Out-of-town Buyers, Mispricing and the Availability Heuristic in a Housing Market

ALEX R HORENSTEIN*, DANIEL OSGOOD† AND AVICHAI SNIR‡+

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*Department of Economics, University of Miami, Coral Gables, FL 33124 (horenstein@bus.miami.edu)

†The Earth Institute, Columbia University, Palisades, NY 10964 (deo@iri.columbia.edu)

‡Department of Banking and Finance, Netanya Academic College, Netanya, Israel 42365, (sniravic@netanya.ac.il)

+Correspondent author.

ABSTRACT

There is evidence that asymmetric information in the housing market between sellers and buyers is an important source of mispricing, especially when involving out-of-town buyers (Chinco and Mayer 2016, Kurlat and Stroebel 2015). In this paper we show that a specific cognitive bias, *the availability heuristic*, can exacerbate pricing errors in an environment with asymmetric information and out-of-town buyers. When people use the availability heuristic, they make their judgments based on the most salient, rather than the most relevant information. Through studying Arizona's market for *ranchettes*, small ranches located near main urban areas, we find that *non-Arizona buyers* who purchase ranchettes earn smaller returns than *Arizona buyers*. Furthermore, we find that there is also a difference in realized returns between different non-Arizona buyers that is related to variations in the natural landscape at the time they visit the prospective property. As such, we find that non-Arizona buyers base their predictions about amenities on the observations they made while visiting, even when these observations are not representative.

1. INTRODUCTION

Asymmetric information between buyers can cause severe valuation biases in housing markets (e.g. Chinco and Mayer 2016, Kurlat and Stroebel 2015, Levitt and Syverson 2008). In this paper we study the effects of asymmetric information between local and out-of-town buyers using data from Arizona on repeat sales of ranchettes: small ranches used for agriculture and recreation.

Because ranchettes are used for agriculture and recreation, their value is partly determined by the average amount of vegetation surrounding them. Thus, the return a buyer obtains depend on her ability to estimate, prior to purchase, the average amount of vegetation.

Our results suggest that local buyers obtain greater returns than out-of-town buyers when they resell their properties, and that the difference becomes greater when out-of-town buyers visit a ranchette at a time when it is surrounded by greater than average amount of vegetation. As such, our results suggest that out-of-town buyers tend to use the amount of vegetation at the time of the visit as a cue for the typical amount of vegetation. Consequently, when the amount of vegetation at the time of the visit is large, out-of-town buyers often overestimate a ranchette's value.

Furthermore, we find that the amount of vegetation affects the returns of out-of-town buyers despite the availability of reliable information on the average amount of vegetation surrounding each ranchette. Therefore, the results suggest that out-of-town buyers do not use the information they have effectively. Rather, it seems that they give greater weight to their personal one-time experience over more reliable but less salient information.

Thus, our results add on to findings in the literature which show that out-of-town buyers often make smaller returns than local buyers (Chinco and Mayer 2016, Kurlat and Stroebel 2015, Levitt and Syverson 2008). Our results may therefore add to the understanding of the price volatility observed in housing markets where a large share of the buyers is from out-of-town (Rajan 1994, Muellbauer and Murphy 1997, Genosove 2003, Grenadier and Wang 2007, Sinai 2012, Chinco and Mayer 2016, Kurlat and Stroebel 2015).

Further, the results suggest that in our dataset at least some of the difference between local and out-of-town buyers is the outcome of *projection errors*, systematic errors in the predictions of benefits from future consumption of goods and assets (Saunders 1993, Loewenstein and Adler 1995, Conlisk 1996, Mullainathan 2002, Loewenstein et al. 2003, Cao and Wei 2005, Conlin et al. 2007, Busse et al. 2012). Thus, our results provide further evidence suggesting that the effects of projection biases are not limited to small ticket assets and to situations where consumers are time constrained (Kahneman and Frederick 2002, Kahneman 2003, Loewenstein et al. 2003, Cao and Wei 2005, Conlin et al. 2007, Busse et al. 2012). Indeed, the average price of an asset in our sample is over 124,000 US dollars in 1995 prices, and buyers have several weeks to analyze all the available information before signing a contract.

Below, we suggest that the projection bias we find is likely to be an outcome of the *availability heuristic*, the tendency to judge information according to its availability to the cognitive process rather than according to its representativeness. Further, our paper, as well as prior work, shows that adding information usually does not cancel the effects of the projection biases (Schwarz and Vaughn, 2002, Sloman, 2002, Kahneman, 2003). These findings illustrate some of the reasons why available information about the amenities and quality of houses seem to have little effect on the price appreciations in housing markets with large shares of out-of-town buyers, such as Los Angeles, Las Vegas, Miami and Santa Barbara in the early 2000s (De Bondt and Thaler, 2002, Koehler et al., 2002, Cox, 2013).

The rest of the paper is organized as follows. In the next section we discuss the effects of projection biases and the availability heuristic. In Section 3 we describe our data. In Section 4 we present our main analysis and results. We conclude in Section 5.

