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Homebuyer Purchase Decisions: Are They Anchoring to Appraisal Values or Market Prices?

Ka-Shing Cheung *, Chung-Yim Yiu and Yihan Guan

Department of Property, The University of Auckland, 12 Grafton Road, Auckland 1010, New Zealand; edward.yiu@auckland.ac.nz (C.-Y.Y.); yihan.guan@auckland.ac.nz (Y.G.)
* Correspondence: william.cheung@auckland.ac.nz

Abstract: Price discovery is an important research topic in real estate due to the heterogeneous nature of housing attributes and relatively thin trading activities compared to other assets. In Commonwealth countries, including New Zealand, governments usually conduct periodic appraisals for the purpose of collecting rates and levies. Such official appraisal values of properties, also known as capital values (*CVs*), are considered a price anchor for market participants in their negotiation processes. Real estate agents often use these appraisal values to advertise their listings and negotiate transaction prices. In this study, we aim to make an initial attempt to study the influence of *CV* on market prices using Granger causality tests and a hedonic pricing model. To test the lead-lag relationships, three million housing transactions from 1990 to 2020 in New Zealand are used to construct the capital values (*CVs*) and transacted prices (*TPs*) indices in both primary and secondary housing markets. The Granger causality test suggests that the indices of *TPs* and *CVs* have a bi-directional lead-lag relationship in the secondary housing market, whereas the relationship does not follow in the primary market where the information on *CVs* is unavailable. The results imply the existence of a *CV* anchoring effect. Such anchoring effects are also contingent on the timeliness of price anchors, which is consistent with the availability heuristic from behavioural economics.

Keywords: appraisal; transaction prices; housing market; New Zealand

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1. Introduction

Housing markets are characterised by incomplete information, costly search, decentralised transactions, and low trading volume (Quan and Quigley 1991). The price discovery process of housing assets can be inferred from recent limited transactions or from appraisal values set by valuers. In Commonwealth countries, including New Zealand, governments periodically provide the general public with their official appraisal values of properties, also known as capital values (*CVs*), for the purpose of collecting rates. Market participants in those property markets commonly refer to these appraisal values in setting the listed prices. However, government appraisals constantly refer to the market transaction prices (*TPs*) to estimate *CVs*. Many studies have demonstrated the phenomenon of "appraisal smoothing", in which appraisers rely on historical prices to determine the appraised values (Ibbotson and Siegel 1984). From a behavioural science perspective, the *CV* is argued to be a price "anchor" because market participants, either buyers or sellers, refer to the *CV* as a price point at which to start their negotiation process. More importantly, this information is publicly available at no cost.

Using the terminology of time series analysis, the movement of transaction prices (*TPs*) is said to lead the capital values (*CVs*) in the appraisal process. In contrast, capital values (*CVs*) lead the transaction prices (*TPs*) in the negotiation process. This study aims to test the hypothesis of such a lead-lag relationship between the *TP* and the *CV* movement over time. We make use of the primary (first-hand) and secondary (second-hand) housing markets in New Zealand to test two hypotheses on *CV* and *TP* (i.e., anchoring effect). The

less trivial implication is to exploit the fact that no *CV* is available for buyers in the primary housing market. Thus, in the primary housing market, the *TP* is hypothesised to lead the *CV*, whereas in the secondary housing market, the *TP* and the *CV* are hypothesised to have a bi-directional lead–lag relationship. Primary housing transactions refer to the sale of newly or to-be-completed (first-hand) houses from developers, whereas secondary housing transactions are the sale of existing (second-hand) houses from house owners. In this study, the house transaction data of New Zealand from January 1990 to December 2020 is used. The dataset is subscribed from Corelogic, an international real estate data services provider. The apartment type property, vacant lands, and leasehold properties are excluded from the dataset to keep the consistency of property type.

This paper is structured as follows. In Section 2, we review the literature on the effect of property valuations on transaction prices and the anchoring effects of appraised values in the property market. In Section 3, we outline the research design. In Section 4, we present the data with the empirical results. In Section 5, we conclude with our findings and the implications of the study.

2. Literature Review

Property appraisal values and transaction prices affect each other in a real-life context. The development of valuation theory is worthwhile for empirical testing (Parker 2006). In property valuation, the most common appraisal method is using comparables. This method requires appraisers to make reference to the market prices of recently transacted properties (RICS 2019). Property appraisal values are therefore intrinsically reliant on market prices, and it is expected that changes in market prices cause changes in appraisal values. Kain and Quigley (1972) found a systematic error in estimated house prices, which was attributable to the socio-economic characteristics of the owner-occupants, and the knowledge of these estimation biases can be used to improve the accuracy of both the individual and aggregate estimates of market value. Raymond and Love (2000) also suggested that, when buyers set their initial offers, they always take the appraised value as a useful estimate to start with the negotiation process.

