HOW CAN BIG DATA GIVE MORE POWER TO BUYERS IN THE IRISH RESIDENTIAL PROPERTY MARKET?

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ABSTRACT

With demand far outweighing supply in the Irish residential property market, house prices are rising more rapidly than income. This presents a barrier to home-ownership for buyers especially those entering the sales market for the first time from an already unaffordable rental market. This report investigates how big data can help give more power to the Irish buyer in a seller's market. Critical analysis of past literature was conducted to assess big data's applications in the property market, this analysis was then used to assess the ways in which big data can help the buyer. A case study was also reviewed that was particularly focused on using data science in the Irish residential property market. More accurate valuations and a more personalised buying experience through content-based filtering were among the ways in which data can help the buyer improve decision making and get the most value for their money. Big data does possess the potential to revolutionise the buying experience, however it is also subject to limitations. Inaccuracies in some predictive methods and slow adoption, as well the average buyer's lack of technological knowledge and computing power mean that it is not the answer to all buyers' problems in the market. Some onus will be placed on listing agencies and real estate agencts to provide buyers with easy to use interfaces in order for them to fully reap the rewards of data in the market.

INTRODUCTION

Irish residential property has been among the asset classes least negatively affected by Covid-19 during 2020 and into 2021, as citizens around the country were told to stay at home. Despite the global pandemic residential house prices rose 2.2% year-on-year in 2020 (CSO, 2020). The outlook for 2021 is similar with house prices expected to rise 4% on average nationally. Limited supply of properties is one of the driving factors behind the expected increase, with the Society of Chartered Surveyors Ireland predicting that supply may not satisfy demand until 2031 (SCSI, 2021). In the latest report by Daft.ie the supply of properties listed for sale fell 40% in March 2021 as compared with the year previous, while demand has remained much the same in spite of the pandemic. Supply hasn't been as low since 2014 following the financial crisis when demand was significantly lower (Daft.ie, 2021). This has lead to the increase in property prices we are seeing and will likely continue to see until supply can satisfy demand.

The rental market offers no solace to prospective home buyers, prices have risen 2.7% year-on-year in 2020 (Residential Tenancies Board, 2021). Rental prices have increased on average 6.3% every year from 2013 to 2019 and in early 2020 were 32% higher than before the financial crisis in 2008 (Jose Doval Tedin & Faubert, 2020). Buyers in the Irish market are stuck between a rock and a hard place, renting is a costly option long term but the required mortgage deposit of 10% the property value is unattainable for many.

Just as rental and housing prices have grown since the 2008 financial crisis so too has digitisation and data. In 2010 there was just 2 zettabytes (trillion gigabytes) of data in the world, this number has grown to 59 zettabytes in 2020 and is expected to reach 149 in 2024 (Statista.com, 2020). Could all this newly created data be the answer to the problems in the market? Can big data help give more power to buyers in the Irish residential property market?

Big data is defined as data available in such large quantities and from such a variety of frequently updated sources that it requires advanced technologies and analytics to process and glean value from the data (De Mauro, et al., 2016). Big data in the context of the Irish property market can take many shapes and forms. Buyers may be primarily focused on amenities, transport links, and schools in the area surrounding their desired property as well as the specifications of the property itself. For suppliers there may be more focus on the industry details; customer engagement data, planning permission records, building energy ratings (BERs) etc. Using specialised big data analytics industry leaders could harmonise these disparate datasets and improve decision making on both the buyer and seller side of the market.

This report will discuss how big data driven improvements to property valuations and more personalised buyer experiences can help give more power to buyers in the absence of increased supply in the market. This includes a case study specific to finding a home in Dublin using big data analytics. The report also discusses the challenges that face buyers in getting access to big data.

While the focus of this report is centred on the Irish residential property market, given the global availability of data, many of the potential advantages and disadvantages of big data could be easily translated to other property markets. An interesting area of further research would be to compare how big data can shape property markets with excess supply rather than demand, for example commercial and office properties in a market shifting towards working remotely. Other areas could include focusing on how big data could help Irish property developers and government improve decision making and bridge the gap between housing supply and demand in the market, or how using big data to cut construction costs could lower the average house price in Ireland making housing more affordable.

