

## **A Closer Review and Strategic Implications of the Comparative Market Analysis in Setting the List Price**

**Chu V. Nguyen**  
**University of Houston-Downtown**

**Lucille L. Pointer**  
**University of Houston-Downtown**

**Charles Strain**  
**University of Houston-Downtown**

*Investigating the belief that real estate properties selling within the time of the listing agent's contract duration are correctly priced based on comparative market analysis revealed that per square foot listed and sold prices, not their percentage deviation from the average of recent past sold prices, contribute more to the Time on Market (TOM) of listed property. Comparative Market Analysis (CMA) pricing is thus not as critical a factor in the prediction of Time on Market (TOM). Instead, other contributing factors contribute significantly to the TOMs of listed properties. As such, strategic planners may need to rethink their sales strategies.*

### **INTRODUCTION**

Historically, the US has pursued a standing policy promoting home ownership through regulations and institutional arrangements. The introduction of Regulation Q and the creation of the Federal Home Loan Bank System, Ginnie Mae and Freddie Mac are examples of how the U.S. government has encouraged and facilitated the channeling of funds from economic units with surplus funds to the home mortgage markets. The net effect was that it made mortgage funds available to consumers at affordable rates. Consequently, almost sixty seven (67) percent of American families owned their own homes before the subprime mortgage crisis, and residential real estate is by far the largest investment for the average American as well as the largest component of individual wealth. In 2007, realtors sold over 6 million new and used homes. This created a large, politically strong group of real estate agents and brokers in the U.S.

The literature is replete with studies investigating the diverse strategies used to sell real estate (Turnbull & Zahirovic-Herbert, 2012; Benefield & Sirmans, 2009; Johnson, Benefield & Wiley, 2009; Anglin, Rutherford & Springer, 2003). Real estate agents influence many decisions in the marketing of property including setting the listing price for property. The list price is the price that a particular property when it is put up for sale. Normally a realtor does a comparative market analysis (CMA) to help the client set the list price. A common belief is that the listing price and the attendant psychological reactions of the potential buyers to the listed price significantly influence both the final sales price and the total number of days that the property remains on the market (TOM). Although price is an important factor, evidence

indicates other factors may influence the TOM. Other variables such school district, the number of bedrooms and baths, mortgage rate and its recent changes, number of listings in the particular area, and so on, certainly can play a role in the TOM of the properties.

Given the previous discussion, a logical question to ask is to what extent list price influences a property's TOM and to what extent other variables influence Time on Market (TOM). Secondly, how useful is the CMA as an instrument for setting list prices. Because of the subjective judgment in performing a CMA, the monetary benefit, and reputation of the listing agents in the industry for the quick sale of listed properties suggest the possibility that properties are underpriced.

In light of the aforementioned, this study utilizes Cox's (1972) proportional hazard and Tobit models to discern the above issues and evaluate the robustness of the empirical results obtained from them. Although researchers used the Cox, proportional hazard Model in numerous studies, the Tobit has been used less in studies of this nature. These models belong to the general class of the logistic regression model, used to handle discrete and truncated dependent variables.

### **Review of Literature**

Given the economic impact of the housing market sales in the American financial system, researchers have conducted studies to understand the factors predicting the length of time property remains on the market (TOM) for close to forty years. Within this time, industry research found a myriad of factors might be predictors of TOM. The vast quantity of research focused on three distinct streams beginning with the physical characteristics of the property, liquidity issues and lastly characteristics of the sellers or a combination of these. Even though the list price has been included in many models, there is less focus on how list prices are determined in the housing market (Haurin, et al., (2010). The property list price is of critical concern for both sellers and prospective buyers. Buyers view the list price as a primary factor in the length of time property remains on the market because it captures the effects of the many hypothesized drivers of sales (Knight 2002). According to several researchers, the *listing price provides an upper boundary for expected sales offers and signals market information to potential buyers* (Haurin, et al., (2010); Anglin 1997 and Horowitz 1992). Examining the effects of selling price, TOM, and financing premiums, Ferreira & Sirmans (1989) found that the initial list price positively affect TOM and the greater the difference between the list price and sales price the longer the days on the market. Yavas & Yang (1995) research support the commonly prevailing notion that list price affects how long it takes for a real estate sell but they also show a reciprocal effect because TOM influences the final selling price.

Most studies consistently find a positive relationship between higher than average list price and longer TOM (Jud, Seaks, & Winkler, 1996; Asabere, Huffman, & Mehdian, 1993; Miller & Sklarz, 1987, Kang, & Gardner, 1989; Trippi, 1977; Anglin, Rutherford & Springer, 2003; Haurin, et al., 2010), shows that sellers increasing sensitivity to the arrival rate of potential buyers in a market, results in sellers reducing list prices to maintain a steady flow of potential buyers. Knight (2002) and Huang & Palmquist (2001) examined the interrelationship between list price and time on the market finding that it is crucial to list homes at the right price initially. Accordingly, the level of the initial list price will influences the rate at which a seller learns about the buyers and the distribution of offers. Higher listing prices, reduces the number of potential buyers and as a result fewer offers. Research shows that when we revise the original listing prices, the effect not only increases TOM but also results in lower selling prices due to the existence of a hypothesized stigma effect, which Taylor (1999) originally proposed. Benjamin & Chinloy (2000) show that property moves faster when priced at or below market value oppose to overpricing property. This effect must be qualified depending on geographic or spatial factors. In a study of the residential housing major in a major U.K. city where most residential homes sell at a premium above the listed price, McGreal, et al., (2009), found that although the list price influences TOM, it is a more complex relationship. Properties selling higher than list price experienced a shorter TOM and those selling for less than the list price had a longer TOM. However, this relationship only exists for properties on the market for less than 6 months.

