My Home's Market Value: An Active Market Pricing Model

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Abstract

The current US residential real estate market is recovering although price growth remains stagnant. The non-linear pricing model examined represents a first investigation in the area of a single variable, polynomial correlation model. Using data from Easton, Connecticut demonstrated that when sellers set initial prices outside of a computed 95% confidence interval for similar properties no offers are forthcoming prior to asking price reductions and offered properties remain on the market longer.

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Starting around 1965 national home ownership and occupancy rates grew on a positive basis (United States Census Bureau [Census], 2010). As a result, paying a premium on purchase was acceptable as the probability was high that the market would eventually 'catch up' to their pre-purchase valuation. Sellers' and buyers' agents had a high level of confidence that listings would continue to sell in a reasonable time frame. Linear models for residential real estate valuations were widely acceptable to all parties.

Between 2005 and 2008 owner occupancy flattened and then declined following the Great Recession of 2008 (Census, 2010). The immediate effect of the 2008 financial crisis on residential real estate was to lower market valuations from 10% to 50% depending on the geographic location (Census, 2010). Sellers either withdrew from the market or rented their properties to avoid realizing a loss on sale and buyers stayed out of the market not wanting to overpay for a property that could continue to lose value (National Association of Realtors [NAR], 2014).

Although the residential real estate market has stabilized in the five years following the financial crisis of 2008 the market remains generally depressed with price growth stagnant (NAR, 2014). Sellers remain reluctant to accept this market change as structural while buyers want to embrace the change and agents for the parties lack a pricing model to reduce the time gap as measured in Days on Market [DOM]. This results in increasing costs for sellers and agents while reducing the opportunity risk of waiting for buyers as properties remain active for longer periods versus the pre-2008 market. In turn forecasting an initial asking price using traditional hedonic pricing models is problematic: buyers have lost confidence in the market's future demand to offset a buyer purchase premium. It is timely to develop a residential real estate

pricing model that can offer guidance to sellers on the initial listing price and concurrently provide buyers with a measure of the potential premium they may pay.

Modeling an Initial Asking Price

The prevailing approach to developing an initial asking price for a residential sales offering is to apply some variation of a hedonic pricing model (Sirmans, Macpherson, & Zietz, 2005). Hedonic pricing models are based on the premise that the price of an item can be decomposed into its elements—internal or relating to the property and external relating to things such as the quality of the school or the air quality (Sirmans et al., 2005). As originally conceived hedonic modeling is based on decomposing a complex item into a subset of components that have individual market value. As such these variables could be measured and should be independent of each other (Sirmans et al., 2005).

Hedonic Model Applications

While a residence can be decomposed into its parts such as a kitchen or a bedroom, a market does not exist for such decomposed items. Any value analysis leads to creating a set of dependent variables as a component's price is a function of other components such as total house size and neighborhood location. In using a multivariate hedonic approach, these dependent variables are included to build model explanation.

As a result of this variable dependence, these pricing models present artificially high measures of correlation. Research supports alternative correlation models given, investigations into spatial relevance superseding hedonic modeling variables (Smith, 2009), application of a paired repeat sales estimator as a hedonic model alternative (McMillen, 2012) and the finding that consumer sentiment is a significant exogenous variable in home pricing versus hedonic variables (Changha, Soydemir, & Tidwell, 2014).

Hedonic model variables. Although hedonic decomposition leads to sets of auto-correlated dependent variables it is significant to note that two variables—age and home size—consistently emerge as the primary explainers for price variance in hedonic price modeling (Sirmans et al., 2005). Each variable can be controlled through a selection process that groups homes of similar age within a given locale. This moderates the effect of age on the model.

A community's general development process should also be incorporated. The growth of housing stock reflects the growth in the population and the state of the economy (NAR, 2014). During the second half of the 20th century much of the housing stock growth occurred with multiple homes becoming available in tracts as developers met market needs. Such developments would offer home models that could accommodate families of between two and six members. Given that the value of a bedroom is dependent on family size in a decomposition of a house the value of the item would have wide variability. As a proxy for family accommodation square footage has the widest application (Forgey, 1996; Kluger & Miller, 1990).