2. PROJECTION BIASES, AVAILABILITY HEURISTIC AND HOUSING MARKETS

There is evidence that in housing markets, out-of-town buyers obtain lower returns than locals. This is often attributed to information advantages of local buyers and to differences in utilization between local and out-of-town buyers (Levitt and Syverson 2008, Chinco and Mayer 2016, Kurlat and Stroebel 2015).

Below, we show that in some housing markets, projection biases caused by the availability heuristic could be another reason why out-of-town buyers overestimate the future returns from housing services. Thus, the availability heuristic can exacerbate the differences in realized returns between local and out-of-town buyers.

Projection biases are systematic errors in the evaluation of future benefits. Previous studies suggest that decision makers are often affected by contemporary cues when assessing future returns and, consequently, they often make significant errors in their evaluations. For example, it was shown that in winter, consumers often value the benefits from summer clothes more on sunny days than on cloudy days although the current weather has no effect on the eventual benefit. It was also found that when investors are in a good mood they tend to overvalue stocks although their mood is not correlated with information about the stocks' expected performance (Conlisk, 1996, Kahneman, 2003, Loewenstein et al. 2003, Cao and Wei, 2005, Busse et al. 2012).

Heuristics are likely to be another reason that can cause projection biases because heuristics are cognitive processes that simplify decision-making. The evidence suggests that when the cognitive efforts required for performing fully rational decisions are high and the necessary cognitive resources are scarce, most decisions are taken on the basis of heuristic evaluation (Tversky and Kahneman 1974, Conlisk 1996, Sloman 2002, Kahneman and Frederick 2002, Kahneman 2003). Heuristic decision making seems to be common, for example, when consumers choose goods while facing time constraints or when they have to complete several tasks simultaneously.

When decision makers have the time and the cognitive resources to further analyze the information, however, it seems that they usually make their decisions on the basis of in depth information processing. The likelihood that decision makers will process the information in depth increases also when the costs of making an error increase (Navon and Gopher 1979, Kahneman 2003).

It should be expected, therefore, that heuristics will have only a small effect on decisions in housing markets because the values of these assets are usually high and the decision makers typically have several weeks to consider their decisions. Decision makers therefore have both the time and the incentives to implement an efficient decision (Navon and Gopher 1979, Conlisk 1996, Thaler 2000, Sloman 2002, Kahneman and Frederick 2002, Kahneman 2003, Camerer 2008, Beshears et al. 2009).

It seems, however, that because the heuristic processing is almost automatic and is highly salient, the outcomes of heuristic processing are often fed as inputs into the in depth analysis. Thus, the outcomes of in depth evaluations are often biased by the outcome of the heuristic valuation (Camerer 2008). Therefore, even when in depth analyses are performed, the compensations for the initial, heuristic estimates are usually insufficient (Epley and Gilovich 2002, Kahnenman 2003).

One of the most studied heuristics is the availability heuristic (Tversky and Kahneman 1974). When decision makers are affected by the availability heuristic they judge information on the basis of its salience to the cognitive process rather than by its representativeness.

For example, being close to winning increases the likelihood that gamblers will bet again because although the winning probability is the same regardless of the outcome, the image of a win becomes more salient after a close miss (Tversky and Kahneman, 1974). Participants in a survey often judge the frequency of a letter in the English language as higher after they observe a list containing a large number of words beginning with that letter, because it becomes easy for them to think of examples that use that letter (Epley and Gilovich, 2002).

The availability heuristic is also likely to affect consumers that have to judge the value of goods and assets when salient information about the goods differs from information from other sources. For example, it has been shown that car buyers that intend to buy a certain model after reading the results of large consumer surveys change their decisions after hearing the story of a single dissatisfied consumer. Apparently, the saliency of the one incident gives it greater weight in the decision making process than the information from the surveys, although the surveys' results represent the opinions of thousands of consumers whereas the anecdote represents the opinion of a single consumer (Nisbett et al., 1976).

Considering the aforementioned evidence, we hypothesize that buyers that judge the value of real-estate assets will be similarly affected. Thus, we expect that because personal experience is more salient than second hand information, a buyer that is exposed to a large amount of written and other second hand information about the quality of an asset will nevertheless often base her decision on personally acquired information (Nisbett et al., 1976, Kahneman, 2003). Therefore, when the personal experience deviates from the second hand information in favor of the asset, we expect that a buyer will overvalue the asset.

The market we study is the Arizona market for ranchettes, small ranches used for agriculture and recreation. Previous studies suggest that one attribute that affects the value of a ranchette is the average amount of vegetation surrounding it. Vegetation has both aesthetic value that appeals to recreational owners and practical value for owners that use the land for pasture and/or for growing crops. Large, consistent amount of vegetation therefore adds to the value of a ranchette (Sengupta and Osgood 2003, Nagler and Osgood 2006, Polyakov et al., 2013).

Buyers, therefore, have to estimate the average amount of surrounding vegetation before deciding on their reservation prices. The greater is the expected amount of average vegetation, the higher the reservation price.