PROPERTY VALUATION

The price of housing in Ireland is proving a barrier to home ownership for many especially those entering the housing market for the first time. EY found in a study using their property tool that in 46% of counties in the country houses were unaffordable for first-time buyers. This finding was based on two criteria, the deposit required to secure a mortgage (typically 10% of the property valuation), and the cost of the mortgage repayments (EY, 2021). The challenges facing buyers in the market start with the valuation of properties but can much can we trust these valuations?

HOW ACCURATE ARE PROPERTY VALUATIONS?

Prior to sophisticated data modelling and predictive methods property valuations were conducted using one of three heuristic approaches to produce a valuation estimate, the cost approach, the income approach and the comparable sales approach (Cannon & Cole, 2011). The comparable sales approach, the most common of the three used the sales price of similar properties to arrive at a valuation. The cost approach used the cost of constructing a building to replace the valuation building. Meanwhile the income approach utilises the income produced from renting the building. All three heuristic approaches have their downfalls, for both the cost and income approaches, construction costs and renting prices can vary greatly causing the valuation to be inaccurate. The comparable-sales method can be inaccurate as two properties are never truly comparable, two houses opposite one another on the same street could have different levels of natural light, different previous owners and most importantly sold under different market conditions (Kok, et al., 2017).

In their study Cannon and Cole found that property valuations had an absolute deviance of 12% on average from the true sale price (Cannon & Cole, 2011). They also found that valuations tended to lag behind the market and as such over-priced properties during market troughs and under-priced values in market peaks. This study focused only on commercial property in Chicago and as such may not be as easily applicable to the Irish residential market. The study also used data ranging from 1984

to 2010 when manual and traditional valuation methods would have been more common practice in the industry.

MSCI however produce a yearly global report detailing the variance between property valuations and their eventual sale price. As compared with the Cannon and Cole (2011) study the 2019 MSCI report is more likely to include sophisticated valuation methods utilising mathematical and machine learning models. This might explain lower absolute differences between the valuation and sale price. The report was perhaps more thorough and due considerations were given to ensure that the valuation and sales price data is representative. These considerations include; 1) using only valuations made over 3 months before the sale to avoid any valuation influence on the sale price, 2) adjusting the valuation to the market at the time of the sale to mitigate any variance caused by the time value of money, 3) excluding unrepresentative data and outliers. The study found that the global average absolute difference between valuations and their sale prices stood at 10.4% in 2019. They also indicated that the 10-year average stood relatively stable at 10.52% (Walvekar & Kakka, 2020).

Ireland was grouped with 11 other small countries for the report and the average absolute difference for this group in 2019 stood at 10.1% with the 10-year average absolute difference standing at 11.3%. Applying this 10-year difference to the average house price in Ireland, €275,751 (Daft.ie, 2021), yields an average absolute difference of €31,160 between the valuation and sales price, no small sum for a first-time buyer.

AUTOMATED VALUATION MODELS (AVM)

Manual and traditional valuation methods have been shown to be imperfect but how do modern predictive methods fare in comparison? Will hedonic regression, artificial neural networks (ANNs), and non-traditional predictors replace the cost, income and comparable sales approaches in the future of property valuation?

Hedonic regression is among the most commonly used of the modern price predicting techniques as a result of its understandability and ease of implementation. Hedonic regression plots the linear relationship between the dependent variable (property value) and independent variables (desirable features of property, e.g. number of bedrooms, sea-view etc.) (Investopedia, 2021). The regression model can be used to produce weights for each desired feature based on how much it influences the property value.

Hedonic regression does have its limitations, not all predictors of property value have a linear relationship with this value(non-traditional predictors). As such regression fails to account for these and tends only to describe the relationship between traditional predictors such as property size, number of bedrooms etc. In a study of over 18,000 transactions of single-family homes in Berlin Schulz et al. using Monte Carlo simulations show that hedonic regression produced a mean absolute percentage error

(MAPE) of 22.4% when predicting the price of properties in the dataset (Schulz, et al., 2014). This underperforms against manual and traditional valuation methods.