With the availability of online market transaction data at almost zero cost, an interesting question is whether home buyers and sellers refer to usually out-of-date appraised home values, recent market house prices transacted nearby, or both. Seiler et al. (2014) suggested that homeowners are prone to accept information from experts or authorities instead of that from other participants on the market. This finding suggests that the appraised value from the government is prone to be considered an "authorised" benchmark for many homeowners. Diaz and Hansz (2001) raised the hypothesis that there is an anchoring and adjustment heuristic by testing whether valuers rely on any reference point when making judgements. The results show that, when valuers face uncertainty in an unfamiliar area, they are more likely to rely on previous price information to make their judgements. This result also applies to laypeople participating in the property market. Ordinary buyers and sellers are usually more vulnerable than valuers in an unfamiliar area and are more likely to rely on "reference points".

Chandrashekaran and Grewal (2006) studied how "selling price" and "advertised price" influence buyers' internal reference price. The results show that, when the selling price exceeds the internal reference price of buyers, the price discrepancy exerts upward pressure on buyers' internal reference prices. The opposite outcome follows when the selling price falls below this internal reference price. In addition, the advertised price also partially affects the internal reference price. When the "internal reference price" aligns with the property buyer's estimate, the listed or advertised price influences homebuyers' perceptions by "anchoring" such external information. Studies on anchoring can be traced back to Simon and Newell (1971), who indicated that people's limited problem-solving capacity needs cognitive efficiency or shortcuts to decision making. Tversky and Kahneman (1974) showed that people are prone to use heuristics to achieve a more straightforward judgemental operation. "Anchoring and adjustment" is one of these heuristics.

Einhorn and Hogarth (1986) indicated that information from the external environment is often used as anchors when people make estimations under uncertainties, especially in housing markets where heterogeneous characteristics are always a problem.

The anchoring effect is a widely accepted theory supported by empirical evidence from stock market decision making (Chang et al. 2013), auctions (Dodonova and Khoroshilov 2004; Gao and Cao 2019), and consumer price negotiation (Kristensen and Gärling 2000). In the property literature, researchers have also found the anchoring effect in the home purchase decision-making process. Gallimore (1994) showed that valuers are affected by heuristic biases in the valuation process. Diaz and Hansz (2007) found that real estate professionals seek simplified heuristics to facilitate information processing. More specifically, Diaz and Wolverton (1998) revealed that the appraisal value is anchored with previous value judgement, causing the appraisal smoothing problem. Compared with property professionals, ordinary home buyers and sellers, who are less experienced and have access to less market information, tend to be influenced by the anchoring effect to a larger extent. Northcraft and Neale's (1987) findings suggest that anchoring biases influenced both professionals and laypersons but that the laypersons appeared to be more reliant on the pre-set "anchor". Da Silva et al. (2019) also demonstrated that the anchoring effect influences both property professionals and non-professionals, and non-professionals are more prone to be influenced. Scott and Lizieri (2012) found a strong anchoring effect on the price perceptions of homebuyers. In terms of residential property auctions, Bucchianeri and Minson (2013) indicated that a higher listing price (anchor) is associated with a higher transaction price. An anchoring bias even exists in public housing purchases (Arbel et al. 2014).

More recent research also provides evidence that the anchoring effect is likely to influence the price perceptions of market participants. Khezr and Ahmad (2018) found that property buyers tend to use the asking price as the anchor or reference point of the desired price. They suggested that buyers consider that the subject property may have some unobserved characteristics, so they raise their expectations and then raise the price. Shie (2019) found that property historical peak price is used as a reference point. They found that the 9-year-high price positively correlates with the price return. Cheung et al. (2021) conducted a natural experiment and found that anchoring effects dominated the asymmetric information effect in the housing market of Hong Kong.

Although many studies have already suggested that home buyers and sellers rely on price anchors in their decision-making process, most of this literature was conducted a decade or more ago. Market information was not as readily available as it is now on the Internet. Property technologies such as "Blockchain", "Property Passports", or "Automated Valuation Models" in recent years have made valuation much faster and cheaper. Abidoye et al. (2022) investigate the barriers, drivers, and prospects of adopting artificial intelligence valuation methods in practice. Whether home buyers and sellers anchor to the traditional appraisal values or to market transaction information is the fundamental research question of this study.