Buyers can acquire reliable information about ranchettes' amenities, including vegetation, at low prices from several sources. This information is available from local authorities, real estate agents, neighbors, newspapers and more. Thus, if buyers use the available information efficiently, they should not make systematic errors in estimating a ranchette's values.

We expect, however, that the availability heuristic will bias the judgments of buyers about the value of ranchettes when the buyers have salient information about the amount of vegetation that is different than the information provided by other sources. For out-of-town buyers, the most salient information they are likely to have is their personal experience when visiting the ranchette. Hence, we expect that the amount of vegetation surrounding a ranchette at the time of a visit will affect an out-of-town buyer's valuation. When the amount of vegetation is above the average level, we expect that an out-of-town buyer will overvalue the ranchette relative to other out-of-town buyers that visit when the amount of vegetation is about average.

We do not expect, however, that local buyers will be affected by the availability heuristic to the same extent because local buyers are likely to have a large number of personal experiences with the amount of vegetation around ranchettes. The amount of vegetation they observe when they visit a ranchette at a particular time is just one more experience that they have and that has similar status as their other experiences. Hence, we expect that the amount of vegetation at the time of a visit will increase the wedge between local and out-of-town buyers beyond the difference predicted by other information advantages that local buyers might have over out-of-town buyers.

To sum up, our hypothesis states that out-of-town buyers that visit the ranchettes when the amount of vegetation is significantly greater than the average amount will be affected by the availability heuristic and, therefore, will tend to overestimate the ranchettes' value relative to out-of-town buyers that visit ranchettes when the amount of vegetation is about average. Therefore, we expect that out-of-town buyers that visit when the amount of vegetation is uncommonly large will not only make smaller returns when selling their ranchettes than local buyers, but they will also make smaller returns than other out-of-town buyers that visit when the amount of vegetation is average.

3. **DATA**

We use data on a market for real-estate assets known as ranchettes. Ranchettes are small ranches used for agriculture or for recreation. We have observations on 1,013 repeated sales of ranchettes in Yavapai County, Arizona, between January 1991 and September 2000. The data was provided by the Yavapai County assessor.

For each repeated sale, we have the dates, prices, lot sizes in acres, assessed value of improvements between the repeated sales, billing address of the buyer and location of the ranchette. We use the information on locations to calculate the ranchettes' distances from the nearest city, from the nearest main road and from the nearest river. We use the dates of sales to augment the dataset with information about the interest rate, the GDP growth rate and the number of housing starts in the United States at the time of each sell.

One attribute that was previously found to have a positive effect on ranchettes' prices is the average amount of vegetation surrounding it. It seems that large amount of vegetation makes a ranchette attractive for two main reasons. First, for buyers that are interested in using the ranchette for agricultural or semi agricultural purposes, ranchettes that are rich with vegetation offer greater value because vegetation is a signal for arable land and for pasture. Second, buyers that use ranchettes for recreation seem to attach aesthetic value to natural vegetation (Sengupta and Osgood 2003, Nagler and Osgood 2006).

We therefore measure the amount of vegetation around each ranchette by using observations on the *Normalized Difference Vegetation Index* (*NDVI*), which is an index of the level of photosynthesis occurring in plants. Healthy vegetation absorbs most of the visible radiation and reflects large amounts of near-infrared radiation, whereas stressed or dead vegetation reflects more red light and less infrared light. Barren land and land without vegetation have a more even reflectance across the light spectrum than vegetated areas.

The NDVI is calculated by taking satellite measurements of the near-infrared and visible radiation and then measuring the ratio between them. The NDVI receives values between -1 and 1. Negative NDVI values usually indicate water. NDVI of zero indicate barren land. Values between zero and one indicate some amount of vegetation with values above 0.8 indicating extremely dense vegetation that is typical of rain forests.

NDVI scores are commonly used to study vegetation. They were used, for example, for studying crop vegetation, draughts, climate and forage estimation (Nivens et al. 2002, Dall'Olmo and Karnieli, 2002, Anayamba and Tucker, 2005). For the area we study, observations are collected every two weeks and are available at a resolution of 1 km^2 (Tucker et al., 2004).

As proxies for the amount of vegetation at a time that a buyer visits a ranchette, we record for the location of each ranchette the NDVI one and two months prior to the sale. We also calculate for each ranchette the average NDVI and the standard deviation of the NDVI.[1]

Summary statistics about the ranchettes and the macroeconomic conditions during the relevant period are presented in Table 1. The average ranchette has an area of 6.9 acres. It is located about 5.2 miles from the nearest city and 3.6 miles from a river. The average amount of vegetation, as measured by NVDI score, is 0.33, suggesting that the vegetation surrounding the average ranchette is sparse and mostly composed of shrubs.[2] An increase of one standard deviation in the NDVI score to 0.44, means that the amount of vegetation becomes quite dense whereas a decrease of one standard deviation to 0.22 suggests an amount of vegetation typical of arid lands.