While hedonic regression underperformed in comparison to manual valuations, neural networks have the potential to outperform traditional valuation methods. Neural networks are inspired by the human brain, and made up of neurons. A neuron takes an input, processes it using a formula and produces an output (Appendix 1), much in the same way a brain takes stimuli, noise for example, processes it and turns it into a spoken word (Zhou, 2019).

In a study of 321 properties in Lagos, Nigeria, an artificial neural network outperformed a hedonic regression model, reducing the MAPE from 38.23% to 15.94% (Abidoye & Chan, 2018). This study was limited in its approach, while sufficient data cleaning was carried out the sample size is rather small and as such given a larger sample size it could be expected to see not only the artificial neural network accuracy improve but also the accuracy of the hedonic regression.

In perhaps a more well rounded study by Nils Kok et al. an ANN produced an MAPE of just 9.2% lower than that of the traditional methods (Kok, et al., 2017). The study contained over 36,586 unique properties spread across California, Florida and Texas, three distinct locations. The inclusion of a rigorous data enrichment process and the sheer size of the data sample lend the study more credibility than Adiboye and Chan's 2017 study.

NON-TRADITIONAL PREDICTORS

Most interestingly about Kok et al.'s study is the inclusion of non-traditional predictors in their data. The artificial model was able to use variables such as 'water body within 30 min', 'bars within 3 min' etc. to more accurately predict the value of properties in the dataset. In appendix 2 Kok et al. outline the importance of each category of variable to their prediction models. The results are surprising with the property's attributes paling in significance to the amenities and market dynamics of the location (Kok, et al., 2017).

McKinsey expand on this reporting that "Nearly 60% of predictive power can come from non-traditional variables." These non-traditional variables compliment ANNs and machine learning predictive models more than hedonic regression models as many of these predictors don't have a linear relationship with the value of the property. For example proximity to a singular supermarket may increase property value however proximity to several supermarkets may increase noise pollution or traffic and thus decrease the property value as a result (McKinsey & Company, 2020).

HOW DO MORE ACCURATE VALUATIONS HELP BUYERS?

While big data analytics such as the use of ANNs and non-traditional variables can help improve the precision of property valuations, it is evident there is still a ways to go before the precision reaches the

region of commonly desired 95% confidence levels. But how will more accurate property valuations help the buyers in the Irish residential property market?

With 12,000 properties on sale at any given moment in Ireland narrowing this down to properties within a certain price range is made more difficult when valuations are inaccurate. More accurate information regarding the ultimate sale price of properties can help buyers in Ireland narrow their search, rather than operating in a price range of close to over €62,000 (± average absolute difference of €31,159) buyers in the market can more accurately pin point properties within their means.

As shown by Cannon and Cole (2011) traditional valuation methods tend to lag behind the property market, undervaluing in market highs and overvaluing in market lows. Were this to change such that valuations tracked the market more accurately, buyers and sellers could align their interests and increase efficiency in the market. This could lead to higher throughput in the property market and match buyers with sellers of matching interests.

MORE PERSONALISED BUYING EXPERIENCE

Buyers in the market may also benefit from a more personalised experience catered to their needs. As McKinsey showed non-traditional variables hold 60% of predictive power, this is primarily because buyers are willing to pay more for homes that are close to amenities desirable to them. This section will analyse how different amenities affect the price of housing and discuss a case study in which an Irish data scientist used geographical information systems (GIS) and a range of traditional and non-traditional predictors to find his ideal home.

HOW PROXIMITY TO AMENITIES AFFECTS HOUSE PRICES

Both buyers and sellers have long pedalled the phrase "location, location, location" when it comes to property value. As shown in appendix 2, a properties attributes proved to be less influential overall as compared with attributes of the properties location. As big data becomes more and more common however the traditional locational predictors of value, sea-views and proximity to public transport links for example, are now being joined by newer predictors of value; Starbucks and Yelp reviews.