### **TOM and Selling Prices**

In the US residential real estate market, the actual selling price more often than not differs from the list price (Horowitz, 1992; (Haurin, et al., (2010). Many studies document an inverse relationship between selling price and TOM compared to the positive relationship between list price and TOM (Belkin, Hempel & McLeavey, 1976). Examining the relationship between selling price and marketing time, Benefield, Rutherford, and Allen (2011), found that across all homes including both normal, foreclosed and homes classified as estate sales, TOM had an inverse relationship to selling prices. However, estate homes, which were typically older and smaller with a significant lower list price and selling, price and spent slightly less TOM than the non-estate homes. While investigating the effects of list price, Haurin, et al., (2010) confirmed that homes atypically raises the ratio of list price to sales price at a decreasing rate and dwellings with greater atypically have a longer time on the market. The study confirms that sellers of atypical properties tend to set prices relatively high, and offer higher discounts from list prices, which supports Knights (2002) findings. Research shows that seller heterogeneity or constraints impacts list price, selling price and TOM. As sellers holding costs increases, reservation prices decreases and TOM decreases (Cheng, Lin, & Liu, 2010; Sirmans, Turnbull, & Dombrow, 1995; Glower, Haurin & Hendershott, 1998; and Arnold, 1992). Kang and Gardner (1989) note that the relationships between selling price, list price, housing characteristics are complex ones that are often dependent on market conditions.

### **List Price, Comparative Market Analysis and Agents**

The prevailing belief in the real estate industry is that correctly priced properties sell within the time of the listing agent's contract duration. Overpriced properties tend not to sell quickly, thus remaining on the market too long and eventually leading to the expiration of the listing agents' contracts. This conviction is the basis for realtors to perform a comparative market analysis. A CMA is supposed to help both the agents and consumers decide upon the correct price for the listing property. To perform a CMA, real estate agents search the Multiple Listing Services (MLS) archive to find at least three "*comparable*" properties, preferably in the same geographic area, that were sold in the past six months. If agents cannot find comparable properties in the same geographic area or within the last six months, the agent must rely on properties in another geographic area, which should be in relatively close proximity. These issues force the agent to make many adjustments to find the "comparable" properties for a CMA. There are no hard rules for these adjustments. Instead, their determination requires a subjective evaluation. Additionally, during the period when the real estate property prices move rapidly and monotonically such as in the recent residential real estate market, six months is a long time. Therefore, to provide a good CMA, the agent must be very knowledgeable of the current economic and financial conditions of the economy as well as the conditions of the current market in the prevailing phase of the business cycle.

The real estate industry consists of agents with varying levels of skills and knowledge due to several factors. To become an agent, an individual must meet the state educational requirements and provide proof of competency by passing the state examination. Subsequently, active agents must satisfy an annual state educational requirement known as the mandatory continued education requirement (MCE.). The current MCE requirements consist of a minimum number of quantitative calculations in the areas of economics and finance. These minimum requirements result in a high variability in the skills and abilities of the licensed agents. Reputable real estate companies provide excellent training to their agents. These companies in return keep a large portion of the sales commissions from their associates. Due to this bias against the commission sharing structure, newer real estate firms developed known as one hundred percent companies. In these new firms, the principal brokers are available to answer questions from their sale associates, but provide little training. In this arrangement, the real estate sale associates pay a minimum annual fee and about one hundred dollars per transaction. Thus, agents in these establishments learn by doing, which in turn exacerbates the problems associated with the quality of agents and their ability to develop good CMAs. The principle agent problems are a factor affecting the agents' inputs on clients' decisions on setting the list price and acceptance of offers. Levitt & Syverson (2008) show that realtors sell their own homes at a higher price than they sell their clients and leave them on the market

longer, which led them to conclude that realtors often work to their own optimal advantage rather than to their clients best interest. Turnbull & Dombrow (2007) demonstrate that agent specialization influences property selling price and time on the market. Agents specializing in listing properties obtain higher prices for their sellers while those who specialize in selling obtain lower prices for their buyer. This highlights the importance of agents being experienced and knowledgeable in the market. A knowledgeable agent should help set the “right” price through their CMA. The purpose of this study is to investigate the relationship between list price, CMA and TOM. Do properties listed close to CMA sell within the time of the listing agent’s contract period?