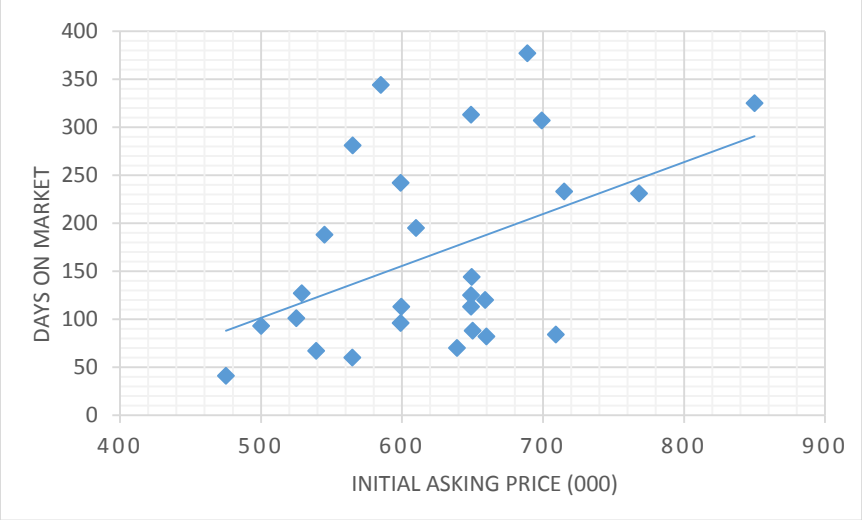
Initial Listing Price Strategies

In modeling the home seller's search for a buyer it has been proposed that a Poisson distribution would be appropriate as buyers arrive at a certain rate (Rosenthal, 2011). This suggests that a link between an initial asking price and the DOM should exist however, it has not been clearly demonstrated. Yavas and Yang (1995) introduced a two-stage regression model that uses a hedonic approach in stage one. The authors found that sellers will routinely overprice their initial asking price due to market ignorance or naïve optimism, which leads to increased DOM. Concurrently the authors demonstrated that DOM could introduce a discounting factor into buyer negotiations once an initial asking price is subsequently reduced to the point that offers are forthcoming (Yavas & Yang, 1995).

These findings parallel an earlier empirical study (Asabere & Huffman, 1993) estimating that when DOM exceeds the accepted number, which has hovered around 90 days during recent years (NAR, 2014) sellers will pay a premium of as much as 0.08% per day for each day that the home remains on the market. One outcome of such studies is to ignore the initial asking price to DOM relationship (see Figure 1) given weak measures of the coefficient of determination (r^2) and leads to settling on a simpler ordinary least squares [OLS] model (Sirmans et al., 2005).

Although DOM is not considered as a variable in these OLS models, a preliminary review supports that modeling decision. Using OLS regression, the initial asking price regressed against the DOM yielded a weak r^2 value of .203. This suggests that the data contains substantial variation as shown in Figure 1.

Figure 1.



Initial asking price is the independent variable and DOM the dependent. Simple regression yields a weak r^2 value reflecting the wide variance between $500,000 and $700,000 asking prices.

Market Transparency

In actively traded markets such as equities or options, excessive asset pricing does not pose a problem; sellers and buyers are continuously adjusting transparent asked and offered

prices, which results in sales transactions that minimize each party's exposure to market risk as many sellers and buyers are in the equity market at any moment (Lin & Vandell, 2007).

In contrast, residential real estate transactions are considered to be heterogeneous within decentralized markets that suggest extensive seller searching for a buyer (Lin & Vandell, 2007). This creates a situation where sellers and buyers are adjusting asked and offered prices in the absence of instantaneous market feedback. This state of ignorance is compounded by not seeing a set of asking versus offered prices at any moment in the negotiation process. Real estate agents act as the intermediaries and buyers are strongly discouraged from bidding on more than one property at a time.