To remove the effects of monetary inflation, we report all prices in 1995 constant prices. We find that the average ranchette was purchased in November 1995 for a price of 80,525 US dollars and resold in August 1998 for a price of 124,113 US dollars. The average return per annum was 17.6%. The average return per annum made by owners from Arizona, is 20%, about twice the average return made by owners from outside Arizona, which is around 10%. The difference between both returns is statistically significant (t=4.45, p<0.01).

[Table 1: Summary Statistics]

4. ANALYSIS

4.1 Predictions

The availability heuristic predicts that market participants will overweight salient information and underestimate information that is less salient, even when the less salient information is more reliable or more representative. In the ranchette market, the only firsthand experiences that out-of-town buyers often have with an asset are obtained when they visit it. Local buyers, on the other hand, are likely to have other

[1] The NVDI data is available at:
http://iridl.ldeo.columbia.edu/expert/SOURCES//.UMD//.GLCF//.GIMMS//.NDVIg//.global//expert/SOURCES/.UMD/.GLCF/.GIMMS/.NDVIg/.global/X/-113.5/-111./RANGEEDGES/Y/33.8/35.7/RANGEEDGES/.ndvi/figviewer.html?map.url=X+Y+fig-+colors+coasts+lakes+-fig&my.help=more+options

[2] www47.homepage.villanova.edu/guillaume.turcotte/studentprojects/arboretum/NDVI.htm

firsthand experiences with the asset and with similar ones in addition to any visit that they make before purchasing a specific one.

We therefore expect two sources of divergences in realized returns between ranchette buyers. First, we expect that local buyers are likely to have an informational advantage over out-of-town ones as in other real estate markets (e.g. Chinco and Mayer 2016, Kurlat and Stroebel 2015). Second, we expect that because of the availability heuristic, out-of-town buyers that visit a ranchette at times when the amount of vegetation was large will make lower returns than other out-of-town buyers who visit when the amount of vegetation was average or below average. Hence, we expect that the availability heuristic will not only increase the difference between local and out-of-town buyers but that it will also create a difference between the returns obtained by out-of-town buyers that visit at times with different vegetation density.

4.2 Definitions

Our data is on repeat sales. We use the term *owners* to refer to home buyers that bought an asset at the beginning of the period and then resold it. An average *owner* in our dataset purchased a ranchette in November 1995 for a nominal price of 82,388 US dollars and then sold it in August 1998 for a nominal price of 135,783 US dollars.

Below, we differentiate between local owners that live in Arizona and out-of-town owners that live elsewhere. We define owners as *Arizona owners* if their billing addresses are in Arizona and as *non-Arizona owners* if their billing addresses are in another state.

4.3 Results

The amount of vegetation surrounding a ranchette is an attribute that has a positive effect on a ranchette's prices. Buyers, therefore, have to estimate the typical amount of vegetation that is likely to surround a ranchette when predicting the expected benefits.

To test our hypotheses about the difference between Arizona and non-Arizona owners and also between non-Arizona owners that bought when the amount of vegetation was different we use OLS regression with robust standard error.The dependent variable is the annualized returns that an owner made in the period between buying and selling a ranchette.

The benchmark regression includes dummies for Arizona owners, for the amount of vegetation (*NDVI*) two months before each transaction, and an interaction between the Arizona owners' dummy and the *NVDI* two months before a transaction. We use the information about the amount of vegetation two months before the sale because real estate agents informed us that this is the average duration between a buyer's visit and the completion of the transaction. Moreover, this is also similar to the duration between a buyer's visit and the signature of the contract in other US markets (Busse et al., 2012). Robustness checks using information about the NDVI one month before the transaction yield similar results.[3]

The regression also includes random effects for the months of the year in which the transaction was signed because seasonality might affect the prices either because of differences in sellers' and buyers' time constraints in different months, self selections, differences in demand in different months, etc. (Ngai and Tenreyro, 2013). For example, it might be that non-Arizona buyers have more vacations in summer months and, therefore, they are more likely to search for a ranchette in summer than in winter.

The results are reported in the first column of Table 2. They suggest that Arizona owners have an informational advantage over non-Arizona owners because on average, Arizona owners earn about 10% more in annualized returns than non-Arizona buyers. We also find that as hypothesized above, the amount of vegetation at the time of the visit does not affect Arizona owners, as the effect of the NDVI two months before the transaction is small and not significant.

At the same time, the effect of the amount of vegetation two months before the sale on non-Arizona owners is large and marginally significant. The difference in annual appreciation between a non-Arizona owner that bought her ranchette when the

[3] The results are available from the authors upon request.

amount of vegetation was average and one that bought it when the amount of vegetation was one standard deviation (0.11) greater is 0.49 × 0.11 = 5%.

Thus, the results of the benchmark regression provide evidence that the returns for non-Arizona owners depend on the amount of vegetation at the time they visit the property. Non-Arizona owners make smaller returns than Arizona owners not only because of the information advantage that the Arizona owners seem to have, but also because non-Arizona owners are affected more than the Arizona owners by the amount of vegetation at the time of the visit.