### **Potential Contributing Factors to TOM of Listed Residential Real Estate**

For the most part, real estate property owners tend to have an upward bias when pricing their properties. However, given the above discussion on the industry, the CMA is a useful instrument for listing agents to recommend the listing prices for properties. Listing prices based on CMA may not account for all the variables influencing their TOM. Based on prior research, it is logical to postulate that the listed price of a property is an important factor in its TOM; it is not the only factor contributing to its TOM. Other factors specific to that property may influence the TOM of a real estate property. National economic and monetary policies, which manifest in the personal income, interest rate, unemployment, and inflation affect the willingness and the ability of the population to purchase residential properties, are also contributing factors to the TOMs of listed residential properties.

To investigate the predictors of TOM, this study uses commonly investigated home characteristics with the exception of loan to value which were identified from prior studies (see for example Haurin 1988; Kang & Gardner 1989; Glower, Haurin & Hendershott, 1998; Turnbull & Dombrow, 2007; Culp & Retzlaff, 2008; Bourassa, et al., (2009); McGreal, et al., (2009); Benefield, Rutherford & Allen, (2011):

- per square foot listed prices
- sold prices under or over the CMA (which is the average of sale prices in the school district where the listed property is located)
- loan to value ratio
- change in state unemployment rates from five to four months ago
- change in the conventional mortgage rates from four to three months ago
- independent school district where the property is located
- period when the property is listed measured by dummy variable assuming different values for different periods when data is collected—Aprils and Augusts of 2006, 2007, and 2008
- number of full bathrooms
- number of bedrooms
- the cross between the number of bedrooms and full bathrooms to measure the functional obsolescence of the property
- number of car garages
- square footage
- number of stories of the buildings
- square footage of the lots
- whether the property has a private swimming pool
- per square foot of listed and sold prices
- amount the seller helps with closing costs
- amount of money the seller spent on repairs
- dollar listed price of the property
- year property built
- bonus offered by the seller to buyer’s agent

## Methodology

The methodological challenge in studying TOMs of listed real estate properties is whether the measures days in the market itself is discrete and truncated from below, i.e., TOM is an integer and cannot be negative. This truncating phenomenon renders the conventional econometric procedure inappropriate to identify the characteristics contributing to the TOMs of listed real estate properties. To use any regression model with truncated data, the probability density of the dependent variable must relocate from plus and minus infinity to the range between zero and positive infinity. To overcome this statistical challenge and to check for the robustness of the empirical results, this study follows several other studies (Haurin, 1988; Glower, Haurin & Hendershott, 1998) using the semi-parametric Cox proportional hazard model that discerns the aforementioned issues and to check the robustness of the results by comparing them to the results obtained from estimating a parametric Tobit model.

## COX PROPORTIONAL HAZARD MODEL

Let the TOM be a random variable  $T$  with a probability distribution function  $f(t)$ , (where  $t$  is a realization of  $T$ ) represent the TOM. As such, the following equation provides the cumulative probability:

$$F(t) = \int_0^t f(s)ds = \text{Pr ob.}(T \leq t) \quad (1)$$

The probability that the TOM is of a length of at least—in the terminology of this topic matter, the property is said to “survive” for the length of  $t$ —can be described by equation (2)

$$S(t) = 1 - F(t) = \text{Pr ob.}(T \geq t). \quad (2)$$

Given the listed property has lasted until time  $t$ , the probability that it sells in the next short interval of time, denoted by  $\Delta t$ , expresses as: (equation (3))

$$l(t, \Delta t) = \text{Pr ob.}(t \leq T \leq t + \Delta t | T \geq t). \quad (3)$$

A useful function for characterizing this aspect of the distribution is the hazard rate which is given by equation (4), Greene (2008, p. 933.)

$$\lambda(t) = \lim_{\Delta t \rightarrow 0} \frac{\text{Pr ob.}(t \leq T \leq t + \Delta t | T \geq t)}{\Delta t} = \lim_{\Delta t \rightarrow 0} \frac{F(t + \Delta t) - F(t)}{\Delta t S(t)} = \frac{f(t)}{S(t)} \quad (4)$$

As pointed out by Greene (2008, p. 934), the hazard rate is roughly the rate at which the listed residential real estate properties are sold after the duration of  $t$  days, given that they are on the market for  $t$  days. As such, the hazard function discerns the following intuitive question that the longer a listed property is on the market, the more likely that it sells within the next week. The speculative position of the real estate agents is that the longer a property has been on the market, the more difficult it will be to sell this property because of the potential buyers’ psychological thinking; thus, it is less likely that it sells in the next short time interval.