When buyers become active in the residential home market much of the initial evaluation of their needs and the availability of housing stock has been determined (NAR, 2014). On average a typical active buyer will view ten properties over a ten week period before moving to a purchase contract (NAR, 2014). Much of the preliminary sorting of properties once handled by personal inspection is now conducted using Internet-based multiple listing services [MLS] (GAO, 2005). The effect is to limit or hide the number of participants in the buyer pool from which sellers are seeking prospects. In essence, in person showings have declined which extends the seller's search time. Additionally, the prospective buyer has been conditioned to expect that properties will remain on the market for longer periods given seller over-market initial asking prices. This situation is compounded with the lack of data regarding asked and offered prices.

Model Data

Easton is an exurban community approximately 65 miles northeast of Manhattan New York. It is considered within a commutable distance of Manhattan. 75% of the town is not available for development being a part of the Southern Connecticut watershed. The town excludes commercial development with the exception of local farms. Approximately 7200

residential properties exist in the town and lot sizes range from less than an acre to five or more with three acres being the average.

The “sweet spot” for the Easton $400k-$750k single family home market is a 2850 square foot property that sells for $210.00 per square foot or a closing price of $598.5k. As property sizes decrease the cost per square foot to build is not directly proportional resulting is a higher per square foot closing price with smaller homes up to the point that the house footprint is too small to build. As an example, a 2000 square foot home may have an average per square foot closing price of $270.00 with a total closing price of $540k versus the 2850 square foot home with an average closing price of $598.5k (see Table 1).

Table 1.

Easton, CT Properties Sold During the Past Twelve Months Ranked By Total Square Footage

Address	Sq. Ft	Init. Ask	Price Reduction/s	Closing Price	Multiple Offers	Days on Market*	Reduced/Init. Ratio	Closing/ Reduced Ratio	Closing/Init. Ratio
480 Judd	1616	500	0	500	0	93	0.0%	--	100.0%
949 Sport Hill	1838	545	495	465	0	188	90.8%	93.9%	85.3%
134 Wilson	1938	475	0	430	0	41	0.0%	--	90.5%
35 Staples	1969	599.5	574.5	550	0	113	95.8%	95.7%	91.7%
92 Gate Ridge	2030	565	519	515	0	281	91.9%	99.2%	91.2%
212 Sport Hill	2190	649	610	600	0	313	94.0%	98.4%	92.4%
286 Morehouse	2264	539	0	530	0	67	0.0%	--	98.3%
45 Glovers	2308	599	0	600	1	96	0.0%	--	100.2%
20 Ridgedale	2448	564.7	0	547.7	0	60	0.0%	--	97.0%
76 Burr	2464	768	620	590	0	231	80.7%	95.2%	76.8%
89 Far Horizon	2512	529	499	444	0	127	94.3%	89.0%	83.9%
52 Tersana	2574	649	0	606.1	0	125	0.0%	--	93.4%
729 Morehouse	2612	650	0	615	0	88	0.0%	--	94.6%
45 Knollcrest	2635	525	525	485	0	101	100.0%	92.4%	92.4%
14 Virgina	2728	709	0	720	1	84	0.0%	--	101.6%
50 Deepwood	2967	659	649	630	0	120	98.5%	97.1%	95.6%
22 Division	3000	850	725	723.8	0	325	85.3%	99.8%	85.2%
8 Vista	3000	689	569	525	0	377	82.6%	92.3%	76.2%
19 Gregory Farm	3010	599	590	576	0	242	98.5%	97.6%	96.2%