However, there is a possibility that the differences in the appreciation rates are not because of differences in the amount of vegetation but because differences in vegetation are correlated with differences in macroeconomic conditions or because of differences in the preferences for ranchettes' attributes, or differences between owners that purchase at different times. For example, it might be that ranchaette buyers that buy when the amount of vegetation is large do so because buyers that come to search for ranchettes at times when the amount of vegetation is large have different time preferences or are affected differently by macroeconomic conditions than other buyers. In Column 2 we therefore add controls for the macro economic conditions and in Column 3 we also add controls for ranchettes’ attributes.

The macroeconomic controls that we add are the average interest rate in the period between the sale and the resale, the GDP growth in the years prior to the sale and the resale and a linear time trend for the time of the purchase. The controls for the ranchette's attributes include the log of each ranchette's area, the log of the distances from the nearest river, main road and city, the sum spent on renovations between the purchase and the resell and the average and standard deviation of the amount of vegetation in each ranchette.

We include the GDP growth rate in the period before the sale and the resale because these are likely to affect reservation prices at the time that the transactions took place. We include the interest rate in the period between the sales because it is a proxy for the opportunity costs of owning a ranchette and should therefore have a positive effect on the appreciation rates.

We include the ranchettes' area and distances from rivers, cities and roads to capture changes in buyers' tastes over time. If the buyers' tastes did not change over the period, then these attributes should affect the price level, but not the appreciation rates for a ranchette with a given attribute. Similarly, the average and standard deviation of the amount of vegetation should affect the prices of ranchettes because the amount of vegetation and its predictability affect the value for both agricultural and recreational uses. As long as buyers' tastes do not change over time, however, these controls should have only little effects on the appreciation rates.

We find that, as in the benchmark regression, in both columns 2 and 3 Arizona owners make greater returns than non-Arizona owners. These coefficients suggest that Arizona owners make these larger returns because they have an absolute advantage over non-Arizona owners. Second, we also find that whereas vegetation conditions at the time of the visit do not affect Arizona owners, they negatively affect the returns of non-Arizona owners. Consequently, a non-Arizona owner who happens to visit her ranchette at a time when the amount of vegetation is greater than normal makes smaller returns than another non-Arizona owner who visits the same ranchette when then amount of vegetation is average.

Hence, the results of Columns 2 and 3 suggest that the baseline result of a negative effect on returns from the amount of vegetation at the time of the visit cannot be attributed to a time of year effect, to differences in tastes for ranchettes' attributes, to renovations' values or to macroeconomic conditions. Furthermore, including these variables only strengthen the statistical significance of the main controls and therefore adds further robustness to the conclusions.

As a further robustness check, we replace the NDVI variable with a variable that captures the difference between the average NDVI and the NDVI two months before the transaction. As the owners care about the amount of vegetation throughout the year, this variable captures the difference between the true level of the vegetation amenity and the level as perceived by an owner before he purchases.

With this specification, we estimate the effects of any differences between the amount of vegetation around the ranchette that an owner should expect on the basis of reliable second hand information and the amount of vegetation the owner observed while visiting the ranchette. We also include all the controls for the macroeconomic conditions and for the ranchette's attributes as in the previous regression.

The results show that the main findings remain unchanged. We find that the coefficient of Arizona owners is significant and positive, suggesting that Arizona owners have information advantages over non-Arizona owners and, consequently, Arizona owners earn almost 9% more in annual appreciation than non-Arizona owners. Furthermore, the differences in the returns between Arizona and non-Arizona owners become greater when the amount of vegetation at the time of the visit is greater. The coefficient of the interaction between Arizona owner and the difference between the NDVI at the time of the visit and the average NDVI suggests that a non-Arizona owner that visits when the amount of vegetation is greater than average by one standard deviation unit of the difference (0.03 NDVI units) earns approximately 1.8% less in annual appreciation than a non-Arizona owner who visits at a time when the amount of vegetation is average.

Thus, as predicted by the hypothesis that out-of-town owners are affected by the availability heuristic, the results show that there are differences beyond those we expect to observe between local and out-of-town owners. More precisely, there are also differences in annual appreciation between out-of-town owners that depend on the amount of vegetation they observe when they visit the ranchettes.

As we discuss above, the differences between out-of-town owners cannot be attributed to differences in information, because different out-of-town owners are likely to have access to similar information about the local vegetation conditions. Furthermore, it seems that this information is cheap, easily available and reliable, and it should therefore be accessible to all owners.

It therefore seems that despite the large value involved in the transaction and the availability of both information and time for making in depth value judgments, the salient effect of watching the amount of vegetation in the ranchette at the time of the visit has a significant effect on the valuation. This effect seems to bias the value that out-of-town owners expect to receive from their ranchettes and consequently make them buy ranchettes that yield them lower than expected returns (Kahneman et al., 1990, Cao and Wei, 2005, Busse, 2012). According to the results in our benchmark regression, for example, the projection bias caused by the availability heuristic renders non-Arizona owners that visit when the amount of vegetation is one standard deviation larger than the average a reduction of about 5% in annualized returns. This means that non-Arizona owners that visit when the amount of vegetation is large lose about 4,000 US dollars per year in 1995 fixed prices relative to other non-Arizona owners that visited the amount of vegetation is average.