Greene, (2008) and Elandt-Johnson & Johnson, (1980) further articulated that the hazard function, the probability density function, the cumulative density function, and the survival function are all related. Equation 5 provides the hazard function and equation 6 describes the probability density function.

$$\lambda(t) = \frac{-d \ln S(t)}{dt} \quad (5)$$

$$f(t) = S(t)\lambda(t). \tag{6}$$

Another important function for this model is the integrated hazard function provided by the following expression (7).

$$\Lambda(t) = \int_0^t \lambda(s)ds \tag{7}$$

Equation (8) describes the survival function.

$$S(t) = e^{-\Lambda(t)}. \tag{8}$$

Therefore, equation (9) provides an alternative expression of the integrated hazard function. In this setting, the integrated hazard function is a generalized residual.

$$\Lambda(t) = -\ln S(t). \tag{9}$$

As pointed out by Greene (2008, p. 937), one limitation of the above class of model is that external factors are not incorporated as potential contributors to the survival distribution and adding a set of “covariates” or explanatory variables to the models is fairly straightforward. To this end, let  $x = (z_1, z_2, z_3, \dots, z_n)$  be an  $n$  by 1 vector of covariates, then the following equation (10) specifies Cox’s (1972) proportional semi-parametric hazard method of analyzing the effects of covariates on the hazard rate:

$$\lambda(t) = \exp.(x' \beta)\lambda_0(t) \tag{10}$$

Thus, an alternative to equation (10) is:

$$\ln\left(\frac{\lambda(t)}{\lambda_0(t)}\right) = x' \beta \tag{11}$$

In this equation,  $\beta$  is the vector of unknown regression coefficients we plan to estimate and  $\lambda_0(t)$  is the unknown hazard function for a listed real estate property with covariate vector  $x = (0_1, 0_2, 0_3, \dots, 0_n)$ . Also, as pointed out by Hopkins (1981, p. 576), this specification models the log-linear effect of the covariates upon the hazard function.

Additionally, when agents list residential real estate properties, some of them will be under contract quickly and contracts on some of the remaining properties will follow. Properties that do not sale during this period tend to remain on the market much longer and eventually lead to the expiration of the listing agents’ contracts. In addition, TOM can never be negative. The behavior of the TOM violates the normality assumption in conventional OLS procedure. As pointed out by Greene (2008, p. 906), when modeling this type of event, although an underlying regression model is in fact at work, it is not the conditional mean function that is of interest. The objects of estimation are certain probabilities of events. Researchers often use the exponential model for phenomena such as these.

Econometrically, Greene (2008, p. 941) articulates that the proportional hazard model (semi-parametric model) is a common choice for modeling these events because it is a reasonable compromise between the non-parametric Kaplan-Meier estimators (Kaplan & Meier, 1958), and possibly excessively

structured parametric models. Cleves, Gould, Gutierrez, & Marchenko, (2008) and Meyer (1988), have devised another, “semi-parametric”, specification for hazard models.

Hopkins, (1981) provides a method by which we may estimate the regression parameters. Let  $(t_1, t_2, t_3, \dots, t_k)$  represent  $k$  distinct times for a property to sell among the  $m$  observed times when the listed properties sell. The conditional probability that a listed property with covariate vector  $x_i$  is sold, given that only one property is sold at time  $t_i$  and that the set of  $R_i$  (indices of properties on the market prior to time  $t_i$ ) is the ratio of the hazards:

$$\frac{\exp.(x_i' \beta)}{\sum_{j \in R_i} \exp.(x_j' \beta)} \tag{12}$$

If there is no multiple sales (ties) among the listed residential real estate properties at the times,  $t_i$ 's, then as Cox (1975) points out, multiplying these probabilities together for each of the sales time,  $t_i$ , yields the partial likelihood function (13):

$$L(\beta | x) = \prod_{i=1}^k \frac{\exp.(x_i' \beta)}{\sum_{j \in R_i} \exp.(x_j' \beta)} \tag{13}$$

When there are ties or multiple sales among the listed residential real estate properties at the times,  $t_i$ 's, then Breslow (1974) proposes the following likelihood function (14).

$$L(\beta | x) = \prod_{i=1}^k \frac{\exp.(s_i' \beta)}{\left( \sum_{j \in R_i} \exp.(x_j' \beta) \right)^{m_i}} \tag{14}$$

The equation provides that  $m_i$  is the number of sales of the listed real estate residential properties at time  $t_i$ ,  $s_i$  is the sum of the covariates of the  $m_i$  of the sold properties. Maximization of the appropriate partial likelihood function yields estimators of  $\beta$ 's with the properties similar to those of the usual maximum likelihood estimators such as an asymptotic normality, Hopkins (1981, p. 578.) As articulated by Kiefer, (1988), the  $\lambda_0(t)$ , the baseline hazard with unknown parameters, will normally require estimation. In the above specification, we obtain the effects of the covariates by multiplying the hazard  $\lambda_0(t)$  by a factor  $\exp.(x' \beta)$ , which does not depend on the duration of  $t$ . Additionally, this specification is convenient because non-negativity of  $\exp.(x' \beta)$  does not impose restrictions on  $\beta$  and the estimations and inferences are straightforward. More importantly, estimation of  $\beta$  in the above model does not require the specification and estimation of the baseline hazard,  $\lambda_0(t)$ , Greene (2008, p. 940) and Kiefer, (1988).