Traditional locational amenities such as views and closeness of public transports are well known to add value to housing. In a 1998 study of properties in Bellingham, Washington State, USA, poor ocean views (those with partially obstructed views) added 8.2% to the value of the property as compared with those that had no view of the ocean at all. This rose to 58.9% for unobstructed ocean views and even higher to 126.7% for properties with lake frontage as these had access to views and recreational amenities (Benson, et al., 1998). The study covered 5,095 property transactions, dating from 1984-1993, after extensive exclusions to ensure valid results. The quality of views was judged

based on manually assessing the percentage of unobstructed view to guide classification, some subjectivity was used in instances to distinguish between views with similar levels of obstruction but with varying degrees of visual impact. While this subjectivity is useful in distinguishing between extreme cases (unobstructed view of a bay vs. unobstructed view of a bay with a nuclear powerplant in direct view for example) it would be recommended that subjectivity be kept to a minimum to produce accurate results.

In a similar study of how proximity to transit-oriented development (i.e. proximity to transport links and quality pedestrian conditions) affected condominium prices in San Diego, researchers found that favourable pedestrian conditions and being within 0.3 km from a tram station could add between 11.6 and 15.3% premium above the market base price (Duncan, 2011).

Both of these studies came prior to the rapid growth in AI and ANNs, as such both used hedonic regression. As discussed earlier in the report hedonic regression possess limitations with regards to accuracy. It would be of particular interest to see whether these results would significantly change utilising ANNs or machine learning approaches.

With more access to big data buyers will have the potential to utilise content-based filtering to seek out homes with access to traditional amenities that they deem important to them. Big data will also allow buyers in the market to filter on more non-traditional predictors of value such as the amount of 5 star Yelp reviewed restaurants or the number of Starbucks in the area.

In 2015, Zillow (an American online listing agency similar to Daft.ie) observed that properties with Starbucks or Dunkin' Donuts in the vicinity experienced significant growth as compared with those that lacked either of the franchises (See appendix 3 & 4). US property prices had appreciated 65% on average from 1997 to 2014, however those within 400m of a Starbucks had appreciated 96% notably more than the average household (Rascoff, 2015).

As we can see utilising traditional and non-traditional value determinants prospective buyers could search to maximise the value of their homes with regards to their individual needs. This method has been applied to the Dublin housing market in the case study below, in which a data scientist utilises big data below to find his ideal home.

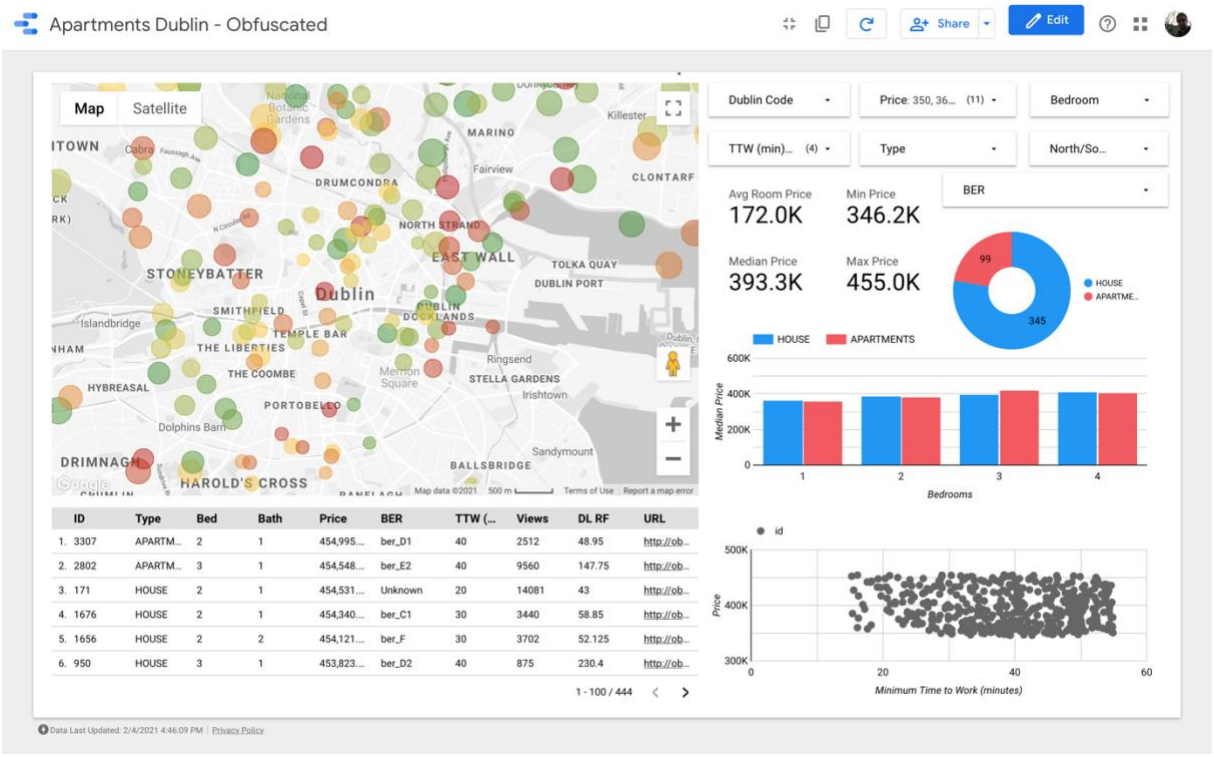
USING DATA TO FIND THE IDEAL HOME: A DUBLIN CASE STUDY