3. Development of Hypotheses

Many previous works in the literature suggest that the anchoring effect plays a significant role in the property industry, especially when market participants estimate property values. They seem more prone to anchor to some external information. In New Zealand, capital value, or *CV*, is the value of the property appraised by the government used for collecting property rates. The Government of New Zealand is required to carry out an assessment of property value to set rates every three years according to the Rating Valuations Act 1998. *CV* is also sometimes called Government Valuation (GV) or Rateable Value (RV). The *CV* is defined as "the most likely selling price at the date of valuation" (Auckland Council 2021). Even though it is explicitly stated that "the aim of the general property revaluation is not to provide values for property owners to use for marketing, sales or any other purposes" (Auckland Council 2021), the information of the *CV* becomes trusted pricing information, which market participants often use to assess property values.

Property sellers sometimes use the current *CV* in marketing efforts for their properties, and *CV* becomes a reference point in buyers' decision making (Filippova 2014).

This research exploits the lead–lag relationship between the appraisal values and market prices of residential properties in New Zealand to examine whether anchoring effects exist. The lead–lag relationship plays a crucial role in asset markets. Some stock pairs may not have a concurrent correlation in financial markets but may be highly correlated during certain lead–lag periods. This phenomenon, whereby a time series partially or entirely replicates the movements of another at a specific time lag, is called the lead–lag relationship. Provided that home buyers and sellers use the *CV* as an anchor in their price negotiation, the movement of the *CV* leads the movement of transaction prices (*TP*). Nevertheless, when considering the method used in estimating *CVs*, the movement of the *TP* leads the movement of the *CV* instead. The Rating Valuation Rules 2008 (Land Information New Zealand 2010, p. 25) also explicitly states that *CV* estimation is "compared to the market sales evidence". Theoretically, *CVs* are always lagging behind *TPs* in the valuation process.

To avoid this simultaneous causality bias and to examine whether anchoring effects to the *CV* exist, we exploit a less trivial implication between the primary and secondary housing markets to infer the anchoring effect. We make use of the fact that no *CV* is available for buyers in the primary housing market. In Auckland, primary residential properties are pre-sold before completion of their construction. When a first-hand property is sold, its *CV* is not yet appraised by the government. Meanwhile, the *CV* of a second-hand property is appraised every three years, and therefore it has at least a three-year new appraised value for the second-hand property. The valuers of an independent organisation value the *CV* by using mass valuation technology. The recent sales transaction data in the area and other factors of the subject property, including property type, location, land size, zoning, floor area, and improvement work, are considered. The property values are audited by the Valuer-General to ensure accuracy (Auckland Council 2021). Therefore, in this research, we separate primary and secondary sales transaction data to distinguish properties with different statuses of *CV* appraisal. Thus, in the primary housing market, the *TP* is hypothesised to lead the *CV*, whereas in the secondary housing market, the *TP* and the *CV* are hypothesised to have a bi-directional lead–lag relationship. Thus, we hypothesise that at the aggregate market level:

Hypothesis 1. *(H1-Anchoring Effects) In the primary housing market, the index of the TP unidirectionally leads the CV, whereas in the secondary market, the TP and the CV has a bi-directional lead–lag relationship.*

To confirm the anchoring effect of *CVs*, we further derive a testable implication based on the availability heuristic, which influences probability judgements according to a person's ease in recalling previous occurrences of an event or in imagining an event occurring (Tversky and Kahneman 1973; Bazerman and Moore 2012). For example, investors may judge the quality of an investment based on information that has recently been in the news, ignoring other relevant facts. *CVs* are well-known public information among property market participants in New Zealand, and the public can easily access the information. The release of *CVs* is also the headline news in the local media (Leahy 2021). For property market participants, such availability of *CVs* serves as a pre-condition of the availability heuristic.

In consumer research, the availability heuristic can play a role in various estimates, such as store pricing (Ofir et al. 2008) or product failure (Folkes 1988). The availability of information in memory also underlies anchoring effects. In property research, Gallimore and Wolverton (1997) studied whether the "pending price" as readily available information influences property valuers' judgement. The results showed that, when "pending price" becomes readily available in the property information package, it influences the resulting valuation. Black (1997) found that during property negotiation processes, the negotiators tended to increase the importance of the readily available information, such as asking prices,

whereas information that was hard to cognitively recognise was neglected. Havard (2001) contended that people tend to use their experience in similar situations, especially the most recent information, to make a decision. Evans et al. (2019) suggested that limited access to information sources increases the use of the availability heuristic. When buyers and sellers do not have enough sources of information, they tend to use the most readily accessible information, such as a *CV*, to support their judgements.

