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**Two-Stage Least Squares: Simultaneous Determination of  
Days on Market, Length of Contract, and Percentage  
Overpriced**

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## **ABSTRACT**

In this paper, we examine the simultaneous determination of time on market (TOM), length of listing contract (LOC) and percentage overpriced (POP) of residential real estate listings. Our fundamental speculation is that overpriced properties and those that have extended listing contracts will incur a longer TOM. The finding of this research confirms that the more a property is overpriced, the longer it will take to sell. Similarly, as LOC increases so does the expected TOM. This may be helpful knowledge for a potential seller in determining the listing contract duration assuming realistic price expectations. These findings assume the absence of any moral hazard problems.

## **INTRODUCTION**

Previous theoretical and empirical literature has established several relationships concerning the market duration of residential properties. However, the literature is sparse in regards to the manner in which LOC may affect TOM. It is logical to speculate that a listing broker would rather not list a property he considers to be overpriced without the concession of longer listing contract. Listing an overpriced property without extending the typical contract length would be a waste of the broker's resources and potentially damaging to reputational capital, a very important element in the sales industry. Furthermore, it stands to reason that listing brokers will desire a listing contract, regardless of list price, with unlimited duration in order to ensure that a commission is earned.

We diverge from previous research by modeling the key price concept as the degree to which a home is overpriced (POP), defined as the percentage difference

between the listing and sales prices. This measure introduces all of the initial and end-of-contract price incentives that introduce simultaneity. Thus, TOM, LOC, and POP are simultaneously determined either at the initiation of the seller/broker relationship or at the sale of the property.

## **DATA**

Data used for this study was collected from a Multiple Listing Services (MLS) in southern Virginia. The initial data set included 818 observations between April 2004 and September 2007. Due to incomplete, missing or illogical data, the data set was culled down to 607 observations used in the analysis of this paper. In addition to data collected via the MLS, additional information such as broker's experience was obtained from the Department of Professional and Occupational Regulation's website.<sup>1</sup>

The data used for this study is defined in Table 4. Additionally, some descriptive statistics are also provided in Table 4.

## **LITERATURE REVIEW**

The literature on marketing duration of residential properties covers a wide array of topics including atypicality, brokerage commissions, brokerage firm size and of course price (Haurin, 1988; Zorn and Larsen, 1986; Yang and Yavas, 1995; Yavas and Yang, 1995; Clauretje and Daneshvary, 2008). Additionally, there seems to be a consensus that TOM is positively associated with list price. Miller (1978) finds that higher priced properties incur a longer marketing duration. Likewise, Anglin, Rutherford, and Springer (2003) find TOM to be positively related to increases in list price. Haurin, (1998) posits

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<sup>1</sup> <http://www.dpor.virginia.gov/dporweb/dpormainwelcome.cfm>

that atypical properties will generally face higher variations in offers thereby increasing TOM. Knight (2002) uses a maximum-likelihood model to assess TOM and selling price and the effects of listing price changes. He finds that houses with a larger difference between list price and sales price face a longer TOM and ultimately a lower selling price. Knight (2002) and Peng and Cowart (2004) also suggest that vacant properties sustain increased TOM.

Clauretie and Danshvary (2008) find that the principal-agent relationship changes over time and the broker may have more of an incentive to encourage a reduction in property's list price rather than to increase their marketing efforts as the listing contract nears expiration. Miceli (1989) proposes the theoretical use of a shortened duration listing contract as motivation to increase broker effort to sell the listed property before contract expiration so that they may earn a commission. Waller, Brastow and Johnson (2008), in an attempt to empirically test Miceli's theory, find that the length of listing contract is a positive and significant factor in the determination of TOM. This research diverges from previous works in that it attempts to specify the LOC and POP models, whereas previous works have focused on the sales or list price model specification.