In an article on towardsdatascience.com, a data scientist based in Dublin details how after struggling to find a home within his budget using traditional home seeking methods he took matters into his own hands. Using data scraped from online listing agencies such as Daft.ie and data from numerous other APIs he was able to use data analytics to cluster houses and identify a match to his requirements.

The information requirements outlined were as follows, the length of the commute to work, the number of properties in a specific area, the number and type of amenities in the locality, the average

asking price for properties in a given sample and finally how long had a property been listed. The author cited that while online listing companies aggregate the data of individual real estate agents they fail to harmonise data outside the attributes of the properties themselves. This as has been show (Kok et al., 2017; McKinsey & Company, 2020) is sub-optimal when pricing and selecting a new home.

The author was able to harmonise these datasets and carry out extensive analysis, culminating in a dashboard that allows the user to personalise the experience to their own needs. By setting criteria for their desired home the user is able to assess both visually and quantitatively which homes and areas are most suited to their needs.



The author uses clustering to identify homes with similar traits in distinct locations. This ultimately narrowed the original dataset from c. 4,000 properties to c. 200 and using local knowledge of Dublin narrow this further to 26 prospective properties that matched his needs. This is a promising result that will certainly cut down on the search time for buyers in the market.

Finally the author notes some areas in which the dashboard could be improved: as a result of a storage budget, amenities had to be excluded from the final public dashboard although they were included in his personal analysis, with a greater budget and storage space this could take the product to the next level. Another potential area of improvement cited would be the use geographical information systems such as QGIS, these can make use of sensor data, such as noise pollution or road traffic as well crime rates among other useful datasets to produce telling visualisations for the user (Lalenti, 2021).

This was a fascinating use of big data particular to the Irish market that helped the user narrow their search from thousands of potential homes to a select few. As the author noted online listing agencies often fail to harmonise these datasets and act only as an aggregator for select data. Were Daft.ie for example to implement datasets including traditional and non-traditional value predictors the buyer experience could be radically changed and improved.

CHALLENGES AHEAD

Despite the benefits of big data to the Irish home buyer there are still numerous challenges ahead that need to be addressed before they reap the full rewards of new technologies. Many of these challenges lie at the feet of the supply side of the market. Though big data has the potential to revolutionise the buying experience, the majority of buyers do not have access to sufficient technologies or knowhow to make use of the data. The onus will be on suppliers in the property market to provide buyers with easy to use interfaces to navigate the large quantities of new information entering the market.

To date the property market has been a slow adopter of new technologies. In KPMG's 2021 Data Strategy Survey, 57% of organisations had implemented a digital strategy, this had risen from 52% in both 2018 and 2017. This growth is slow when compared to other industries such as finance or healthcare. Despite the growth in data strategies, only 26% of organisations have data scientists among their staff, this could be a significant barrier to developing user facing products reliant on big data (KPMG, 2021).

