Price Spreads and Residential Housing Market Liquidity

By: G. Donald Jud, Daniel T. Winkler, and Grace E. Kissling

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Abstract:
Most studies of housing market liquidity twee measured liquidity in terms of time on the market (TOM), and have sought to explain TOM in terms of property characteristics and measures of market conditions. This paper departs from past studies of housing market liquidity by examining the spread between the listing and contract prices.

We develop theory to explain the price spreads in the residential housing market. The model includes the list price of the home, the cost of the search, the standard deviation of offer prices, and TOM. Empirical tests using 3,597 sales for 25 months show a robust relationship of housing market spreads and these variables. Listing price and cost of search have the predicted positive coefficients, and the standard deviation of price offers is found to be negatively related to the price spread.

Key Words: housing price spread, housing market liquidity, housing bid-ask spread, time on the market, housing sequential search

Article:
Anyone who has ever sold a house has had to confront the reality that residential housing is an illiquid asset. That is, it cannot be converted to cash quickly at low cost with any certainty of price. Irving Fisher (1912, p. 11), in his 1912 book, *The Nature of Capital and Income*, discussed the process of selling a house, explaining that the seller:

> often has an "asking price," that is, a price at which he tries to sell, usually above the price of the actual sale. In the same way there is often a "bidding price," which is usually below the price of the actual sale. The price of sale thus generally lies between the prices first bid and asked.

The spread between the asked (or list) price and the final (or contract) price in the market for any asset is a measure of the liquidity of the asset.' As Walter Bagehot (1971) has explained, "the liquidity of a market is inversely related to the spread." In liquid asset markets, like money markets, the spread is very small, while, in markets for more illiquid assets, the spread is much larger.

Time on the market (TOM) also is a measure of asset liquidity. Glenn G. Munn, et al. (1991) define liquidity as, "The amount of time required to convert an asset into cash." Looking again at liquid asset markets, like money markets, TOM usually is so short that it approaches zero, while, in illiquid markets like housing, TOM normally is measured in weeks arid months.

This paper examines the spread between the listing price and the contract price as the measure of market liquidity. The paper develops a model of housing liquidity that demonstrates that liquidity is affected by both the level and the variance of housing prices as well as macro-market conditions.[2]

1. Previous Studies or Housing Market Liquidity

Most studies of housing market liquidity measure liquidity in terms of TOM and explain TOM in terms of property characteristics and measures of market conditions. Belkin, Hempel, and McLeavey (1976) show that TOM is negatively related to the ratio of the contract price to the listing price (the concession ratio). Miller (1978) demonstrates that TOM is positively correlated with selling price. His results are corroborated by Haurin (1988), who shows that TOM is positively associated with the atypicality of a house. Since atypical houses tend to be more expensive houses, Haurin's results support those reported earlier by Miller: higher-priced, more atypical homes are more illiquid.

Kluger and Miller (1990) develop a measure of liquidity that is closely related to TOM. They show that their liquidity measure is related to the characteristics of the house. Asabere, Huffman, and Mehdian (1993) show that overpricing, neighborhood, and interest rates affect TOM. And Kalra and Chan (1993) show that TOM is affected by regional economic conditions, with TOM being positively related to interest rates and negatively associated with area employment.

2. A Model of Housing Market Spreads

We assume that the home seller lists his property at the maximum price that he can expect to receive.[3] As Miller (1978) has argued, the seller adopts this strategy in the hopes of receiving all possible bids. The seller also has an *acceptance price*, (p'), such that if a buyer offers at least the acceptance price, the offer will be accepted. Otherwise, the offer will be rejected and the seller continues to receive bids.

The model assumes a process of sequential search. The assumptions necessary for optimality with sequential search have been defined by McCall (1970).[4] Sellers accept bids from a pool of potential buyers. An individual offer is defined as 0_n, where the subscript defines the location of the offer in the sequence. Offers are distributed by the probability density function $\phi(O)$, which is known to the seller. The seller also knows Max O, which equals the list price p^L.

It is assumed that the number of offers received per unit of time is constant. The seller sustains the cost of waiting to sell the house and the cost per offer (C) is constant. Any increase in the level of market activity lowers C.