## **METHODOLOGY**

The use of a two-stage least squares model is necessary to adjust for the simultaneity issues associated with TOM, POP and LOC. This research employs a two-stage least squares model with the following specifications;

$$TOM_i = \beta_0 + \beta_1 \hat{POP}_i + \beta_2 \hat{LOC}_i + \beta_3 X_i + \varepsilon_i$$

$$\hat{POP}_i = \gamma_0 + \gamma_1 Y_i + \varepsilon_i$$

$$\hat{LOC}_i = \lambda_0 + \lambda_1 Z_i + \varepsilon_i$$

where  $X_i$ ,  $Y_i$ , and  $Z_i$  are vectors of relevant market, broker, and house characteristics.

Variable definitions along with descriptive statistics are provided in table 4.

This study posits that TOM, POP and LOC are determined simultaneously. That is, the time at which the property is priced for sale, the length of the listing contract and the time the property will remain on the market all impact one another and are determined simultaneously.

The following hypotheses are investigated and are outlined below;

**H1: TOM will increase as LOC increases.**

**H2: TOM will increase as POP increases.**

**H3: TOM will increase as SQFT increases.**

**H4: TOM will increase as FED increases.**

As outlined in the first hypothesis, we expect to find that the time it takes to sell a property will increase as the length of the listing contract increases. Likewise, we expect a property's TOM to increase as the degree of overpricing increases. We also expect larger homes to take longer to sell, therefore increasing TOM. Finally, we would anticipate rising interest rates to make buyers more hesitant and thus increasing the overall time a property will remain on the market.

## RESULTS

While the robustness of the first stage regressions for LOC and POP were less than expected (Tables 1 & 2), the explanatory power of the second stage TOM regression was quite satisfactory (Table 3). The results of the estimated POP equation are shown in Table 1. The twenty three independent variables account for only approximately 16% of the explained variation in the pricing. Of the independent variables used in explaining POP, only six are significant at conventional levels. The results of the LOC equation are shown in Table 2. The independent variables in the LOC equation represent a mere 13% explanatory power with six of these variables being significant at conventional levels.

The second stage results are shown in Table 3. The fed funds rate, percentage overpriced, length of listing contract, and square footage explains 51% of the volatility in a property's time on market. The POP coefficient is positive and significant indicating properties that are listed significantly higher than their sales price will incur a longer marketing time, or TOM. This may suggest that irrational sellers and/or their brokers may have had unrealistic expectations as to the asking price for the property. The estimated coefficient for the fed funds rate is negative and significant. This unexpected sign indicates that as interest rates increase, the TOM is reduced. This is counter intuitive to what is expected and one explanation may be that only those sellers that are desperate to sell stay in the market during times of high interest rates and may lower price in order to sell their property. The estimated coefficient for square footage is positive and significant indicating that larger homes will take longer to market and sell. The LOC coefficient is positive and significant at the 1% level and indicates a direct relationship between the length of a listing contract and TOM. This provides empirical support to the

theoretical findings of Miceli (1989) in that the length of the listing contract may be used as a mechanism for motivating the broker to list, show and sell in a shorter duration. The estimated LOC coefficient of .75 indicates that a listing contract that is extended by 3 months will increase the TOM by approximately ten weeks. The LOC coefficient is extremely robust and was positive and significant across numerous equation modifications.

As expected, the length of the listing contract (LOC) has a significant impact on the time a property remains on the market (TOM). These results provide empirical support to the theoretical findings of Miceli (1989) in that the length of the listing contract may be a means by which the seller can use the listing contract to expedite the sale. These results support and extend the findings of Waller, Brastow and Johnson (2008) in that the length of the listing contract is modeled to better understand the factors that go into determining LOC. These findings provide an abundance of evidence that brokers may practice “rational procrastination” in their listing contracts as suggested by Geltner, Kluger, and Miller (1991). They argue that this conflict is potentially severe near the beginning of the listing contract but dissipates as the contract nears expiration. These results are based on numerical analyses, but Clauretie and Daneshvary (2008) empirically test and find the price reduction effect dominates the broker increased effort effect.