## TOBIT MODEL

To check for the robustness of the empirical results, we estimate the Tobit model (a parametric member of the class of the logistic regression model developed by economist James Tobit 1958) using the same data set. Again, the objective of the analysis is to construct a probability model that links the changes in a set of independent variables or covariates to the probability of an outcome. Following

Greene (2008), this study specifies equation (15) as the basis condition to construct the Tobit model, where  $y^*$  is unobservable a dependent variable relating to a set of covariates  $x'$  as follows:

$$\begin{aligned} y^* &= x' \beta + \varepsilon \\ y &= 0 \quad \text{if} \quad y^* \leq 0 \\ y &= y^* \quad \text{if} \quad 0 < y^* \end{aligned} \tag{15}$$

Econometrically, equation (15) specifies how a vector of factors,  $x$  influences the TOMs of listed real estate properties. Green (2008, p. 928), shows the development of the log-likelihood of this model from two sets of terms as follows:

$$\ln L = \sum_{y_i \leq 0} \ln \Phi \left[ \frac{0 - x_i' \beta}{\sigma} \right] + \sum_{0 < y_i} \ln \frac{1}{\sigma} \Phi \left[ \frac{y_i - x_i' \beta}{\sigma} \right] \tag{16}$$

This model can be used to estimate the coefficient vector  $\beta$  of the covariates or independent variables  $x$ .

## DATA AND EMPIRICAL RESULTS

This section empirically examines whether or not other variables besides the listed price (based on the CMA) provided by listing real estate agents affect the TOM of listed residential real estate property. To this end, this study collected data for the aforementioned variables on 5,544 residential real estate properties sold in three independent school districts, recorded in the archive of the MLS of Houston Association of Realtors in Aprils and Augusts of 2006, 2007, 2008. Out of these sample properties, 2,927 were listed at the per square foot price above that of the average of the recent past sold prices in the independent school district, which is used as a proxy measure for a CMA.

To appreciate the beauty of the Cox proportional hazard model, it is important to realize that equations (1) and (2) combined or equation (9) indicates that if any given covariate positively affects the hazard rate of the properties, i.e. the reported hazard ratio being greater than one, that covariate in fact shortens this property's TOM. For example, if the estimated coefficient of an independent variable or a covariate is 0.18, then an increase in the measurement of that variable by one unit will cause the hazard rate by 20% since  $\exp.(0.18)$  is 1.20. Alternatively, if an estimated coefficient of a covariate is -0.2231, then an increase in that independent variable by one unit will result in a decrease of the hazard rate by 20% because  $\exp.(-0.2231) = 0.8$ . Clearly, a positive estimated coefficient of Tobit indicates an increase in the TOM of the property; while a positive estimated coefficient of Cox's model indicates an increase in the "hazard" that the property in question to be censored or to be sold., i.e., shortening the TOM of the property in question.

Since some properties were listed under and some were listed over CMA, this study separated the sample in two subsamples—one subsample includes properties listed under and the other consists of those listed above the CMA—and each of the two selected model is estimated with the full sample and these two subsamples as reported in Table 1. Additionally, some sellers offer bonuses to buying agents with the dollar value of the bonus to the buying agent expressed as the percentage of the sold price for the empirical analysis.

Overall, the empirical results reveal the goodness of fit as evidenced by the log likelihoods and the Chi-square statistics i.e. fits the models for all the samples -- full sample and two subsamples well. In determining factors influencing TOMs for the full data sample, the Tobit model reveals that the listing price is marginal significant, while the Cox's model indicates that it is not significant at any conventional level. As to the bonus to agents representing buyers, the Tobit's model suggests that it is not significant, while Cox's model indicates that it is significant at the one percent level. Overall, the comparison

between the two models of the logistic regression model class suggests that Cox proportional hazard model is more powerful in detecting factors that influence the TOMs of listed real estate properties. The consistency of the comparison results lends credence to the empirical findings of this investigation.

Statistically, we determine the significance of individual estimated coefficients of Cox's model by the *z-statistics*, while the *t-statistics* determine the significance of the estimated coefficients of the Tobit model. From the full sample results - except for the aforementioned minor difference between results obtained from the two models - an analysis of the estimation results indicate that many variables are significant at the 1 percent level. These include:

- the independent school district where the property is located
- size of the garage as measured by the number of cars
- number of stories of the unit, per square foot listed price and sold price
- seller's help in closing cost, year built of the unit
- bonus the seller offers to the buyer's agent) are significant at the 1 percent level

The empirical results further indicate that whether the property has a private swimming pool is significant at the 5 percent level. Whereas a change in the conventional mortgage rates from four to three months prior to the contract to purchase by the buyers, seller's paid repairs, dollar listed price are marginally significant and all other included factors are statistically insignificant at conventional levels. Interestingly, the empirical findings reveal that while the levels of the per square foot listing price and sold price but not their deviations from CMAs—listed under or over the average of the recent past sold prices in the independent school district—significantly influence the TOMs of the listed real estate property.

Although using the recent past sold prices in the independent school district as a proxy measure for CMA in this analysis may mitigate the believability of the empirical findings, the empirical results cast doubt on the prevailing belief in the real estate industry that “properties that sell within the time of the listing agent's contract duration are priced right. Properties that do not sale fast and remain on the market too long and eventually lead to the expiration of the listing agents' contracts are not due to them not being ‘priced right’. The results seem to lend some support to the public perception reported in the Real Estate Industry survey 2005 and the aforementioned deficiencies of CMAs prepared by listing real estate agents in the industry.