The higher the acceptance price *(p')* set by the seller, the longer the Listing period, and thus, the higher the total cost of the transaction. In setting an acceptance price, the seller balances the expected gains from waiting for further bids against the cost of waiting.

Drawing on the results presented by McCall (1970), it can be shown that the seller selects an acceptance price (p') so that the marginal cost of obtaining another offer (O) is equated with the expected marginal return of another offer:

$$C = \int_{p'}^{\infty} (O - p')\phi(O)dO \qquad (1)$$

where $\phi(O)$ is the probability distribution of offers. The cost, C, is the cost of searching for another offer. The right side is the expected marginal return of seeking another offer. Therefore, the calculation of the net return from the search for offers can be written:

$$p' = E(O \mid O > p') - C \cdot E(n) \qquad (2)$$

where n is the number of offers and *E(n)* is the expected waiting time until a house is sold. By substituting equation 2 into $(p^L - p')\,/\,p^L$, the percent spread can be shown to be

$$\frac{(p^L - p')}{p^L} = 1 - \frac{E(O \mid O > p')}{p^L} + \frac{C * E(n)}{p^L} \qquad (3)$$

By the assumption that offers are independent and identically distributed, equation 2 can be expressed in terms of the probability density function of offers:

$$p' = \frac{\int_{p'}^{\infty} O\phi(O)\,dO}{\int_{p'}^{\infty} \phi(O)dO} - \frac{C}{\int_{p'}^{\infty} \phi(O)dO} \qquad (4)$$

Feinberg and Johnson (1977) show that if $O \sim N(\mu, \sigma^2)$, the mean of the truncated distribution, $E(O \mid O > Z)$, is $\mu + \phi(Z)\sigma / P(Z)$. Therefore, the optimal contract price is given as

$$p' = \mu + \frac{\phi(Z)\sigma}{P(Z)} - \frac{C}{P(Z)} \qquad (5)$$

where $Z = (p' — \mu)/\sigma$ (the standardized critical value) and $P(Z)$ is the probability of an acceptable offer defined as follows:

$$P(Z) = \int_{z}^{\infty} \phi(Z)\,dZ \qquad (6)$$

Note that $E(n)$, or *TOM*, also equals the reciprocal of the probability of accepting an offer, $P(Z)$.

From equation 5, the spread $(p^L — p')/ p^L$ can be shown to be:

$$\frac{p^L - p'}{p^L} = 1 - \left[\frac{\mu + \frac{\phi(Z)\sigma}{P(Z)} - \frac{C}{P(Z)}}{p^L} \right]$$

$$= 1 - \frac{\mu}{p^L} - \frac{\phi(Z)\sigma}{p^L P(Z)} + \frac{C}{p^L P(Z)} \qquad (7)$$

Letting $S = (p^L — p') / p^L$, and taking the derivative of equation 7 with respect to the standard deviation of offers yields the following expression:[5]

$$\frac{\partial S}{\partial \sigma} = \frac{-\phi(Z)[\sigma Z^2 P(Z) + \sigma P(Z) - \sigma Z\phi(Z) + C \cdot Z]}{\sigma p^L P^2(Z)}. \qquad (8)$$

If $\sigma Z^2 P(Z) + \sigma P(Z) - \sigma Z\phi(z) + CZ > 0$, then $\partial S/\partial\sigma < 0$, otherwise if $\sigma Z^2 P(Z) + \sigma P(Z) — \sigma Z\phi(Z) + CZ < 0$, $\partial S/\partial\sigma > 0$. If the cost of search is large, equation 8 is inclined to have a negative sign. Hence, large search costs assure an inverse relationship between the standard deviation of offers and spread. An intuitive explanation is that a seller who is lucky can do better (i.e., sell at a higher acceptance price) when the standard deviation of offers rises. A larger standard deviation increases the chance that an offer will exceed the acceptance threshold. Thus, it is beneficial for the seller to set a higher acceptance price, or to narrow the discount from the list price that will be accepted.