## **CONCLUSIONS**

The results indicate that LOC may be a very useful tool for sellers as a means to help accelerate the sale of their property. Employing a listing contract with shorter



duration, holding all else constant, may encourage the listing broker to avoid the rational procrastination sometimes observed at the beginning of the listing contract. However, it is important to keep in mind that this type of mentality would consider the degree to which the property is properly priced, the size of the improvement, the atypicality of the property, economic conditions at the time of listing and during the contract period as well as the price category in which the property fall (i.e., low, middle or upper end of price range).

It is unrealistic for a seller to expect a listing broker to sell quickly a very large, expensive, atypical property during a period of economic downturn that is listed 20 percent above appraised value just because a shortened listing contract duration was employed. It is paramount for a listing broker to insist on an extended listing contract duration if the seller insist on listing their property at a price that is above an appraised value or broker's price opinion. A listing broker accepting a listing contract with inadequate duration for an overpriced property would likely result in failure for all parties involved. If the listed property does not sell within the time frame of the contract, then the seller is likely to be disappointed with the broker's performance and may choose to list with another broker.

The ideal LOC and list price vary according to the needs of the individual property owner. Economic conditions, location, and house characteristics are all factors that influence the ultimate TOM. However, assuming all of the above are normal, our results conclude that the most advantageous method of decreasing TOM is accomplished through the use of a shortened LOC.

**Table 1: First Stage POP Regression**

POP	Coef.	Std. Err.	t
CONS	-1.720931	1.11697	-1.54
FED	-.0024636	.0036942	-0.67
SQFT	-4.45e-06	7.06e-06	-0.63
NOMKT	<b>-.0428059</b>	.0219664	-1.95*
LOTAC	-.0002427	.0009726	-0.25
AGE	<b>.0003291</b>	.0000947	3.47***
ROOMS	-.0012598	.0023154	-0.54
BED	-.0082763	.0059414	-1.39
BATH	<b>-.0163039</b>	.0067351	-2.42**
HALF	-.0034869	.008118	-0.43
USQFT	4.02e-07	7.62e-06	0.05
LASEX	-.0021994	.0065122	-0.34
LCOMPLAINTS	<b>-.0164664</b>	.0079663	-2.07**
INTOWN	.0113538	.0086294	1.32
LAT	-.0040818	.0139084	-0.29
LON	<b>-.0254882</b>	.0116347	-2.19**
LFIRMSIZE	-.0000704	.0004341	-0.16
LAFRAN	-.0100204	.007105	-1.41
LAEXP	-1.06e-06	1.00e-06	-1.05
HOME	-.0138363	.0087551	-1.58
ATYP	<b>4.02e-07</b>	8.29e-08	4.85***
SPRING	-.0054106	.0084409	-0.64
SUMMER	-.0074181	.0085244	-0.87
FALL	-.0141892	.0091626	-1.55

\*, \*\*, \*\*\*, significant at the 10%, 5% and 1% levels respectively.

**Table 2: First Stage LOC regression**

<b>LOC</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
<b>CONS</b>	-621.7821	1600.698	-0.39
<b>FED</b>	-28.2559	5.294007	-5.34***
<b>SQFT</b>	-.0079126	.0101145	-0.78
<b>NOMKT</b>	-46.01486	31.47946	-1.46
<b>LOTAC</b>	-1.945543	1.393844	-1.40
<b>AGE</b>	.2916963	.1357317	2.15**
<b>ROOMS</b>	4.888574	3.318184	1.47
<b>BED</b>	2.554499	8.5145	0.30
<b>BATH</b>	12.69108	9.651811	1.31
<b>HALF</b>	8.54997	11.63371	0.73
<b>USQFT</b>	-.0036442	.0109184	-0.33
<b>LASEX</b>	-25.45495	9.332384	-2.73***
<b>LCOMPLAINTS</b>	15.24494	11.41621	1.34
<b>INTOWN</b>	-15.28893	12.36649	-1.24
<b>LAT</b>	15.12622	19.9318	0.76
<b>LON</b>	-4.122616	16.67339	-0.25
<b>LFIRMSIZE</b>	2.167553	.6221658	3.48***
<b>LAFRAN</b>	-22.48571	10.18193	-2.21**
<b>LAEXP</b>	-.0008834	.0014388	-0.61
<b>HOME</b>	26.19608	12.54673	2.09**
<b>ATYP</b>	.0000631	.0001188	0.53
<b>SPRING</b>	.9819143	12.0964	0.08
<b>SUMMER</b>	10.09042	12.21602	0.83
<b>FALL</b>	11.20704	13.1306	0.85

\*, \*\*, \*\*\*, significant at the 10%, 5% and 1% levels respectively.

