11)	(0.11)	(0.15)	(0.17)
Number of observations	2,381	2,381	1,320	1,061
Standard error of regression	1.064	1.095	1.015	0.920
$\chi^{2\,a}$	117.4	119.4	326.0	101.3
P-value[b]	0.001	0.001	0.357	0.013

Notes: Value is obtained from the Boston assessor's office for the year of entry into LINK. All equations contain additional control variables for property attributes.

[a] The degrees of freedom are 19 for column (1), 21 for column (2), and 18 for columns (3) and (4).

[b] For the joint test of the hypothesis that all of the loan/value coefficients equal zero.

price as well. Consequently, we should expect the following. First, the asking price will be a function of LTV. Second, conditioning on the asking price will reduce the effect of LTV on both price and time on the market. If the asking price is a perfect proxy for the reservation price, LTV will have no independent effect on either outcome.

As a preliminary step, Figure 2 shows a nonparametric regression of the list price markup (original list price divided by the assessed value in the year of listing) against LTV. The

TABLE 7—REGRESSIONS USING LOG OF SALE PRICE AND (ORIGINAL) ASKING PRICE (STANDARD ERRORS)

Variable	(1) Sale price	(2) Sale price	(3) Sale price	(4) Asking price	(5) Sale price − Asking price
Loan/value (LTV)	0.08	0.03	0.0004	0.06	−0.035
	(0.02)	(0.03)	(0.06)	(0.03)	(0.019)
(LTV − 0.8)(LTV > 0.8)		0.19	0.23	0.13	0.06
		(0.10)	(0.20)	(0.09)	(0.05)
No mortgage			−0.028		
			(0.043)		
Years occupied	0.003	0.003	0.002	−0.001	0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)
Log (assessed value)	1.05	1.06	1.06	1.05	0.01
	(0.06)	(0.06)	(0.06)	(0.06)	(0.04)
R^2	0.85	0.85	0.85	0.86	0.23
P-value[a]		0.001	0.002	0.0001	0.16

Notes: Value is obtained from the Boston assessor's office for the year of entry into LINK. All equations contain additional control variables for property attributes and time dummy variables. The time dummies in equations (1)–(3) are for the quarter of sale. Equation (4) includes dummy variables for the quarter of first listing. Equation (5) includes dummy variables for both the listing and sale quarters. Number of observations = 665.

[a] For the joint test of the hypothesis that all of the loan/value coefficients equal zero.

regression uses the Epanechnikov kernel, with a bandwith of 0.075. While the percentage markup shows no clear pattern for units with an LTV less than 80 percent, above that threshold the markup appears to be strongly increasing in LTV. That is, owners with high LTVs appear to set much higher asking prices on their condominiums.

Even controlling for factors in addition to LTV that might affect asking prices, column (4) shows that the original asking price still depends on LTV. The estimates indicate that owners with an LTV of 1 set an asking price that is, on average, about 4 percent higher than the asking price set by owners who have an LTV of 0.8. This is similar to the results for the transaction price. In fact, LTV has no effect on price, other than through the asking price. As column (5) shows, the percent discount, which is the excess of the (log) asking price over the (log) sale price, does not depend on LTV.[15] Constrained sellers set a high asking price, but they are no more or less likely than others to accept a given discount off the asking price.

To examine the role of the asking price further, we return to the duration analysis, and add the list price markup to Buckley-James regressions of Tables 3 and 4. Table 8 shows that LTV has a much smaller and insignificant effect on the log-duration once the markup is included. This is true whether or not a spline is included. Thus, here, too, we find that the effect of LTV operates primarily through the asking price. We conclude that variations in the asking price reflect most of the variation in the reservation price.

V. Conclusion

This paper shows that units with low equity take longer to sell and obtain a higher price when sold. A unit with an outstanding mortgage balance equal to its market value has a

[15] When the regression in column (5) is run with the asking price on the right-hand side, its coefficient is estimated at 0.90 and is highly significant. Other coefficients in the equation are basically unchanged. In particular, the loan-to-value terms remain insignificant.