The differentiation of equation 7 with respect to cost of search renders a derivative function that is always positive:

$$\frac{\partial S}{\partial C} = \frac{1}{p^L P(Z)} > 0 \qquad (9)$$

The positive derivative implies that higher search costs are associated with larger spreads. In particular, an important search cost is the interest rate. A seller who declines an offer forgoes the use of capital equal to the contract price (net of expenses) until an acceptable offer is found. A high opportunity cost may induce a seller to accept *a* low bid because it has a higher present value than a higher price received after a longer period of time (Miller, 1978). Accordingly, the present value of the net selling price is maximized according to seller's opportunity cost of time (Miller and Sklarz, 1988). A change in the interest rate alters the opportunity cost, and hence, the cost of search. In addition, an increase in overall market activity often accompanies a decline in interest rates, thereby decreasing the cost of search and, thus, lowering the spread. Other costs (such as advertising and personal selling) are typically not incremental when a seller employs an agent to sell his/her home, as these costs are usually borne by the seller's agent.[6]

The cost of search is a critical determinant of the relation between list price and spread. The derivative of equation 7 with respect to list price shows an indeterminant relation that depends on the cost of search:

$$\frac{\partial S}{\partial p^L} = \frac{\mu P(Z) + \phi(Z)\sigma - C}{(P^L)^2 P(Z)} \tag{10}$$

If $\mu P(Z) + \phi(Z)\sigma > C$, then $\partial S/\partial p^L > 0$. And, if $\mu P(Z) + \phi(Z)\sigma < C$, then $\partial S/\partial p^L < 0$. Dividing both sides by $P(Z)$ and rearranging, if $\mu + [\phi(Z)\sigma]/P(Z) — C/[P(Z)] > 0$ then $\partial S/\partial p^L > 0$. Recall $p' = \mu + [\phi(Z)\sigma]/P(Z) — C/[P(Z)]$ from equation 5. Since the acceptance price (p') is always greater than zero, the partial derivative shown in equation 10 is positive.

By rearranging equation 7, it can be shown that $E(n)$, or expected time on the market (*TOM*), is given by the following:

$$E(n) = \frac{p' - \mu}{\phi(Z)\sigma - C} \tag{11}$$

By taking partial derivatives of the expression for expected time on the market, which is similar to equation 11, Haurin (1988) finds that standard deviation is positively related to TOM while search cost is negatively related to expected TOM.

3. Empirical Evidence

To test the theory of residential housing market spreads, we gathered data from the Board of REALTORS Multiple Listing Service in Greensboro, North Carolina, for the period from April 1991 through April 1993 (25 months). The data set contained 3,597 listings and selling prices and dates of sale for every house sold through the MLS. Monthly aver-ages were constructed for all variables. The monthly subsets of data consisted of an average of 144 housing sales per month; the minimum and maximum were 47 and 211 houses, respectively.

The model was operationally defined as follows:[7]

$$S_t = A_0 + A_1 * p_t^L + A_2 * sd(p_t') + A_3 * r_t + A_4 * TOM_t + e_t \tag{12}$$

where:

S_t = the average spread in month t, defined as $(p_t^L - p_t')/p_t^L$.
p_t^L = the average list price of homes sold in month t.
$sd(p_t')$ = the standard deviation of selling prices in month t.
r_t = the mortgage interest rate in month t (annualized).
TOM_t = the average time on the market (in days) for homes sold in month t.

The average selling (or contract) priced of homes in the sample reflects the bid prices of home buyers that were accepted by sellers (p_t'). The mortgage interest rate (r_t) was introduced to reflect market activity and, thus, the cost of search. It is expected that the coefficient on r_t should be positive, that is, higher mortgage rates reduce market activity and raise the cost of search, thereby raising the spread. Time on the market TOM_t, captured as $1/P(Z)$ in equation 7, is anticipated to have a positive coefficient, consistent with prior research.

Descriptive statistics for the variables in the model are shown in Table I. The empirical estimates of the model are presented in Table 2. The estimates were derived using the Cochrane-Orcutt technique for first- and second-order autocorrelation correction. The first column in Table 2 shows the model estimates obtained using simple OLS. The second column presents estimates derived using two-stage least squares (2SLS), where both the spread (S_t) and time on the market (TOM_t) are treated as endogenous variables. The instrumental variables used to obtain the 2SLS estimates include the consumer price index, the unemployment rate, the percent changes in employment and residential building permits, the number of sales, the average list price, the standard deviation of selling prices, and the mortgage interest rate.