**Table 3: Two-stage regression of Property Duration**

<b>TOM</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
<b>CONS</b>	35.37026	40.64901	0.87
<b>LOC</b>	.7511489	.10811	6.95***
<b>POP</b>	277.342	100.7858	2.75***
<b>FED</b>	-19.06261	4.88279	-3.90***
<b>SQFT</b>	.010179	.004036	2.52**
<b>N</b>	607		
<b>F-Stat</b>	58.70		
<b>R<sup>2</sup></b>	.5066		

\*, \*\*, \*\*\*, significant at the 10%, 5% and 1% levels respectively.

**Table 4: Description of variables and descriptive statistics**

<b>Description</b>	<b>Abbreviation</b>	<b>Mean</b>	<b>Std. Dev.</b>
<b>Fed funds rate on list date</b>	FED	4.527452	.851
<b>Days on market</b>	TOM	141.2474	107.83
<b>Length of listing contract</b>	LOC	214.4627	110.98
<b>Properties that sold within 3 days</b>	NOMKT	.019	.137
<b>List price</b>	LP	157900	93230.51
<b>Percentage overpriced</b>	POP	.0411697	.0757316
<b>Sales price</b>	SP	152580.1	90568.69
<b>Lot size (acres)</b>	LOTAC	3.16407	3.524294
<b>Age of property</b>	AGE	30.64275	40.59038
<b>Number of rooms</b>	ROOMS	7.332357	1.987333
<b>Number of bedrooms</b>	BED	3.234261	.7086792
<b>Number of bathrooms</b>	BATH	1.879941	.636333
<b>Number of half baths</b>	HALF	.2093704	.4178215
<b>Square footage</b>	SQFT	1820.053	800.7399
<b>Unfinished square footage</b>	USQFT	158.9735	440.4835
<b>Whether or not dual agency</b>	dual	.3792094	.4855459
<b>Sex of listing agent</b>	LASEX	.5314788	.4993738
<b>Sex of selling agent</b>	SASEX	.3777452	.4851788
<b>Number of complaints against listing agent</b>	LCOMPLAINTS	.0658858	.3673539
<b>Number of complaints against selling agent</b>	SCOMPLAINTS	.0805271	.3915737
<b>Whether the property is within town limits</b>	INTOWN	.2445095	.430111
<b>Number of agents in listing firm</b>	LFIRMSIZE	11.20521	7.308417
<b>Number of agents in selling firm</b>	SFIRMSIZE	12.07336	6.605667
<b>Whether the listing agent's firm is franchised</b>	LAFRAN	.606015	.4889994
<b>Whether the selling agent's firm is franchised</b>	SAFRAN	.5989111	.4905643
<b>Whether both the listing and selling agents firm is franchised</b>	DUALFRAN	.556369	.4971765
<b>Experience of selling agent</b>	SAEXP	3530.097	2983.095
<b>Experience listing agent</b>	LAEXP	3868.277	3136.236
<b>If property was listed in winter</b>	WINTER	.2240117	.4172354
<b>If property was listed in spring</b>	SPRING	.2781845	.4484332
<b>If property was listed in summer</b>	SUMMER	.272328	.445484
<b>If property was listed in fall</b>	FALL	.2254758	.4182016
<b>If property is home (not mobile home)</b>	HOME	.7906296	.4071574
<b>Haurin's atypicality index</b>	ATYP	55240.35	44408.92
<b>The latitude of the property</b>	LAT		

<b>The longitude of the property</b>	LON		
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