Another challenge facing buyers in the market is the the market hierarchy itself. It is important to distinguish between customers and users especially in the digital market. Buyers aren't charged by online listing agencies or real estate agents, it is the seller who pays these organisations, as such the buyer is demoted to the bottom of the hierarchy with seller's needs taking priority. This spurs information asymmetry in the market with sellers, as customers, being offered more information than buyers who act as users. With that being said property organisations are not using big data to improve their own customer's experience. In the same KPMG data strategy survey only 28% of organisations stated they were using data to improve customer experience while 66% stated that strategic decision-making was the main reason for implementing a data strategy (KPMG, 2021). If organisations are not focused on improving customers' experience then what hope is there for buyers (users) in the market?

There are incentives to improve buyer experience, improved buyer experience leads to quicker sale times and cash conversion cycles for organisations. Narrowing a buyer's search from 4,000 properties to 26 expedites the purchasing process, putting money in the hands of the seller and the agent quicker. It is possible that quicker turnaround times will also lead to better customer experience for property sellers, this in turn leads to repeat business and referrals (McKinsey & Company, 2016). A possible trickle down effect could be incurred whereby improving the buyer experience in turn improves the customer experience allowing organisations to increase and consolidate market share leading to increased revenues as opposed to other organisations lagging behind.

This can be done by providing more information to the buyer side of the market; amenities in the area, sensor data on noise pollution and traffic etc. to help them narrow their search. This, in

addition to advertising homes that meet the buyer's wants and needs would allow for a smoother and quicker purchasing process.

CONCLUSION

With supply unlikely to satisfy demand until 2021 (SCSI, 2021) buyers are likely to struggle in the Irish residential property market, big data can ease some but not all of the burden. More accurate property valuations driven by machine learning and artificial intelligence can equip the Irish home seeker with more accurate information to guide their search for a new home. More information from a wider array of data sources can arm buyers with more choice and knowledge about the areas they are investing their futures in. Non-traditional factors from multiple different data sources can help to revolutionise the way we interpret locational value, building attributes may become secondary to the restaurants and cafés in the vicinity as primary predictors of value. As more data enters the property market buyers will need to lobby listing agencies for information as users rather than customers which may prove difficult. The onus will be on agents and intermediaries in the markets such as Daft.ie to provide buyers with a wider variety of information while assessors of property value could make use of more sophisticated methods to increase the accuracy of their valuations. Big data certainly has the potential to help the buyer while supply shortages continue however there are many challenges ahead in implementing a big data approach to real estate.

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APPENDICES

APPENDIX 1:

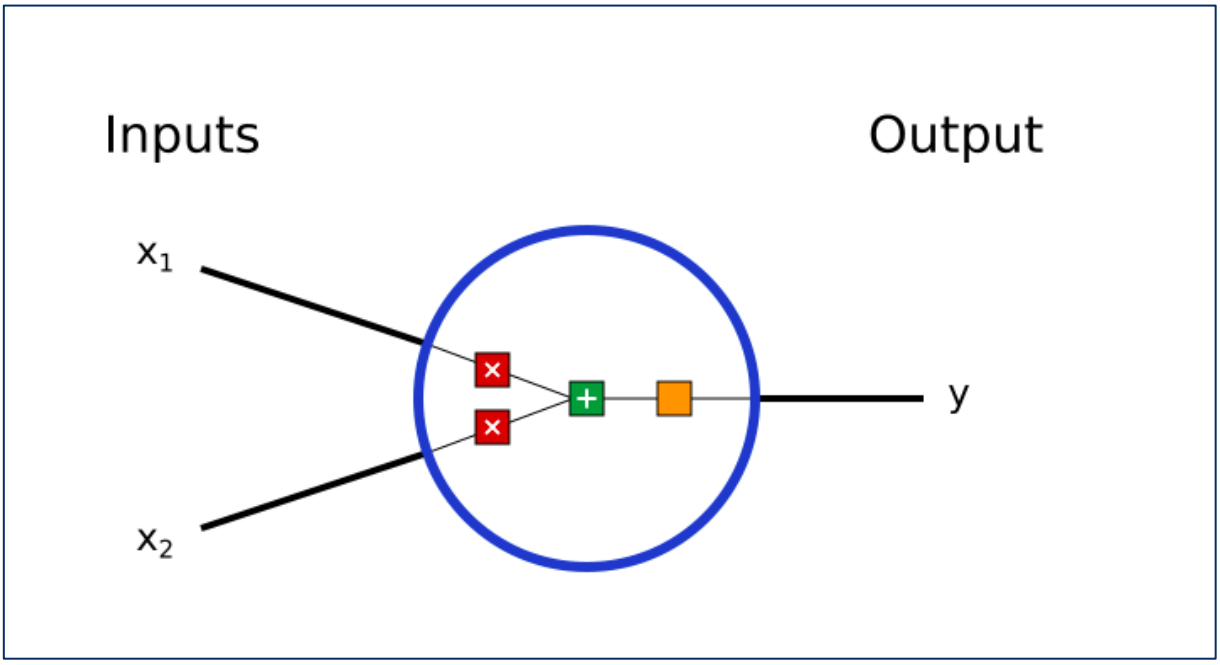


Illustration of Neuron in Neural Network: (Zhou, 2019)

APPENDIX 2:

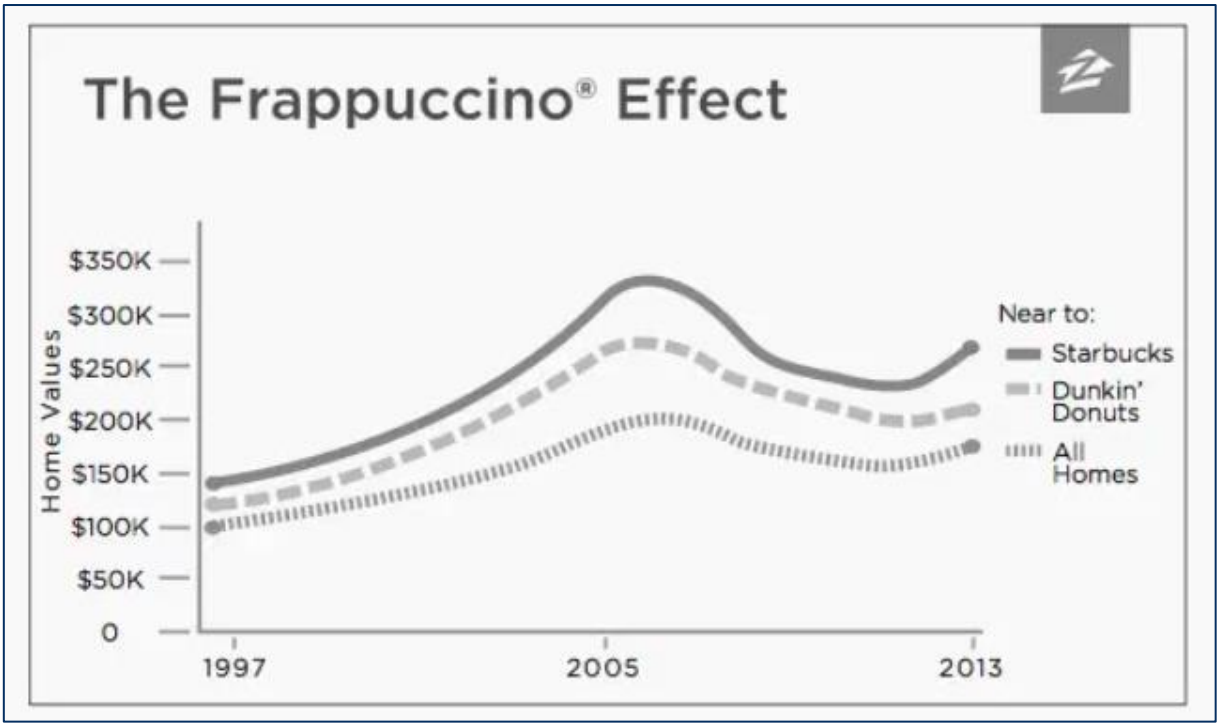
EXHIBIT 5

Model Attributes—Location vs. Property

	Location			Property	
	Amenities	Census	Market Dynamics	Attributes	
Value Model A Excluding NOI	36%	7%	40%	17%	83%/17%
Value Model B Including NOI	25%	18%	33%	24%	76%/24%
NOI Model A 3 state model	50%		11%	23%	16%	84%/16%
NOI Model B MSA LA model	23%	8%	21%	12%	36%	52%/48%