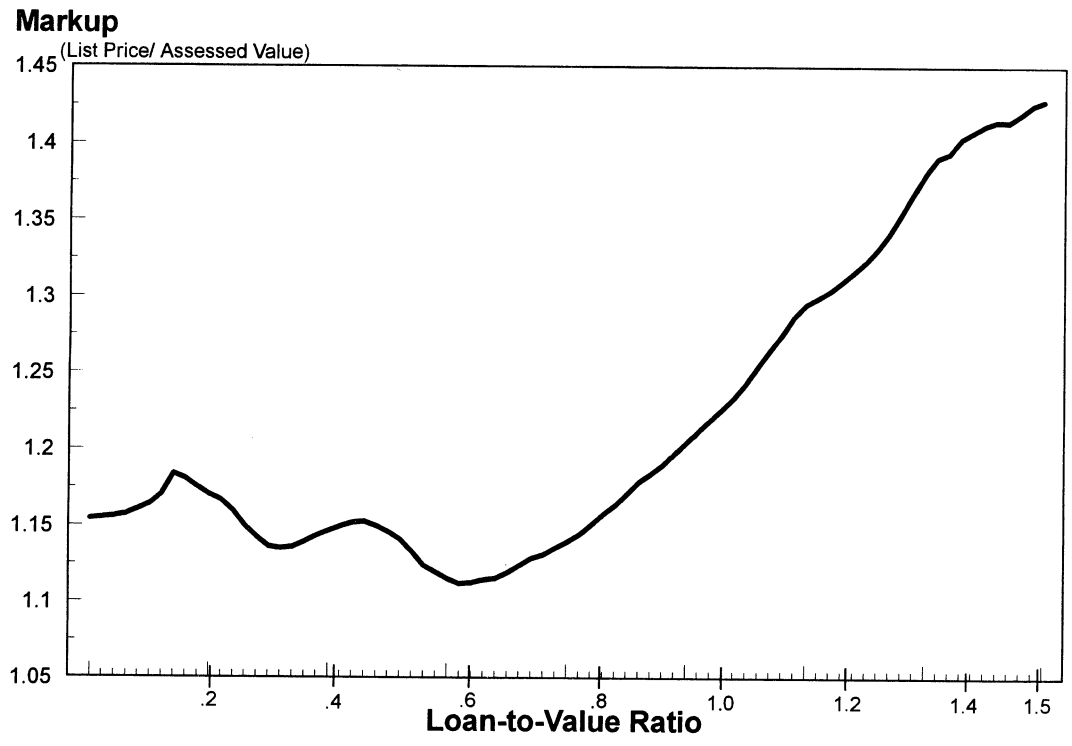

FIGURE 2. KERNEL REGRESSION

Note: Less than 1 percent of the data have a loan-to-value ratio greater than 1.5.

15-percent longer time to sale than a unit with an LTV of 80 percent. Consistent with a strategy of holding out for a high price, the first unit will set an asking price that is 4 percent higher and obtain a price that is 4 percent higher than the second, if both sell. These results are consistent with equity-constrained sellers setting high reservation prices, lending credibility to the hypothesis that an initial decrease in property prices curtails subsequent trade through a reduction in potential sellers' equity.

Other results in the paper provide additional support to the equity hypothesis. Like transaction prices, asking prices are positively related to LTV. The hypothesis predicts that only "constrained" sellers will be sensitive to small changes in their equity position and, indeed, both the log-duration and selling prices are responsive to high, but not low, LTVs.

Notice that the implied discount rate for unconstrained sellers is quite high. Other calculations suggest that the higher reservation price costs low-equity sellers about ten extra weeks on the market, but yields a 4-percent higher price. These numbers simplify to an annualized rate of return exceeding 20 percent, suggesting that unconstrained sellers are willing to give up a significant amount in price in order to achieve a quick sale. Such discount rates might not seem unreasonable, however, if sellers face liquidity constraints which require them to sell their first house in order to purchase a new house when they move.

A somewhat different explanation for the negative correlation between equity and time on the market that still relies on down payment constraints, yet eschews the search framework, is the following. Constrained home owners may have held off selling not in the hope that a particularly willing buyer might materialize, but in the expectation that market prices would eventually increase, and thereby allow them to move to an equivalent home. Within a dynamic extension of Stein's model itself, the

TABLE 8—DURATION EQUATIONS—DURATION VARIABLE IS THE LOG OF THE NUMBER OF WEEKS THE PROPERTY IS LISTED ON THE MARKET BEFORE EXITING (STANDARD ERRORS)

Variable	(1) OLS	(2) OLS	(3) Buckley-James	(4) Buckley-James
Loan/value (LTV)	0.07	0.04	0.15	0.04
	(0.05)	(0.07)	(0.10)	(0.10)
(LTV − 0.8) * (LTV > 0.8)		0.12		0.43
		(0.20)		(0.40)
Original ask price/assessed value	0.15	0.14	0.66	0.64
	(0.06)	(0.06)	(0.20)	(0.20)
$(VALUE)^{-1}$	31	30	134	132
(000s)	(11)	(11)	(28)	(28)
Years since last sale	0.03	0.03	0.09	0.09
	(0.01)	(0.01)	(0.02)	(0.02)
1991 entry	−0.21	−0.21	−0.68	−0.68
	(0.05)	(0.05)	(0.11)	(0.10)
1992 entry	−0.70	−0.71	−0.92	−0.94
	(0.06)	(0.06)	(0.12)	(0.12)
Standard error of regression	0.961	0.961	1.041	1.045
$\chi^{2\,a}$	195.70	196.10	125.10	119.80
P-value[b]		0.29		0.22

Notes: Value is obtained from the Boston assessor's office for the year of entry into LINK. All equations contain additional control variables for property attributes. Number of observations = 2,381.

[a] The degrees of freedom are 18 for columns (1) and (3), and 19 for columns (2) and (4).