**TABLE 1**

Variables	Properties Listed Under CMA		Properties Listed Over CMA		Full Property Sample	
	$\beta$ 's - Cox	$\beta$ 's -Tobit	$\beta$ 's - Cox	$\beta$ 's -Tobit	$\beta$ 's - Cox	$\beta$ 's -Tobit
List Price vs. CMA	0.00383 0.97	-0.36798 -1.27	-0.00002 -0.13	0.00060 0.07	-0.00003 -0.20	0.00124 0.14
Sell Price vs. CMA	-0.00198 -0.52	0.17066 0.62	-0.00119 -0.79	0.07388 0.70	0.00094 1.09	-0.09081 -1.46
Loan Value Ratio	0.00682 0.79	-0.36878 -0.53	-0.00637 -0.60	0.61825 0.95	-0.00107 -0.16	0.15270 0.32
$\Delta$ Unemployment rate from 5 to 4 mos. prior to contract	0.00153 0.19	-0.26385 -0.45	0.01044 1.38	-0.67956 -1.28	0.00741 1.37	-0.52537 -1.33
$\Delta$ mortgage rate. from 4 to 3 months. prior to contract	0.00760 0.72	-0.88131 -1.11	0.01227 1.22	-0.96923 -1.36	0.01233 1.70***	-0.94964 -1.79***
School District—Location	0.10292 2.94*	-6.94591 -2.70*	0.06435 1.78***	-4.66901 -1.88***	0.105212 4.30*	-7.47747 -4.27*
Period Property Sold	0.01134 0.95	-0.52814 -0.59	-0.00133 -0.12	-0.18900 -0.23	0.00478 0.58	-0.27845 -0.46
# Full Bath Rooms	-0.38445 -2.11**	21.94409 1.65***	0.03759 0.23	0.278270 0.03	-0.11451 -1.00	7.81326 0.97
# of Bedrooms	-0.14047 -1.29	5.86655 0.74	0.19081 1.91***	-11.29692 -1.67***	0.05073 0.72	-4.00335 -0.81
Bath/Bedroom Functional Obsolescence	0.07432 1.46	-3.19452 -0.86	-0.03756 -0.74	1.69076 0.49	0.00582 0.17	-0.07598 -0.03
Size of Garage/ # of spaces	0.12913 3.95*	-9.92914 -4.04*	0.09965 3.53*	-6.33306 -3.15*	0.10966 5.26*	-8.24734 -5.33*
Building Sq. Feet	-0.00028 -3.19*	0.02297 3.59*	0.00028 2.80*	-0.01822 -2.69*	-0.00006 -1.21	0.00584 1.51
# of Stories	-0.02866 -0.60	2.02170 0.56	-0.26619 -5.41*	20.76292 6.13*	-0.15088 -4.60*	11.15824 4.63*
Lot Size	0.00001 0.71	-0.00021 -0.66	-0.00001 -0.67	0.00013 0.86	-0.00005 -0.29	0.00005 0.33
Private Pool	0.06149 0.83	-5.92108 -1.06	0.15491 2.08**	-11.14090 -2.14**	0.12929 2.40**	-9.25521 -2.43**
Listing Price per Sq. Foot	-0.05414 -6.66*	4.01576 6.80*	-0.01745 -4.70*	1.07413 4.37*	-0.02633 -8.40*	1.77037 8.19*
Sold Price per Sq. Foot	0.04954 7.04*	-3.54884 -6.95*	0.02371 6.50*	-1.43101 -5.92*	0.02729 8.94*	-1.76273 -8.34*
Seller Paid Buyer's Closing Cost	-0.00002 -2.91*	0.00109 2.97*	-0.00002 -1.97**	0.00113 1.91***	-0.00003 -4.32*	0.00109 3.55*
Seller Paid Repairs	-0.00003 -4.08*	-0.00013 -0.88	-0.00002 -0.71	0.00058 0.44	0.00001 1.67***	-0.00011 -0.76
Year Built	-0.00337 -2.53**	0.22705 2.22**	-0.0040 -3.82*	0.29400 3.84*	-0.00340 -4.24*	0.24383 4.04*
Listing Price in \$000's	0.00001 2.79*	-0.00027 -3.31*	-0.0001 -2.62*	0.00013 2.27**	0.00001 1.17	-0.0000 -1.74***
Bonus paid to Buyer's Agent	0.00315 2.85*	-0.12017 -1.45	0.08347 1.39	-4.89841 -1.17	0.00303 2.80*	-0.11840 -1.48
Chiquare(22)	131.40*	124.83*	173.15*	167.56*	253.77*	236.55*
Log likelihood	-17,934.97	-15,002.26	-20,374.19	-16,66.73	-42,165.20	-31,644.57

Future research may refine the CMA by including the comparable properties very near to the listed property and adjust for their different characteristics to rectify the CMA rudiment. Arguably, the rudiments of the CMA used in this investigation may mitigate the believability of the empirical findings. The important contributions of this study are that it confirms the use of the Cox's model as better model than the Tobit model for business applications. It also confirms that there are several other important factors other than price influencing the TOMs of listed real estate properties.