In the context of property valuation, when trying to make a home purchase decision, the government valuation of the property immediately springs to the forefront of buyers' thoughts. As a result, they may give greater credence to this information and tend to overestimate the relevance of this government appraisal value when an updated appraisal is available. The availability heuristic operates on the principle that the information must be important if one can think of it when making a decision. All people tend to believe that things that come more easily to mind are more accurate reflections of the real world, and the available information regarding property values is no exception. The longer we preoccupy ourselves with such pricing information, the more available it is in our minds. Moreover, we are more likely to treat this pricing information as an anchor (or a price point). Excessive media coverage can also cause this to happen. Thus, we further hypothesise that in each transaction:

Hypothesis 2. *(H2-Availability Heuristic) The impact of the CV anchoring effect is larger in the year of reassessment, and the effect diminishes over time.*

4. Research Design

4.1. The Test for Hypothesis 1 (Anchoring Effects) Lead–Lag Relationship between CV and TP

To examine the lead–lag relationship between capital value and transaction prices in both primary and secondary housing markets, three house price indices are constructed by the hedonic price model, viz., (a) Index of Transaction House Prices in the Primary Market, (b) Index of Capital Values, and (c) Index of Transaction House Prices in the Secondary Market. Equation (1) shows the semi-log hedonic price model with monthly dummies for constructing the price index (Yiu and Cheung 2021). One advantage of using a semi-log form model is its ease of interpretation, i.e., the percentage change in prices with respect to a unit of change in property attributes. The semi-log model can also help normalise transaction prices to avoid the chances of producing errors from any skewed property price and value distribution in its level in the linear OLS regression:

$$\ln(V_{its,y}) = \alpha_{0,y} + \sum_{t=1}^{T_m} \beta_{t,y} M_{it} + \sum_{k=1}^{K} \pi_{k,y} X_{ki} + \sum_{s=1}^{S} \theta_{s,y} L_{is} + \varepsilon_{its,y} \quad (1)$$

where M_{it} denotes the monthly dummy, which is set to 1 if the ith house is sold at time t, and otherwise to 0 ($t = 1, \ldots, T$). $V_{its,y}$ denotes the value of property i being assessed or transacted at time t and located at suburb s ($i = 1, \ldots, n$; $t = 1, \ldots, T$; $s = 1, \ldots, S$). The subscript y stands for the three indices: when the values are capital values in the secondary market, $y = CV2$; when the values are transaction prices in the primary market, $y = TP1$; and when the values are transaction prices in the secondary market, $y = TP2$. $\beta_{t,y}$ denotes the logarithm of the price index, and $\pi_{k,y}$ and $\theta_{s,y}$ denote the implicit prices for the kth property characteristic of X_{jk} ($k = 1, \ldots, K$) located at sth suburb location dummy L_{is} ($s = 1, \ldots, S$). The error term $\varepsilon_{its,y}$ denotes the mean zero error with variance σ^2. The coefficients can be estimated by the ordinary least square method. The price index is constructed by taking the exponential of β_t, mathematically:

$$I_{t,y} = \exp(\beta_{t,y}) \quad (2)$$

After constructing the four hedonic indices, their stationarities are tested by the unit root test. The lead–lag relationships are tested by Granger causality tests (Granger 1969),

which are widely used to test the causality between two time-series variables. In this study, we use the Granger causality test to examine the relationship between CV and house price.

$$TP_t = \alpha_0 + \alpha_1 TP_{t-1} + \cdots + \alpha_p TP_{t-p} + \beta_1 CV_{t-1} + \cdots + \beta_p CV_{t-p} + \mu_t \quad (3)$$

$$CV_t = \gamma_0 + \gamma_1 CV_{t-1} + \cdots + \gamma_p CV_{t-p} + \delta_1 TP_{t-1} + \cdots + \delta_p TP_{t-p} + \lambda_t \quad (4)$$

In Equations (3) and (4), TP represents the transaction house price index. CV is the capital value index assessed by the government. A, β, γ, and δ are the coefficients that need to be tested, and μ and λ are the unobserved terms. When $\beta_1 = \beta_2 = \ldots = \beta_p = 0$, CV does not Granger-cause TP, and otherwise CV Granger-causes TP. At the same time, when $\delta_1 = \delta_2 = \ldots = \delta_p = 0$, TP does not Granger-cause CV, and otherwise TP Granger-causes CV. This indicates that, when $\delta_1 = \delta_2 = \ldots = \delta_p = 0$, no explanatory variable is retained in the regression to add any extra explanatory power to the model. However, sometimes the time series variables are not stationary, and some' unobserved' parameter is involved in asymptotic distribution, biasing the test result. Therefore, we follow a modified Granger causality test by Toda and Yamamoto (1995) to fix the issue that the variables are non-stationary (See also Li et al. 2016 as an illustration in the property research).