5. CONCLUSIONS

It has been shown that out-of-town buyers tend to pay more than locals for similar assets due to information asymmetries (Chinco and Mayer 2016, Kurlat and Stroebel 2015). In this paper we contribute to this literature by showing that projection biases can exacerbate the pricing errors observed in transactions involving out-of-town buyers. Importantly, we not only show that projection biases can exacerbate observed differences in realized returns between local and out-of-town buyers, but they also generate differential returns between different out-of-town buyers.

It was suggested that projection biases and systematic misjudgments of values can occur when temporary events affect decision makers' evaluations (Loewenstein et al. 2003, Conlin et al. 2007, Busse et al. 2012). It also was suggested that such biases should be small in markets where decision makers have time to reconsider their decisions and the monetary incentives are large (Loewenstein and Adler 1995, Loewenstein et al. 2003).

We study the effect of the availability heuristic in Arizona’s market for ranchettes, small ranches used for recreational and agricultural activities. Our results suggest that non-locals (not Arizona) buyers seem to be affected by the availability heuristic, because although information about the average conditions is inexpensive and available, there are large differences between the returns made by non-locals. Furthermore, these differences seem to depend on the time that the non-locals visit. Non-locals that visit when the amount of vegetation in the ranchette is untypically large make significantly smaller returns than non-Arizona buyers that visit when the amount of vegetation in the ranchette is average.

Thus, it seems that although all non-Arizona buyers are likely to have the same information about the local conditions from local press, authorities, real estate agents, neighbors, etc., the effect of the salient information from the time of the visit lasts and affects value judgments even though it is less representative than information available from other sources. Hence, our results suggest that the availability heuristic seem to cause projection biases that have significant effect on returns in a housing market where assets have a value of over 124,000 US dollars in 1995 prices and when buyers have time to consider their decisions.

The results therefore suggest that the large difference in the returns between local and non-local buyers is not only the information advantage that locals are likely to have over non-locals (Chinco and Mayer 2016, Kurlat and Stroebel 2015). This difference is also because non-locals are affected differently than locals by the conditions at the time that they visit and, consequently, non-locals that visit at a time that the conditions are uncommonly good are likely to make lower returns than other non-locals that buy at a different time.

Hence, our results suggest that research on heuristics can contribute to understanding deviations of asset prices from their fundamental values (Bordalo et al. 2013). For example, evidence on housing prices in places like Phoenix and Miami before the subprime mortgage crisis of 2008 suggests that the pricing behavior there might have been affected by out-of-state buyers' valuation errors. This similarity between the market we study and other markets that were strongly affected in the crisis of 2008 suggest that studying heuristic valuation may contribute to understanding price fluctuations in some of the housing markets that were most significantly affected by the subprime mortgage crisis (Muellbauer and Murphy 1997, Sinai 2012).

The findings reported in this paper may also contribute to improving selling techniques. For example, real estate agents in Arizona suggested to us in private conversations that they try to convince potential buyers to come for a visit during the rainy season. We do not find evidence in the data, however, that the share of houses that are bought by out-of-town buyers increases when the amount of vegetation is large.

This might be explained if times with large amount of vegetation coincide with the time in which local buyers, as well as out-of-town buyers tend to make more transactions. This might also be explained if the number of potential out-of-town buyers is relatively fixed at each point in time and real estate agents cannot wait too long before closing deals. Nevertheless, the findings suggest that both home buyers and real estate agents should be aware of the effect of projection biases.

Finally, the results may also assist authorities in designing policies that will reduce price variability in housing and similar markets: providing buyers with reliable information might not be enough to prevent pricing errors. Under some conditions, it might even exacerbates the errors if it affects the buyers' confidence or if it causes them to split their attention between too many sources of information (Falkinger, 2008, Cox 2013).

References

Anayamba, A. And C.J. Tucker (2005), "Analysis of Sahelian Vegetation Dynamics Using NOAA-AVHRR NDVI Data from 1981–2003, *Journal of Arid Environments* 63, 596–614.

Beshears, John, James J. Choi, David Laibson, and Brigitte C. Madrian (2009), "Can Psychological Aggregation Manipulations Affect Portfolio Risk Taking? Evidence from a Framed Field Experiment," Working Paper.

Bordalo, Pedro, Nicola Gennaioli and Andrei Shleifer (2013), "Salience and Asset Prices," *American Economic Review* 103(3), 623 – 28.

Busse, Meghan R., Devin G. Pope, Jaren C. Pope, and Jorge Silva-Risso (2012), "Projection Bias in the Car and Housing Market," Working Paper.

Camerer, Colin (2008), "The Case for Mindful Economics," in A. Caplin and A. Schotter (eds), The Foundations of Normative and Positive Economics, (New York, NY: Oxford University Press), p. 43 – 67.

Cao, Melanie and Jason Wei (2005), "Stock Market Returns: A Note on Temperature Anomaly," *Journal of Banking and Finance* 29, 1559 – 73.