A comparison of empirical results obtained from estimating the two models reveals that some aforementioned factors becomes more/less or significant/not significant determinant of TOMs of some listed real estate properties in one sample versus another. More specifically, a change in the conventional mortgage rate from four to three months prior to buyers' contracts to buy contributes significantly to TOMs for the full sample, but becomes insignificant when the models were estimated using two subsamples. In addition, number of bedrooms marginally contributes to TOMs of properties with per square foot listing price below the CMA level, but does not affect TOMs of other properties. Additionally, number of stories of the unit is highly important in determining TOMs of properties when the 'per square foot' listing price is above the CMA and is irrelevant regarding the TOMs of properties when the 'per square foot' listed price is below CMA level. We conjecture that these differences are attributable to the synergic effects of the characteristics of the properties in these samples and the buyers of these properties. For example, a buyer of an upper quality property, hence higher per square foot listing price would have taste for different amenity of the property than the taste of a buyer of a property with lower than the CMA price per square foot.

## CONCLUSION

To investigate the belief that properties that sell within the time of the listing agent's contract duration have the correct price and other factors, which affect a property's Time on Market (TOM), this study used both the Cox's (1972) proportional semi-parametric hazard model and Tobit model. Interestingly, the empirical findings reveal that the levels of the per square foot listed price and sold price, but *not their deviations from the proxy measure of the CMA*, significantly influence the TOM of listed real estate properties. Therefore, CMA pricing is not as critical a factor in the prediction of TOM. The model comparisons reveal that both models fit the data well, however, Cox's model is more powerful in determining factors contributing to days on the market of listed real estate properties. For example, the estimated coefficient of the bonus paid to buyers' agents was highly significant in Cox's model, but was not significant at any conventional level in Tobit model.

The estimation results indicate that the following are significant at the one-percent level:

- the independent school district where the property is located
- size of the garage as measured by the number of cars
- number of stories of the unit, per square foot listing price and sold price
- seller's help with closing costs
- year built of the unit
- bonus the seller offers to the buyer's agent

The empirical results further indicates that whether the property has a private swimming pool is significant at 5 percent level, while change in conventional mortgage rates from four to three months prior to the contract to purchase by the buyers, seller's paid repairs, dollars listing price are marginally significant, all other included factors are statistically insignificant at conventional levels. Thus, real estate strategic planners may need to rethink the variables they use in developing their sales strategies.

## REFERENCES

- Anglin, P. M., (1997). "Determinants of Buyer Search in a Housing Market", *Real Estate Economics*, 1997, 25, 567-89.
- Anglin, P.M., Rutherford, R. C. & Springer, T. M. (2003). "The Trade-off Between the Selling Price of Residential Properties and Time-on-the-Market: The Impact of Price Setting", *Journal of Real Estate Finance and Economics*, 26, 1, 95 – 111.
- Anglin, P. M. (2003). "The Value and Liquidity Effects of a Change in Market Conditions", Mimeo, Department of Economics, University of Windsor.
- Arnold, M. A. (1992). "The Principal-Agent Relationship in Real Estate Brokerage Services", *Journal of the American Real Estate and Urban Economics Association* 20: 89 – 106.
- Asabere, P., Huffman, F. & Mehdian, S. (1993). Mispricing and Optimal Time on the Market," *Journal of Real Estate Research* 8 (1), 149 – 156.
- Benefield, J. D. & Sirmans, G. S. (2009). "The Influence of Contingent Closing Costs on Sale Price, Time on Market, and Profitability of Sale", *Journal of Housing Research*, 18, 2, 121-142.
- Benefield, J. D., Rutherford, R. C. & Allen, M. T. (2011). " The Effects of Estate Sales of Residential Real Estate on Price and Marketing Time, *Journal of Real Estate Finance Economics* (online).
- Benjamin, J. D. & Chinloy, P. T. (2000). "Pricing, Exposure and Residential Listing Strategies", *Journal of Real Estate Research*, 20:1/2, 61-74.
- Belkin, J., Hempel, D. J. & McLeavey, D. W. (1976). "An Empirical Study of Time on Market Using Multidimensional Segmentation of Housing Markets," *AREUFA Journal* 4: 2 (Fall), 57-75.
- Bourassa, S. C., Haurin, D. R., Haurin, J. L., Hoesli, M. & Sun, J. (2009). "Housing Price Changes and Idiosyncratic Risk: Impact of Property Characteristics", *Real Estate Economics* 37; 2; 259-270.
- Breslow, N. E. (1974). "Covariance Analysis of Censored Survival Data." *Biometrika*, 30, pp. 89-99.
- Cheng, P., Lin, Z. & Liu, Y. (2010). "Home Price, Time-on-Market and Seller Heterogeneity Under Changing Market Conditions", *Journal of Real Estate Finance Economics*, V. 41, 3, 272-293.
- Cleves, M., Gould, W., Gutierrez, R. & Marchenko, Y. (2008). *An Introduction to Survival Analysis Using Stata*, 2<sup>nd</sup> Edition, Stata Press.
- Cox, D. R., (1972). "Regression Models and Life Tables", *Journal of the Royal Statistical Society*, Series B, 34, pp. 187-220.
- Cox, D. R., (1975). "Partial Likelihoods" *Biometrika*, 62, pp. 269-276.
- Culp, R. P. & Retzlaff, T. M. (2008). "Duration of Marketing Time of Residential Housing with Dissimilar Buyer Search Effort", *Southern Business and Economic Journal* 31; 3&4, p. 19-42.
- Elandt-Johnson, R. C. & Johnson, N. L. (1980). *Survival Models and Data Analysis*, John Wiley and Sons, New York.