Firstly, we identify the lag periods using the Akaike Information Criterion (AIC): the optimal number of lag periods p can be determined. It needs to be checked that there is no serial correlation in the residual; otherwise, we need to adjust p until the correlation is fixed. Secondly, we check the stationarity of the variables by using the Augmented Dickey–Fuller (ADF). After conducting the ADF, we can also obtain the maximum order of integrating variables (m), which represents how many times the variables need to be differenced to be stationary. So, if the order of integration of a variable is 1, and that of another is 0, then we call the maximum order of integration 1. After identifying p and m, we can determine the optimal lag periods that we use in the test by $p + m$. Therefore, we can test the null hypothesis with the differenced stationary variables under the $p + m$ lag periods. It is also crucial that we do not exclude the coefficient of the extra m lags in the test, since they are only used to resolve asymptotic in the test.

4.2. The Test for Hypothesis 2. (Availability Heuristic) Diminishing Anchoring Effects of CV on TP over Time

We further examine the availability heuristic hypothesis to determine whether the timeliness of appraisal values (CV) significantly impacts the anchoring strength of capital value on transaction prices. Given that the result of Hypothesis 1 suggests that the CV leads to the TP, we set up a hedonic pricing model with transaction prices being the dependent variable and with the CV as one of the independent variables. In Equation (5), θ_s denotes the implicit prices for the kth property characteristic of X_{jk} ($k = 1, \ldots, K$) located at sth suburb location dummy, L_{is} ($s = 1, \ldots, S$). The error term ε_{ist} denotes the mean zero error with variance σ^2. The coefficients can be estimated by the ordinary least square method. $D_{it\tau}$ denotes the timeliness of the appraisal value, measured by the number of days counted from the assessment date to the date of transaction. The larger the value of $D_{it\tau}$ is, the more "outdated" the valuation information represents. The difference-in-differences model is shown in Equation (2) below:

$$\begin{aligned} \ln(V_{its,TP2}) = {} & \alpha_0 + \alpha_1 ln(V_{i\tau s,CV2}) + \alpha_2 D_{it\tau} + \alpha_3 (D_{it\tau} \times ln(V_{i\tau s,CV2})) \\ & + \sum_{t=1}^{T_m} \beta_t M_{it} + \sum_{k=1}^{K} \pi_k X_{ki} + \sum_{s=1}^{S} \theta_s L_{is} + \varepsilon_{its} \end{aligned} \quad (5)$$

where $V_{i\tau s,CV2}$, $V_{its,TP2}$ denote the value of property i being assessed at the time τ and transacted at time t, respectively. $D_{it\tau}$ denotes the outdatedness of the appraisal measured by the number of days from the assessment date to the date of transaction. Whereas $ln(V_{i\tau s,CV2})$ is the main effect of the CV on the TP, the interaction term of $D_{it\tau} \times ln(V_{i\tau s,CV2})$ accounts for the impacts of the CV condition on the timeliness of this piece of information

(in days). If our availability heuristic hypothesis holds, the value of this interaction term is expected to be negative. The rationale is that, as time goes by, the relevance or the "availability impact" of *CV* diminishes.

5. Empirical Data and Results

The models are empirically tested using housing transaction data of New Zealand, from January 1990 to December 2020 (372 months), which provide about three million housing transactions. An extensive housing transaction dataset helps to exclude any potential estimation problems due to insufficient data. The dataset is subscribed from an international real estate data provider, CoreLogic. This study confines freehold house-type transactions by excluding apartment-type housing, vacant sites, and leasehold interests from the dataset to keep housing type and land tenure uniform. The dataset provides a comprehensive list of housing characteristics and neighbourhood characteristics, including the age of houses, to identify whether they are transacted in the primary or secondary markets. Typically, the government's official district valuation roll only includes the built cohorts in the decade for each individual property. The building age variable is unavailable from those official property data sources, including the property data we purchased from CoreLogic. Therefore, this study gathers information on the home-built year from online property platforms, such as OneRoof.co.nz (Yiu and Cheung 2022). Other attributes include the number of bedrooms and bathrooms, building floor area, regions, and views.

In Auckland, primary residential properties are mostly pre-sold before construction is complete. When the first-hand property is sold, its *CV* is not yet appraised by the government. In contrast, as per the conduct rule of revaluation, the *CVs* of second-hand properties are appraised every three years, so all properties in the secondary market have at least a three-year new appraised value. Therefore, in this research, we separate the primary sales transaction data and the second-hand transaction data to distinguish properties with different statuses of *CV* appraised.