Chinco, Alex and Chris Mayer (2016), "Misinformed Speculators and Mispricing in the Housing Market," *The Review of Financial Studies*, forthcoming.

Conlin, Michael, Ted O'Donoghue, and Timothy J. Vogelsang (2007), "Projection Bias in Catalog Orders," *American Economic Review* 97(4), 1217 – 49.

Conlisk, John (1996), "Why Bounded Rationality?" *Journal of Economic Literature* 34(2), 669–700.

Cox, Ruben (2013), "The Demand for Mortgage Insurance," Working Paper.

Dall'Olmo, G. and A. Karnieli (2002), "Monitoring Phenological Cycles of Desert Ecosystems Using NDVI and LST Data Derived from NOAA-AVHRR Imagery," *International Journal of Remote Sensing* 23(19), 4055–4071.

De Bondt, Werner F.M. and Richard H. Thaler (2002), "Do Analysts Overreact?," in T. Gilovich, D. Griffin and D. Kahnneman (eds.), Heuristics and Biases (New York, NY, Cambridge University Press), 678 – 685.

Epley, Nicholas and Thomas Gilovich (2002), "Putting Adjustment Back in the Anchoring and Adjustment Heuristic," in T. Gilovich, D. Griffin and D. Kahnneman (eds.), Heuristics and Biases (New York, NY, Cambridge University Press), 49 – 82.

Falkinger, J. (2008), "Limited Attention as a Scarce Resource in Information-Rich Economies," ***Economic Journal*** 118, 1596–1620.

Genosove, David (2003), "The Nominal Rigidity of Apartment Rents," *Review of Economics and Statistics* 85(4), 844 – 53.

Grenadier, Steven R. and Neng Wang, (2007), "Investment Under Uncertainty and Time-Inconsistent Preferences," *Journal of Financial Economics* 84, 2 – 39.

Kahneman, Daniel (2003), "A Perspective on Judgment and Choice," *American Psychologist* 58(9), 697 – 720.

Kahneman, Daniel and Shane Frederick (2002), "Representativeness Revisited: Attribute Substitution to Intuitive Judgment," in T. Gilovich, D. Griffin and D. Kahnneman (eds.), Heuristics and Biases (New York, NY, Cambridge University Press), 49 – 82.

Kahneman, Daniel, Jack L. Knetsch and Richard H. Thaler (1990), "Experimental Tests of the Endowment Effect and the Coase Theorem," *Journal of Political Economy* 98(6), 1325 – 1348.

Koehler, Derek J., Lyle Brenner and Dale Gryffin (2002), "The Calibration of Expert Judgment: Heuristics and Biases Beyond the Laboratory," in T. Gilovich, D. Griffin and D. Kahnneman (eds.), Heuristics and Biases (New York, NY, Cambridge University Press), 686 – 715.

Kurlat, Pablo and Johannes Stroebel (2015), "Testing for Information asymmetries in Real Estate Markets," *The Review of Financial Studies*, 2429-61

.

Levitt Steven and Chad Syverson (2008), “Market Distorions when Agents are Better Informed: The Value of Information in Real Estate Transactions,” *The Review of Economics and Statistics*, 599-611.

Loewenstein, George and Daniel Adler (1995), "A Bias in the Prediction of Tastes," *Economic Journal* 105(431), 929 – 37.

Loewenstein, George, Ted O'Donoghue, and Matthew Rabin (2003), "Projection Bias in Predicting Future Utility," *Quarterly Journal of Economics* 118(4), 1209 – 48.

Mullainathan, Sendhil (2002), "A Memory Based Model of Bounded Rationality," *Quarterly Journal of Economics* 117(3), 735 – 74.

Muellbauer, John and Anthony Murphy (1997), "Booms and Busts in the UK Housing Market," *Economic Journal* 107(445), 1701 – 27.

Nagler, G. Maahew and Daniel E. Osgood (2006), “A Lemons ‘Mirage:’ Erroneous Perceptions of Asymmetric Information in the Market for Arizona Ranchettes," *Mountain Plains Journal of Business and Economics* 7, 52-63.

Navon, David and Daniel Gopher (1979), "On the Economy of the Human Processing System," *Psychological Review* 86(3), 215 – 55.

Ngai, Rachel L. and Silvana Tenreyro (2013), "Hot and Cold Seasons in the Housing Market," Working Paper.

Nisbett, Richard E., Eugene Borgida, Rick Crandall, and Harvey Reed, "Popular Induction: Information is Not Always Informative", in J.S. Carroll & J.W. Payne (Editors), Cognition and Social Behavior, Halsted, 1976.

Nivens, H.D., T.L. Kastens, K.C. Dhuyvetter, and A.M. Featherstone (2002), "Using Satellite Imagery in Predicting Kansas Farmland Values," *Journal of Agricultural and Resource Economics* 27(2), 464 – 80.

Polyakov, Maksym, David Pannell, Ram Pandit, Sorada Tapsuwan and Geoff Park (2013), "Valuing Environmental Assets on Rural Lifestyle Properties," *Agricultural and Resource Economics Review*, 159-75.