[b] For the joint test of the hypothesis that all of the loan/value coefficients equal zero.

hope that an up market would follow a down market would have been a rational one and, arguably, empirically valid as well, as Case and Shiller (1989) and Meese and Wallace (1993) have shown. Holding out for market prices to improve, however, would have required a great deal of patience, as average prices continued to fall until the middle of 1994. But whatever were sellers' beliefs about future market conditions, this explanation is incomplete, as it cannot rationalize the results presented in Table 7, which show that sellers with low equity sold their homes for more than the average price in the period of sale. Doing so requires the coupling of the equity argument with search behavior by sellers.[16]

While the anomalous relationship between aggregate asset prices and sales volume described in this article may seem limited to the housing market, Andrei Shleifer and Robert W. Vishny (1992) have suggested that a similar pattern exists in the market for corporate assets. They posit that a financially distressed company may find it difficult to sell industry-specific assets because other firms in the industry are apt to be in a like condition themselves, and have sufficient equity to finance the purchase of those assets.[17]

[16] Using a sample of 121 listings, Michel Glower et al. (1995) show that "motivated" sellers set lower asking prices and sell more quickly than their less-motivated counterparts, which is also consistent with the seller search behavior described in the introduction.

[17] This argument presupposes that externally raised equity is more expensive than internally generated funds.

Although we have shown that equity losses clearly affect sellers' behavior, it is equally clear that other aggregate factors also determine that behavior. Tables 3 and 4 show that properties entering the market in 1991 and 1992 sold twice as quickly as units entering in 1990, even controlling for the initial housing equity. We have already noted the research of Case and Shiller (1989) and Meese and Wallace (1993), which suggests that a reduced willingness to sell in a down market may be a rational response by all sellers to positive expected future returns in the housing market. Alternatively, the uniqueness of individual properties may have prevented sellers from recognizing market-wide price changes, and thus sellers were slow to adjust their expectations in a changing market. One should also not discount an irrational unwillingness to accept the deteriorated market conditions, manifested in a refusal to sell at a nominal loss or below some arbitrary value that is unrelated to the current market price.[18] Future research should continue to explore how sellers adapt to changes in aggregate market conditions.

REFERENCES

Buckley, Jonathan and James, Ian. "Linear Regression with Censored Data." *Biometrika*, December 1979, *66*(3), pp. 429–36.

Case, Karl E. and Shiller, Robert J. "The Behavior of Home Buyers in Boom and Post-Boom Markets." *New England Economic Review*, November/December 1988, pp. 29–46.

———. "The Efficiency of the Market for Single-Family Homes." *American Economic Review*, March 1989, *79*(1), pp. 125–37.

Glower, Michel; Haurin, Donald and Hendershott, Patric. "Selling Price and Selling Time: The Impact of Seller Motivation." National Bureau of Economic Research (Cambridge, MA) Working Paper No. 5071, March 1995.

Heller, Glenn and Simonoff, Jeffrey S. "A Comparison of Estimators for Regression with a Censored Response Variable." *Biometrika*, September 1990, *77*(3), pp. 515–20.

Kiefer, Nicholas M. "Economic Duration Data and Hazard Functions." *Journal of Economic Literature*, June 1988, *26*(2), pp. 646–79.

Lai, Tze Leung and Ying, Zhiliang. "Large Sample Theory of a Modified Buckley-James Estimator for Regression Analysis with Censored Data." *The Annals of Statistics*, September 1991, *19*(3), pp. 1370–1402.

Meese, Richard and Wallace, Nancy. "Testing the Present Value Relation for Housing Prices: Should I Leave My House in San Francisco?" *Journal of Urban Economics*, May 1993, *35*(3), pp. 245–66.

Schneider, Helmut and Weissfeld, Lisa. "Estimation in Linear Models with Censored Data." *Biometrika*, December 1986, *73*(3), pp. 741–45.

Shiller, Robert J. "Arithmetic Repeat Sales Price Estimators." *Journal of Housing Economics*, March 1991, *1*(1), pp. 110–26.

Shleifer, Andrei and Vishny, Robert W. "Liquidation Values and Debt Capacity: A Market Equilibrium Approach." *Journal of Finance*, September 1992, *47*(4), pp. 1343–66.

Stein, Jeremy C. "Prices and Trading Volume in the Housing Market: A Model with Downpayment Constraints." *Quarterly Journal of Economics*, May 1995, *110*(2), pp. 379–406.

Wheaton, William. "Vacancy, Search and Prices in a Housing Market Matching Model." *Journal of Political Economy*, December 1991, *2*(6), pp. 1270–92.

[18] Case and Shiller's (1988) survey of recent home buyers found that 57 percent of the Boston respondents agreed with the following proposition: "Since housing prices are unlikely to drop very much, the best strategy in a slow market is to hold on until you get what you want for a property." Almost 20 percent of the respondents who had previously sold a home noted that they set their reservation price based on what they previously paid.