Among 3,203,047 total observations, 2,838,747 observations contain data on the building's age; therefore, we can only use 2,838,747 observations to conduct the tests. We can separate the primary and second-hand residential properties by extracting the properties with building age equal zero. After separating the first-hand and second-hand transactions, we have 2,387,483 s-hand transactions and 451,264 first-hand transactions. The data on property transactions and the *CV* information are not directly used in the test as heterogeneous characteristics of properties. In order to control the quality differences in the transacted properties and produce the appropriate indices for the *TP* and the *CV*, we use the hedonic regression model to produce the indices. Using this method, we can produce price indices that control the implicit prices of property characteristics.

To examine the lead-lag relationship between capital values and transaction prices in both primary and secondary housing markets, four house price indices are constructed by the hedonic price model, viz., (a) hedonic house prices index in the primary market (*TP1*); (b) capital values index in the secondary market (*CV2*); and (c) hedonic house price index in the secondary market (*TP2*). For the capital value index of the primary market (*CV1*), we use the estimated *CV* typically released by the government after the housing transaction. It is worth noting that, for about 10% of first-hand sales, their *CVs* are released immediately before and around the sales dates. To avoid cherry-picking the data and incurring confirmation bias, we have included these cases in our *CV1* index construction to take into account the possibility that, in some cases, *CVs* can be earlier than the sale date. If the results with such *CV1* remain, it provides an even stronger case to support our anchoring hypothesis. Figure 1 shows the four house price indices.

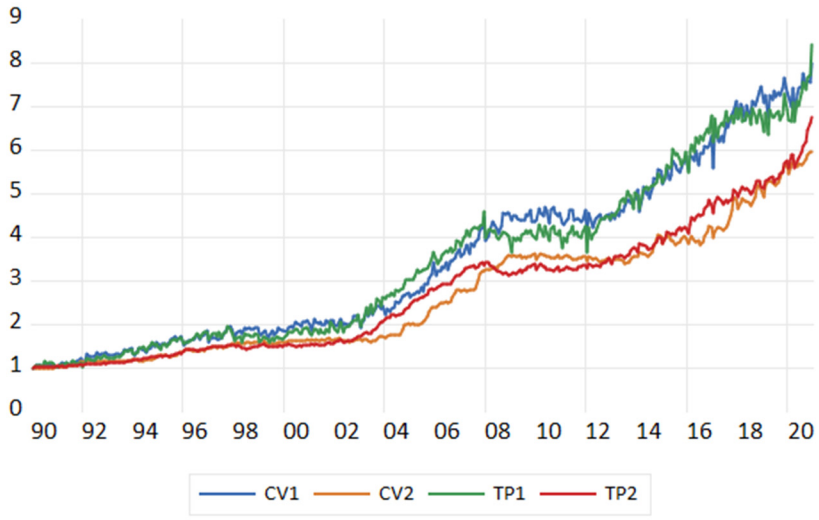

Figure 1. House Price Indices of *CV* and *TP* in the primary and secondary house markets of New Zealand, 1990–2020 (Index = 100 in 1990). Notes: The four house price indices of New Zealand from 1990 to 2020 are (*TP1*) hedonic house prices index in the primary market; (*CV2*) capital values index in the secondary market; and (*TP2*) hedonic house price index in the secondary market. For the capital value index of the primary market (*CV1*), we use the estimated *CV* typically released by the government after the housing transaction.

The descriptive statistics for the data are shown in Table 1. For the house price index of the first-hand market (*TP1*), the mean of *TP1* is 3.46, whereas the mean of *TP1* from 1990 to 2009 is 2.26. The mean of *TP1* from 2009 to 2020 is 5.63, which increased by 149% after the Global Financial Crisis (GFC). For the house price index of the second-hand market, from 1990 to 2009, the index was 1.83, whereas from 2009 to 2020, it was 4.23. The *CV* in the first-hand market is 2.08 for the pre-GFC period and 5.34 for the post-GFC period, and the *CV* in the second-hand market is 1.78 for pre-GFC and 4.11 for post-GFC. Even though the GFC "raided" the market, the change of *TP* and *CV* still kept the same pace.

Table 1. Descriptive statistics of the four house submarkets price indices.

	(1)	(2)	(3)	(4)	(5)
Variable	**Mean (Whole Period)**	**Mean (1990–2009)**	**Mean (2009–2020)**	**Changes in Two Periods**	**Standard Deviation (Whole Period)**
TP1	3.46	2.26	5.63	149%	1.95
TP2	2.67	1.83	4.23	131%	1.41
CV1	3.24	2.08	5.34	156%	1.84
CV2	2.61	1.78	4.11	130%	1.34

Notes: The mean of each variable refers to the mean of the monthly house price index of the variable. Column (1) refers to the mean of the whole data period, whereas Columns (2) and (3) are the means of the pre- and post-GFC periods, respectively. Column (4) refers to the change of the means from the pre-GFC period to the post-GFC period. Column (5) shows the standard deviation of the monthly house price index of the whole period variable.