- Ferreira, E. J. & Sirmans, G. S. (1989). Selling Price, Financing Premiums, and Days on the Market, *Journal of Real Estate Finance and Economics*, 2: 209-222.
- Glower, M., Haurin, D. & Hendershott, P. (1998). "Selling Time and Selling Price: The Influence of Seller Motivation," *Real Estate Economics*, 2: 209-222.
- Greene, W. H, (2008). *Econometric Analysis*. 6<sup>th</sup> edition, Pearson-Prentice-Hall.
- Haurin, D. R. (1988). "The Duration of Marketing Time of Residential Housing", *Journal of the American Real Estate and Urban Economics Association* 16; 4 396-410.
- Haurin, D. R., Haurin, J. L., Nadauld, T. & Sanders, A. (2010). "List Prices, Sales Prices, and Marketing Time: An Application to U.S. Housing Markets", *Real Estate Economics*, 38, 4, p. 659-685.
- Hopkins, A. (1981). "Regression with Incomplete Survival Data." *BMDP Statistical Software, 1981 ed.*, University of California Press, 1981, pp. 576-594.
- Horowitz, J. L. (1992). "The Role of the List Price in Housing Markets: Theory and an Econometric Model", *Journal of Applied Econometrics* 7(2): 115-129.
- Huang J. & Palmquist, R. (2001). "Environmental Conditions, Reservation prices, and Time on the Market for Housing", *Journal of Real Estate Finance and Economics*, 22, 203-219.
- Johnson, K. H., Benefield, J. D. & Wiley, J. A. (2009). "Architectural Review Boards and Their Impact on Property Price and Time-on-Market", *Journal of Housing Research*, 18, 1, 1 – 18.
- Jud, G. D., Seaks, T. G. & Winkler, D. D.T. (1996). "Time on the Market: The Impact of residential Brokerage, *Journal of Real Estate Research*, 12, 447 – 458.
- Kang, H. B. & Gardner. M. J. (1989). "Selling Price and Marketing Time in the Residential Real Estate Market", *Journal of Real Estate Research*, Vol. 4, (1) 21-36.
- Kaplan, E. & Meier, P. (1958). "Nonparametric Estimation from Incomplete Observations." *Journal of American Statistical Association*, 53, pp. 457-481.
- Kiefer, N. M. (1988). "Economics Duration Data and Hazard Functions." *Journal of Economic Literature*, 26, June, pp. 646-679.
- Knight, J. R, (2002). "Listing Price, Time on Market and Ultimate Selling Prices: Causes and Effects of Listing Price Changes", *Real Estate Economics*, V30, 2, p 213-237.
- Levitt, S. D. & Syverson, C. (2008). "Market Distortions When Agents are Better Informed: The Value of Information in Real Estate Transactions", *The Review of Economics and Statistics*, Vol. XC (Nov) (4), 599-611.
- McGreal, S., Adair, A., Brown, L. & James R. Webb (2009). "Pricing and Time on the Market for Residential Properties in a Major U.K. City", *JRER*, Vo. 31, 2, 209-233.
- Meyer, B. (1988). "Semi-Parametric Estimation of Hazard Models." Northwestern University, Department of Economics..

- Miller, N. G. & Sklarz, M.A. (1987). "Pricing Strategies and Residential Property Selling Prices", *Journal of Real Estate Research*, 2 (1): 31-40.
- Sirmans, C. F., Turnbull, G. K. & Dombrow, J. (1995). "Quick House sales: Seller Mistake or Luck?", *Journal of Housing Economics*, 4, 230-243.
- Taylor, C. (1999). "Time on the Market as a Sign of Quality", *Review of Economic Studies*, 66 (3), 555-578.
- Tobit, J. (1958). "Estimation of Relationship for Limited Dependent Variables." *Econometrica*, 26, pp. 24-36.
- Trippi, R. R. (1977). "Estimating the Relationship between Price and Time of Sales of Investment Property", *Management Science*, 23 (April), 838-42.
- Turnbull, G. K. & Dombrow, J. (2007). "Individual Agents, Firms and the Real Estate Brokerage Process" *Journal of Real Estate Finance and Economics*, 35, pg. 57-76.
- Turnbull, G. K. & Zahirovic-Herbert, V. (2012). "The Transitory and Legacy Effects of the Rental Externality on House Price and Liquidity", *Journal of Real Estate Finance and Economics*, 33, 3, 275 – 297.
- Yavas, A. & Yang, S. X. (1995). "The Strategic Role of Listing Price in Marketing Real Estate: Theory and Evidence", *Real Estate Economics*, 23, 3, 347-60.