30 Reilly	3087	649	0	622	0	113	0.0%	--	95.8%
200 Mile Common	3150	715	699	680	0	233	97.8%	97.3%	95.1%
65 Hunting Ridge	3321	639	0	620	0	70	0.0%	--	97.0%
155 Staples	3370	610	0	610	0	195	0.0%	--	100.0%
36 Meadow Ridge	3503	699	649	614	0	307	92.8%	94.6%	87.8%
115 Vista	3530	659.9	644.9	621	0	82	97.7%	96.3%	94.1%
33 Reilly	3697	649.5	0	590	0	144	0.0%	--	90.8%
17 Drewbarrie	4227	585	530	530	0	344	90.6%	100.0%	90.6%

The Model

The Active Market model brings together the seller's desire to optimize the initial asking price and the buyer's desire to avoid paying a purchase premium. The objective of the model is to improve the efficiency of the residential real estate market by providing all parties with non-technical visual tools based on readily available sales data. This model entails using recent residential sales data to determine a ratio of closing price to square footage sold. The use of this ratio works to minimize any problem with heteroscedasticity in evaluating sales of properties of varying sizes. The issue of heteroscedasticity arises when independent variables used in the regression demonstrate variance among their respective dispersions (Sirmans et al., 2005).

Properties sold during a twelve month period—July 2013-July 2014—with initial asking prices between $400k and $750k were drawn from the national Listingbook database for Easton, Connecticut (Listingbook Website, n.d.); a total of 27 properties. Properties identified with a sales price in excess of the asking price, no interim asking price adjustment and a DOM less than the 90 day average (NAR, 2014) were not included. Two such properties were found and removed from the data. The remaining sales data were used in the construction of the model.

To increase data homogeneity sales were analyzed in like groups as a function of total square footage. This application of a nearest neighbor concept is consistent with statistical learning methods. As the absolute closing price increases the closing price to square foot ratio

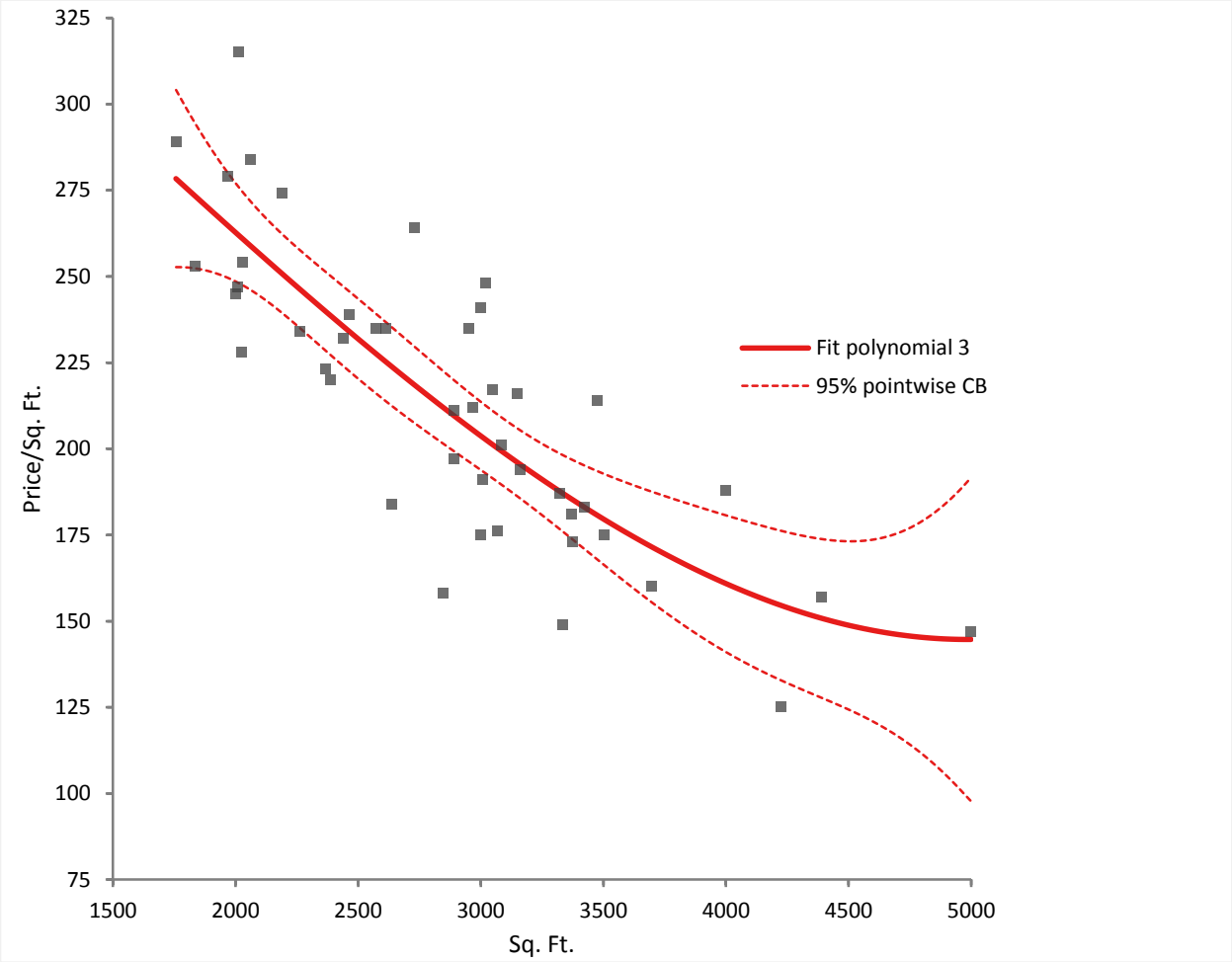
declines. This declining ratio reflects the fact that as a house gets bigger not all components increase in value at the same rate. For example, when the house size increases to accommodate a larger family this may result in additional bedrooms and perhaps greater common space area. However, the increase is not linear as such as the quality of the kitchen may not increase concurrently.