The empirical results shown in2 confirm the predictions of the theoretical model presented in the previous section. All of the variable coefficients in the estimated equations have the expected signs. All coefficients are statistically significant at the .05 level or better using a one-tail test, except for TOM_t, which is not significant in either OLS or 2SLS regressions.

Higher list prices are shown to be associated with higher spreads. Thus, more highly priced houses appear to be more illiquid. This result conforms to that reported by Miller (1978), who found higher list prices to be associated with higher TOM, that is, greater illiquidity.

Table 1. Sample descriptive statistics.

Variable	Mean	Standard Deviation	Maximum	Minimum
S_t	0.051	0.010	0.089	0.038
p_t^L	125,122	12,111	159,672	103,743
$sd(p_t')$	78,765	26,146	189,221	49,740
r_t	8.40	0.708	9.53	7.29
TOM_t	133.400	59.117	340.00	82.999

Table 2. Housing market spreads.

	OLS Coefficient	OLS t-Value	2SLS Coefficient	2SLS t-Value
Constant	−0.128	−4.25	−0.128	−3.97
p_t^L	8.192E-07	4.92	8.192E-07	4.92
$sd(p_t')$	−1.358E-07	−1.98	−1.354E-07	−1.99
r_t	0.010	3.41	0.010	3.24
TOM_t	2.227E-05	1.10	2.287E-05	0.76
F-Value		9.09		8.99
Adj R^2		0.69		0.69
D.W.		2.05		2.05
n		25		25

A larger standard deviation in selling prices, as expected, is found to be negatively related to the spread. This negative association suggests that a wide price distribution may encourage sellers to hold out for higher acceptance prices. A higher variance in bid prices may stem from larger housing atypicality and a resulting deficiency of information about the market among buyers and sellers.

Higher mortgage rates (associated with a decline in market activity and higher search costs) are shown to raise the spread between the listing and contract prices, which is consistent with the notion that higher search costs lead to larger spreads as indicated in equation 9.

Tune on the market is positively related to spread; however, the coefficient is not statistically significant. This suggests that in the presence of other variables, TOM does not effectively explain variations in liquidity as measured by the percent spread.

4. Conclusion

Past studies of housing market liquidity have focused on time on the market (TOM). This paper shows that the spread between listing and selling prices also reflects market liquidity. It develops a theoretical model that demonstrates that housing stock liquidity is influenced by market information, transaction costs, the cost of housing, and time on the market.

The model of housing formulated in the paper is tested using housing market data from Greensboro, North Carolina. Empirical estimates of the model indicate that spreads are positively related to prices and transaction costs and negatively associated with the standard deviation of prices. Since spreads reflect market liquidity, the model suggests that liquidity is a function of transaction costs and market information.

Appendix

$$S = \frac{p^L - p'}{p^L} = 1 - \frac{\mu}{p^L} - \frac{\phi(Z)\sigma}{p^L P(Z)} + \frac{C}{p^L P(Z)}$$

where

$\phi(Z)$ is $N(0, 1)$ density

$$P(Z) = \int_z^\infty \phi(Z)dz$$

$$Z = \frac{p' - \mu}{\sigma}$$

Find $\partial S/\partial \sigma$.

First find $\frac{\partial}{\partial \sigma}\phi(Z)$ and $\frac{\partial}{\partial \sigma}P(Z)$:

$$\frac{\partial}{\partial \sigma}\phi(Z) = \frac{d}{dz}\phi(Z)\frac{dz}{d\sigma}$$

$$= \left(\frac{d}{dz}\frac{1}{\sqrt{2\pi}}e^{-(Z^2/2)}\right)\left(\frac{d}{d\sigma}\frac{p' - \mu}{\sigma}\right)$$

$$= \left(\frac{1}{\sqrt{2\pi}}e^{-(Z^2/2)(-(1/2)2Z)}\right)\left(\frac{p' - \mu}{\sigma^2}(-1)\right)$$