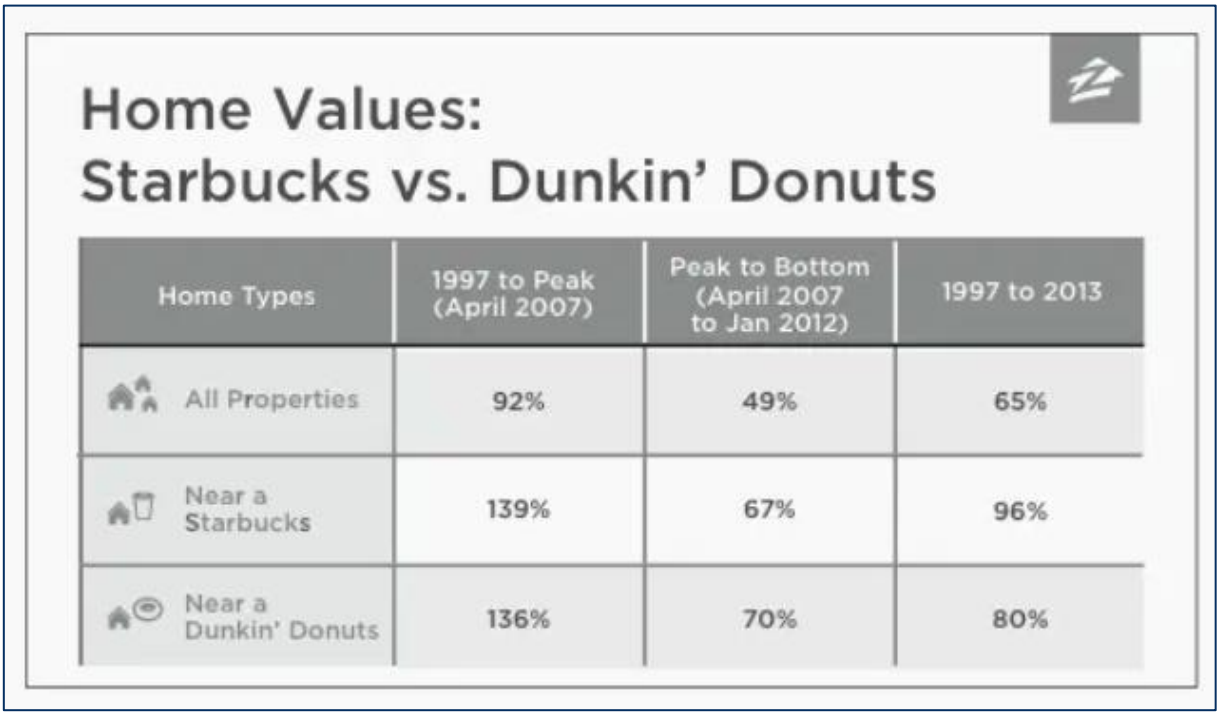
Importance of different property attributes in valuation model: (Kok, et al., 2017)

APPENDIX 3:



Comparing visually the growth in value over time between properties close to Starbucks and Dunkin' Donuts as opposed to all homes: (Rascoff, 2015)

APPENDIX 4:



Home Values: Starbucks vs. Dunkin' Donuts

Home Types	1997 to Peak (April 2007)	Peak to Bottom (April 2007 to Jan 2012)	1997 to 2013
All Properties	92%	49%	65%
Near a Starbucks	139%	67%	96%
Near a Dunkin' Donuts	136%	70%	80%

Comparing numerically the growth in value over time between properties close to Starbucks and Dunkin' Donuts as opposed to all homes: (Rascoff, 2015)