A third degree polynomial regression was used to map and regress closing prices per square foot on the square footage of homes sold in the market. The model explained 68% of the variation of the regression which is considered to be strong (Sirmans et al., 2005). The literature supports the use of a single variable in explaining pricing variance; multivariable analysis is not additive to modeling asking price variance. The resulting model follows:

$$Price/Sq.\ Ft. = Constant - 0.05412\ Sq.\ Ft. - 7.615e\text{-}06\ Sq.\ Ft.^2 + 1.745e\text{-}09\ Sq.\ Ft.^3$$

This model allows sellers to view an active market and determine where their initial asking price will place them relative to recent sales of houses of similar size. This provides the seller with control of the DOM versus any premium that they may want to seek. Concurrently, the model allows buyers to view any market activity and to measure the premium being asked for by sellers versus other active listings (see figure 2).

Figure 2.



Each data point represents a home sale during the past twelve month period. The fitted third degree polynomial is shown in solid red surrounded by the 95% confidence interval—dotted red.

Following the modeling of the data Table 2 highlights the discontinuous nature of buyer activity in the market. Using 2000 square feet for a comparison, the upper and lower limits demonstrate that a modest drop in the per square foot asking price will significantly reduce the number of days that this average home is on the market.

Table 2.

Per Square Foot/DOM Easton $400k-$750k Real Estate Analysis

Source	Resulting Per Square Foot Price	Net Days on Market
Upper Confidence Limit	$280.00/s.f.	269 days
Market average at 2000 s.f.	$265.00/s.f.	169 days
Lower Confidence Limit	$250.00/s.f.	38 days

Using this model sellers can assess where the market is active in terms of sales based on the square footage offered. Similarly buyers can note where the market is active in terms of the square footage that they are interested in. Given this additional information regarding where the market is active, buyers will feel greater confidence in making offers and sellers will see the basis for the buyer's offer. This facilitates a more efficient negotiation process without violating seller – agent and buyer – agent confidentiality.