$$= \frac{\phi(Z)Z^2}{\sigma}$$

$$\frac{\partial}{\partial \sigma}P(Z) = \frac{d}{dz}P(Z)\frac{dz}{d\sigma}$$

$$= \left(\frac{d}{dz}\int_Z^\infty \phi(Z)dZ\right)\left(-\frac{Z}{\sigma}\right)$$

$$= (-\phi(Z))\left(-\frac{Z}{\sigma}\right)$$

$$= \frac{Z\phi(Z)}{\sigma}$$

$$\frac{\partial S}{\partial \sigma} = \frac{\partial}{\partial \sigma}\left(1 - \frac{\mu}{p^L} - \frac{\phi(Z)\sigma}{p^L P(Z)} + \frac{C}{p^L P(Z)}\right)$$

$$= -\frac{p^L P(Z)\left(\frac{Z^2}{\sigma}\phi(Z)\sigma + \phi(Z)\right) - \phi(Z)\sigma p^L\frac{\phi(Z)Z}{\sigma}}{[p^L P(Z)]^2} - \frac{C\phi(Z)Z}{p^L[P(Z)]^2\sigma}$$

$$= -\frac{p^L Z^2\phi(Z)P(Z) + p^L P(Z)\phi(Z) - p^L Z\phi^2(Z)}{(p^L)^2 P^2(Z)} - \frac{C \cdot Z\phi(Z)}{\sigma p^L P^2(Z)}$$

$$= \frac{-\phi(Z)[\sigma Z^2 P(Z) + \sigma P(Z) - \sigma Z\phi(Z) + C \cdot Z]}{\sigma p^L P^2(Z)}.$$

If $\sigma Z^2 P(Z) + \sigma P(Z) - \sigma Z\phi(Z) + C \cdot Z > 0$; $\frac{\partial S}{\partial \sigma} < 0$.

If $\sigma Z^2 p(Z) + \sigma P(Z) - \sigma Z\phi(Z) + C \cdot Z < 0$; $\frac{\partial S}{\partial \sigma} > 0$.

Notes

1. The observable bid price in the housing market is the final (contract) price, and it is also the minimum transaction price, or stop price. The highest unaccepted bid price is not publicly available information. The use of the contract price, therefore, is proxy for the highest unaccepted bid price. The percent spread using the contract

price will underestimate the bid-ask percent spread as measured in securities markets; however, the proxy does not invalidate the relation between spread and liquidity.

2. The theoretical models of bid-ask spreads in the finance literature are based upon inventory-holding cost, order-processing cost, and information cost borne by dealers (see, for example, Stoll, 1989). However, in housing markets, real estate brokers bear the order-processing costs, and sellers pay a fixed commission to these brokers to cover these costs. Inventory costs are carried by the home seller as an opportunity cost, and are measurable by the interest rate. Also, if some traders have superior information about a home that is available to others, this may be reflected in the bid price. We have chosen to employ a search model for the purpose of our study, since bid-ask spread models for securities markets are based upon the aforementioned costs assumed by market makers. However, it should be noted that price, variability of price, and opportunity cost enter the empirical models of the bid-ask spread for securities markets, just as they do in our search model.

3. In the nomenclature of the finance literature, the list price corresponds to the ask price of securities traded in the over-the-counter (OTC)/NASDAQ market. However, unlike the securities market where multiple ask prices usually exist because more than one dealer makes a market for a security, the price of a home is limited to one "ask" price at any specific time. By agreement, die list price is restrictive for all agents, and the list price quotation is disseminated through the Multiple Listing Service (MLS).

4. The assumptions include the following: 1) offers are distributed by a probability density function that is known to the seller; 2) the cost per offer, *C*, is constant; and 3) the seller maximizes expected values and has no risk preference.

5. The detailed steps for the derivation of $\partial S/\partial \sigma$ are shown in the Appendix .

6. Moreover, these costs are typically small in relation to costs associated with interest rate changes, do not change over the duration of the contract, and have little price variation among agents.

7. Another specification was tested that included seasonal dummy variables. The direction and magnitude of the independent variables were largely the same far both specifications, and the explained variation was somewhat increased. However, the definition of seasonal variables is likely to vary across geographic location.

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