The descriptive statistics for the data in the hedonic models are stated below: the mean of the transaction price is NZD323256.8, whereas for the *CV*, the mean is NZD288902.8. In a booming property market, the earlier appraised value should be lower than the price that occurs later. The mean number of bedrooms in the dataset is 3.126, whereas the mean number of bathrooms is 1.398. The average floor area is 125.708 sm. The time dummy variable is monthly data from 1990M01 to 2020M12. The regional dummy variable includes 14 regions, and the View dummy contains three types of view: 'No appreciable view', 'focal point of water view', and 'focal point of other views'.

Empirical Results

In order to conduct the Granger causality test between two time-series, we need to ensure the data is stationary by making sure that none of our datasets has any unit root. To test the stationarity of the variables, we use the Augmented Dickey–Fuller test and the Kwiatkowski–Phillips–Schmidt–Shin test. The results are shown in Table 2. All the variables are not stationary at I (0), whereas at I (1), all the time series variables show as stationary. Therefore, we need to use first differenced data for all the time series variables and follow the modified Granger causality processes to conduct the test.

Table 2. The result of the Unit root test.

Variable	Incl. Trend?	ADF Test	KPSS Test	Order of Integration
ln(TP1)	Without trend	−0.6319	2.3861	
	With trend	−1.7342	0.2268	
dln(TP1)	Without trend	−17.5034	0.0802	I (1)
	With trend	−17.4858	0.0688	I (1)
ln(TP2)	Without trend	0.4198	2.3972	
	With trend	−2.8185	0.1331	
dln(TP2)	Without trend	−3.1530	0.2189	I (1)
	With trend	−3.2187	0.1141	I (1)
ln(CV1)	Without trend	−0.8090	2.3955	
	With trend	−1.4885	0.1984	
dln(CV1)	Without trend	−14.8398	0.0976	I (1)
	With trend	−14.8371	0.0826	I (1)
ln(CV2)	Without trend	−0.3984	2.3851	
	With trend	−3.7292	0.2163	
dln(CV2)	Without trend	−3.2861	0.1088	I (1)
	With trend	−3.3001	0.0790	I (1)

Notes: The 5% critical values of the ADF and KPSS test statistics are, respectively, 2.87 and 0.463 (without trend) and 3.42 and 0.146 (with trend). A significant test statistic indicates the rejection of the null hypothesis, which is non-stationarity in the ADF tests and stationarity in the KPSS test.

Using the AIC test, we are able to determine the lag periods. The AIC test results for the lag length used for the Granger causality test between the natural logarithm of the first-hand *TP* and the natural logarithm of the first-hand *CV* are shown in Table 3. The optimal lag length p is 2 (months) after first differencing *dln(TP1)* and *dln(CV1)*, whereas the maximum order of integration m is 1. Then, we use $p + m$, which is 3 (months), as the lag length between *dln(TP1)* and *dln(CV1)*. At the same time, the result between the second-hand *TP* and the second-hand *CV* after first differencing *dln(TP2)* and *dln(CV2)* shows that the optimal lag length p is 12 (months). By adding the maximum order of integration (m) 1, the lag length we use for the Granger causality test between *dln(TP2)* and *dln(CV2)* is 13 (months).

Table 3. Result of AIC tests.

Variable	Lag Length	AIC Result
dln(TP1)/dln(CV1)	2	−11.91756
dln(TP2)/dln(CV2)	12	−15.54021

Table 4 shows the results of Granger causality tests, which in the first-hand market, the *TP* does not Granger-cause the *CV*, nor does the *CV* Granger-cause the *TP* while in the second-hand market. In the secondary market, the null hypothesis of "*dln(TP2)* does not Granger-cause *dln(CV2)*" is rejected at 5×10^{-5} the p-value, and the null hypothesis of "*dln(CV2)* does not Granger cause *dln(TP2)*" is also rejected at 2×10^{-8} the p-value. This indicates that the result shows that *CV* Granger-causes *TP* and vice versa in the second-hand market.

Table 4. Result of Granger causality tests.

Null Hypothesis	Lag	F-Statistics	*p*-Value
dln(TP1) does not Granger Cause dln(CV1)	3	0.13	0.9433
dln(CV1) does not Granger Cause dln(TP1)	3	0.99	0.3930
dln(TP2) does not Granger Cause dln(CV2)	13	3.46	5×10^{-5}
dln(CV2) does not Granger Cause dln(TP2)	13	5.14	2×10^{-8}

As shown in the results, in the first-hand market, *CV* and *TP* do not Granger-cause each other because the Auckland Council does not appraise the pre-sold properties at the time of being sold. The appraised value is only available for the rates payment when the property is handed over to the owner. The time of the property *CV* being appraised is usually 1 to 3 years later than the time the property is sold; therefore, valuers do not treat the sold price as the only piece of useful information.