Model Validation

Three homes around 2000 square feet that had sold and three homes of similar size that were actively on the market were compared to determine the model's ability to predict the per square foot closing price and the resulting DOM (Table 3).

Table 3.

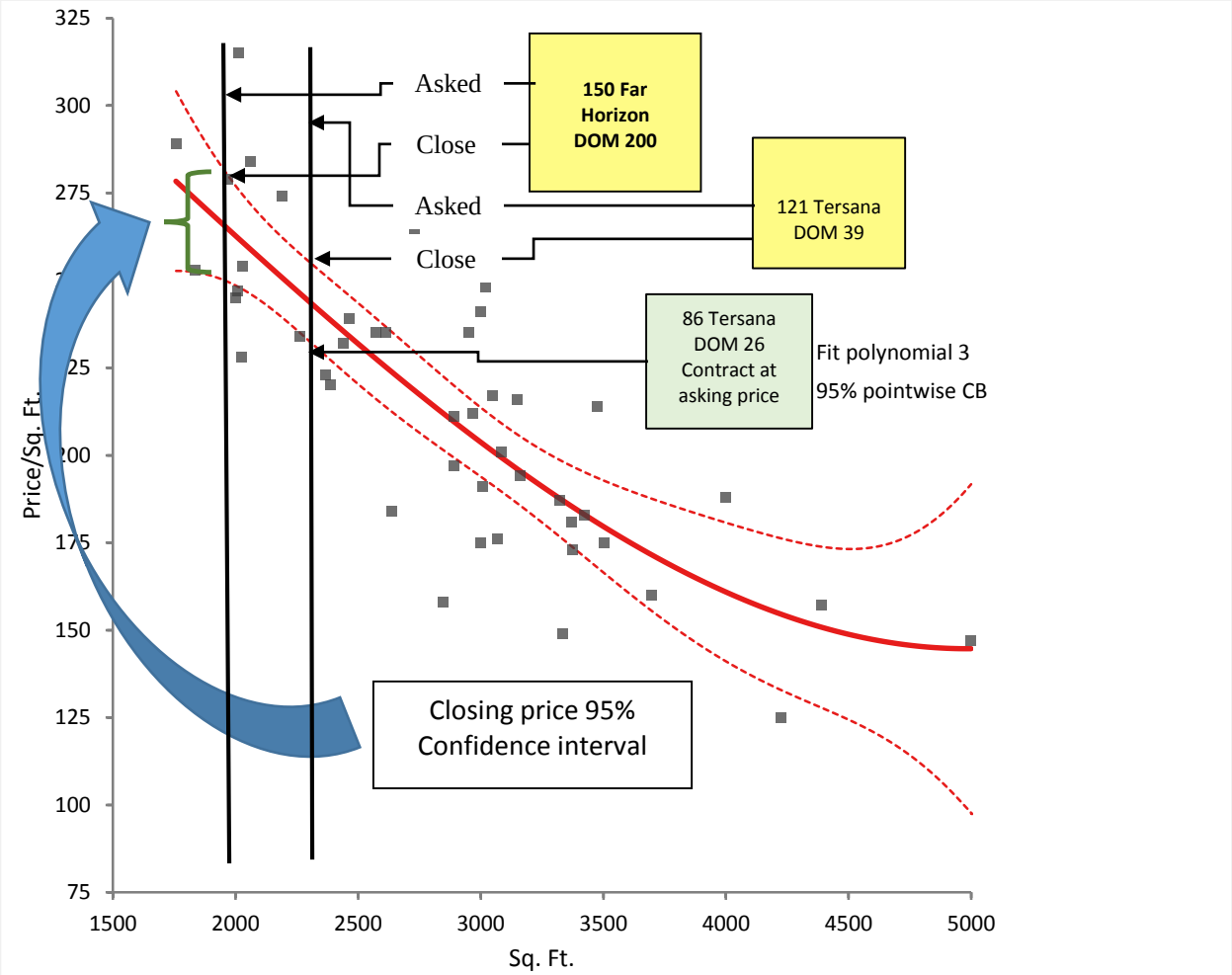
Easton Properties (1930-2030 sq. ft.) sold in the Past 12 Months