Rajan, Raghuram G. (1994), "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence," *Quarterly Journal of Economics* 109(20), 399 – 441.

Saunders, Edward M. (1993), "Stock Prices and Wall Street Weather," *American Economic Review* 83(5), 1337 -45.

Schwarz, Norbert and Leigh Ann Vaughn (2002), "The Availability Heuristic Revisited: Ease of Recall and Content as Distinct Sources of Information," in T. Gilovich, D. Griffin and D. Kahnneman (eds.), Heuristics and Biases (New York, NY, Cambridge University Press),

Sengupta, Sanchita and Daniel E. Osgood (2003), "The Value of Remoteness: A Hedonic Estimation of Ranchette Prices," *Ecological Economics* 44, 91 – 103.

Sinai, Todd M. (2012), "House Price Movements in Boom-Bust Cycles," NBER Working Paper #18059.

Sloman, Steven A. (2002), "Two Systems of Reasoning," in T. Gilovich, D. Griffin and D. Kanhneman (eds.), Heuristics and Biases (New York, NY, Cambridge University Press), 379 – 96.

Thaler, Richard H. (2000), "From Homo Economicus to Homo Sapiens," *Journal of Economic Perspectives* 14(1), 133 – 41.

Tucker, Compton J., Jorge E. Pinzon, and Michel E. Brown (2004), "Global Inventory Modeling and Mapping Studies (GIMMS) Satellite Drift Corrected and NOAA-16 Incorporated Normalized Difference Vegetation Index (NDVI), Monthly 1981 to Present," Dataset, University of Maryland, Department of Geography.

Tversky, Amos and Daniel Kahneman (1974), “Judgment under Uncertainty: Heuristics and Biases,” *Science*, 185, 1124-31.

Table 1: Summary Statistics

This table describes the summary statistics of the data used in our empirical exercise. The data corresponds to ranchettes located in the Yavapai County, Arizona, and was provided by the Yavapai County assessor. We have observations on 1,013 repeated sales of ranchettes between January 1991 and September 2000. For each repeated sale, we have the dates, prices, lot sizes in acres, assessed value of improvements between the repeated sales, billing address of the buyer and geo-coded location of the ranchette.

	Average	Standard Deviation
Original price of the ranchette (1995 prices)	US$80,525.20	US$115,720.10
Resale price of the ranchette (1995 prices)	US$124,112.90	US$241,437.30
Average value of renovations (1995 prices)	US$23,400.30	US$70,600.50
Ranchette's Area (Acres)	6.9	9.13
Distance from a road (yards)	1,940.9	3,394.33
Distance to a river (yards)	6,304.5	6,574.90
Distance to a city (yards)	9,211.1	16,597.20
Average NDVI	0.33	0.110
Annual GDP growth	1.4%	0.62%
Average Annual Federal Interest Rate	4.92%	1.05%
Monthly number of US housing starts	1,405.9	204.54

Table 2: Owners' Real Returns

This table shows several regressions in which the dependent variables are the owners' real returns. Each column corresponds to a different regression using different independent variables. Heteroscedastic robust standard errors are reported in parentheses.

	(1)	(2)	(3)	(4)
Interaction Arizona Owner × NDVI	0.49* (0.289)	0.53* (0.287)	0.54** (0.278)	
Arizona Owner	0.10*** (0.023)	0.09*** (0.023)	0.08*** (0.023)	0.09*** (0.023)
NDVI	0.03 (0.089)	0.03 (0.088)	0.05 (0.091)	
GDP growth rate before ownership		-11.94** (3.983)	-12.10*** (4.135)	-11.95*** (4.128)
GDP growth rate before resale		-0.02 (0.011)	-0.02 (0.011)	-0.02 (0.011)
Interest rate between owning and reselling		0.06** (0.031)	0.05* (0.029)	0.05 (0.032)
Linear time trend		4.16×10^{-5}** (1.9×10^{-5})	4.02×10^{-5}** (1.9×10^{-5})	3.98×10^{-5}** (1.9×10^{-5})
Log area			0.001 (0.013)	-0.001 (0.013)
Log distance to road			-0.004 (0007)	-0.004 (0.007)
Log distance to city			0.003 (0.006)	0.003 (0.006)
Log distance to river			-0.01* (0.007)	-0.01* (0.007)
Value of renovations			7.45×10^{-5}*** (1.39×10^{-5})	7.47×10^{-5}*** (1.39×10^{-5})
Average NDVI			-0.23 (0.484)	
Standard deviation of NDVI			-0.18 (0.179)	
Interaction Arizona Owner × difference between NDVI at visit and average NDVI				0.57* (0.319)
Difference between NDVI at visit and average NDVI				0.06 (0.090)
Constant	0.07 (0.046)	-0.49** (0.214)	-0.34 (0.223)	-0.32 (0.224)
Fixed-Effects for months of first and second transactions	YES	YES	YES	YES
N	1013	1013	1013	1013
R^2	0.028	0.038	0.075	0.075
F	2.06**	2.81***	3.46***	3.46***

* - significant at 10%. ** - significant at 5%. *** - significant at 1%.