Nevertheless, in the second-hand market, *CV* and *TP* Granger-cause each other, which shows that the *CV* influences the property transaction price. The *CV* as price information influences the transaction price by influencing the perception of market participants, and it is more similar to the "market news" in the stock market that directly influences the market participants' value perception. When they receive *CV* information, they estimate the price based on the *CV* and consider that the price should be somewhere around the *CV*. Meanwhile, for sellers, their readily available information that they could use to assist in determining the selling price is a *CV*, so they can also use the *CV* to set the asking price.

Table 5 shows the results of the difference-in-differences test on the *CV*'s outdatedness effect on the anchoring strength on the *TP* from the *CV*. The results show that the anchoring strength of the *TP* from the *CV* is as strong as 93.5%, which is statistically significant at the 1% level. However, the anchoring strength is conditioned by the timeliness of the appraisal. Every one-hundred-day increase in the *CV* timeliness reduces the strength of anchoring effects by 1%. The timeliness of the anchoring strength shows that the market participants, such as home buyers and sellers, are aware that the *CV* is not always up-to-date information; it only represents the value of the property at the time of being appraised. As time goes by and the market changes, the true value of the property deviates from the *CV*. Therefore, farther from the valuation date of *CV*, the market becomes less reliant on the *CV* in the transaction.

Table 5. Empirical results of the hedonic price model.

Variable	Equation (2) Coefficient
$D_{it\tau}$	0.001
	(71.136) ***
$ln(V_{i\tau s,CV2})$	0.935
	(1382.500) ***
$D_{it\tau} \times ln(V_{i\tau s,CV2})$	−0.0001
	(−57.631) ***
Adj. R-sq	0.910
No. of Obs.	1,559,117
Dep. Var.	$V_{its,TP2}$

Notes: The dependent variable $ln(V_{its,TP2})$ is the logarithm of the net transacted house prices in New Zealand dollars. *** Indicates that the coefficient is significant at the 1% level. Figures in the parentheses are the t-statistics. The results of other fixed effects are not shown.

6. Conclusions

Anchoring effects are among the most robust cognitive biases in judgement and decision making. This study explores whether the property market elicits such a decision heuristic. Many laboratory experiments have suggested that some artificial information context causes people to use heuristics that produce decision biases. However, the con-

trolled nature of laboratory experimentation often constrains the amount and types of information. This has not allowed subjects in the experiment to interact with and explore different information sources. This study uses the property market as a case study to examine two acknowledged decision heuristics in behavioural economics, namely the anchoring effect and the availability heuristic, in an information-rich property market. The results described in this paper are consistent with both the anchoring-and-adjustment effects and the availability heuristic.

Most home buyers and sellers are laypersons of the property industry. They may be prone to use heuristics when making estimations or judgements. In New Zealand, capital value (*CV*) is recognised as a trustworthy external information source from the government. Such information provides a shortcut that helps laypersons set their listing prices and make their home purchase decisions. Using both the time-series and hedonic pricing model approach, this study draws a less trivial testable implication: the *CV* in primary housing should have no anchor effect on the *TP* because the *CV* is unavailable until the first sales occur. Exploiting the fact that no *CV* is available for buyers in the primary housing market, the Granger causality test results suggest that the *CV* and *TP* have a bi-directional lead-lag relationship in the secondary housing market, but not in the primary market. The finding implies the existence of anchoring effects in the property market. Furthermore, the hedonic model at the individual transaction level shows that price anchoring effects may diminish over time. This is consistent with the notion of the availability heuristic, i.e., people are more reliant on a *CV* when it is released near the date of reassessment.

It is also crucial to ensure the accuracy of the appraised *CV*. Even though the government has accentuated that "the aim of the general property valuation is not to provide values for property owners to use for marketing, sales or any other purposes." (Auckland Council 2021), based on our results, it is unavoidable that people use *CV* as an anchor. In practice, buyers and sellers believe that the real market price of the property should be adjusted with a certain margin based on the *CV*. However, for ordinary buyers and sellers, it is hard to obtain an accurate value of the property by using the *CV* only and without using any objective market information that they are unable to access, and it is also possible that the *CV* is not accurate and outdated. Therefore, it reminds us that the property price may be distorted by the inaccuracy and inappropriate use of appraisal values.

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