Address	Sq. Ft.	Init. Ask	Initial Asking Price per Sq. Ft.	Closing Price	Closing Price per Sq. Ft.	Days on Market (total)	Closing/Init. Ratio
35 Staples	1969	599.5	$304.47	550	$279.33	113	91.7%
92 Gate Ridge	2030	565	$278.83	515	$253.69	281	91.2%
134 Wilson	1938	475	$245.10	430	$221.88	41	90.5%

Given significantly above initial asking price amounts it is clear that when square foot prices exceed a certain level there is a significant negative effect on DOM.

The three active homes were of similar size in square footage and lot size. Each home was plotted on the original graph depicting the data for the Easton market (Figure 3).

Figure 3.



Of the three homes one—86 Tersana—sold for its asking price in 26 DOM. The asking price was set at the lower 95% confidence interval boundary. In contrast 150 Far Horizon set the initial asking price significantly above the upper 95% confidence interval. It received no offers until the asking price was reduced to close to the upper 95% confidence interval and it closed at the 95% confidence interval boundary. 121 Tersana closed after 39 days on the market after the seller accepted a significantly lower offer versus the asking price. The closing price was at the upper 95% confidence interval boundary.

Conclusion

The residential real estate market has stabilized in the five years following the financial crisis of 2008 although price growth remains stagnant (NAR, 2014). In an effort to secure new owner-occupied home sales listings, real estate agents have allowed sellers to set initial asking prices that do not reflect the structural change that has occurred in the market. Similarly buyers do not want to pay a premium over the market price when they may not be able to recover it through market price appreciation. Essentially this situation has introduced additional uncertainty into the market that is exacerbated by the lack of market transparency.

Despite this increased buyer uncertainty real estate agents continue to use some variation of the accepted hedonic pricing model to help sellers determine an initial asking price (Sirmans, Macpherson, & Zietz, 2005). The literature supports that the application has shortcomings, which may have been hidden by the ebullience of the pre-2008 market. This is coupled with sellers who are using already inflated initial asking prices provided by agents when making their own initial asking price decisions.

The objective in developing the model was to examine how market uncertainty can be reduced as measured in listing times or DOM and market transparency. Using property closing prices per square foot in lieu of actual prices controls for heteroscedasticity; the model is further moderated with the use of data from a community where the properties being offered are homogenous. Lastly, rather than rely on a set of variables that may be highly correlated resulting in artificially high correlation coefficients, the model takes advantage of a non-linear third degree polynomial computational approach.

Building this model with the training data from the Easton community demonstrated that when sellers set too high a price vis-à-vis the closing prices for similar properties it results in no offers prior to asking price reductions. This is to be expected given the discrete variable nature of

asked and offered prices. This model allows sellers to view an active market and determine where their initial asking price will place them relative to recent sales of houses of similar size. The model can also benefit the agent who is working to get the seller to an initial asking price that will generate foot traffic and offers. The model provides buyers with a realistic view on what premium they may have to pay to close on a property.

The model was tested using three homes around 2000 square feet that had sold and three homes of similar size that were actively on the market. Following the selling process for the three active homes validated the model's ability to predict initial asking price points that generate offers while maximizing the seller premium that buyers are willing to pay in today's real estate market. It was clear that the homes that were in line with the model fared better in terms of closing price and DOM.

This model represents a first investigation in this area of single variable polynomial correlation. The dependent variable of closing price per square foot needs validation across a larger pool of properties as well as testing across markets of greater diversity in housing stock. That said, it appears to hold promise in meeting its objective of reducing DOM and increasing market transparency.

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