The Impact of Gains and Losses on Homeowner Decisions*

Dong Hong†, Roger K. Loh‡, and Mitch Warachka§

December 2014

Abstract

Using unique data on condominium transactions that allow for accurately-measured capital gains and losses, we examine the impact of these gains and losses on homeowner decisions. Consistent with the disposition effect, owners with a gain have higher sell propensities than those with a loss. Since real estate prices result from owner negotiations with buyers and tenants, we also examine whether prices vary across otherwise comparable units depending on the owner's capital gain. Owners with a gain accept lower selling prices, list for sale at lower prices, and accept lower rents from tenants. These pricing implications are sensitive to the magnitude of an owner's gain, which is consistent with realization utility, and are economically large. For example, units with a capital gain have selling prices that are 5% lower than those with a capital loss. Overall, our findings indicate that realization utility influences homeowner decisions. Alternative explanations such as financing constraints, informed trading, and mean reversion cannot explain our results.

Keywords: Real Estate, Realization Utility, Disposition Effect

JEL Classification Codes: G2; G11; R21

*We thank Brad Barber, Jiangze Bian, Hyun-Soo Choi, Bing Han, David Hirshleifer, Harrison Hong, Roni Michaely, Joshua Spizman, and Wei Xiong for their helpful comments as well as seminar participants at Claremont McKenna College, Loyola Marymount University, Singapore Management University, and Tsinghua University. We also thank the Sim Kee Boon Institute of Financial Economics for its financial support, as well as Jack Hong and Onson Li for their research assistance.

†Singapore Management University, 50 Stamford Road, Singapore 178899. Email: donghong@smu.edu.sg

‡Singapore Management University, 50 Stamford Road, Singapore 178899. Email: rogerloh@smu.edu.sg

§Claremont McKenna College, 500 East Ninth Street, Claremont, CA., 91711, USA. Email: mwarachka@cmc.edu

1 Introduction

The greater tendency for investors to sell assets with capital gains compared to those with capital losses has been found in the stock trades of retail investors (Odean, 1998) and in experimental markets (Shefrin and Statman, 1985; Weber and Camerer, 1998). The usual economic explanation for this disposition effect is prospect theory (Kahneman and Tversky, 1979). Specifically, capital gains correspond to a concave portion of the value function where individuals are risk averse and consequently less willing to continue holding a risky asset. Conversely, capital losses correspond to a convex portion of the value function where individuals are risk seeking and consequently more willing to continue holding a risky asset. Realization utility (Barberis and Xiong, 2012) also implies the disposition effect under one of the following two conditions; either prospect theory or a positive discount rate representing an investor's impatience. A positive discount rate lowers the pain of losses realized in the future while expediting the pleasure from realizing an immediate gain.

We examine whether capital gains and losses impact homeowner decisions regarding residential real estate. Unlike transactions by retail investors in the stock market or by subjects in an experimental market, a property purchase is typically the largest financial transaction undertaken by a household. Thus, households have stronger incentives to act rationally in order to avoid the disposition effect's negative wealth implications. Real estate transactions are also conducted during a lengthy escrow period, which affords an opportunity to reflect before finalizing the decision. Therefore, one may expect deviations from expected utility theory to be less prevalent in real estate. On the other hand, households may be more emotionally invested in real estate decisions given their implications for household wealth. Barberis and Xiong (2012) assert that every property purchase is likely to comprise an investing episode with a salient reference price and distinct mental account.[1] From this perspective, the disposition effect can impact residential real estate transactions. Therefore, whether or not the disposition effect impacts homeowner decisions is ultimately an empirical question.

An empirical investigation of the disposition effect requires the accurate measurement of capital gains. This requirement poses a challenge to empirical tests since the market value of

[1] With stock investments, the ability to buy and sell a different number of shares over time at different prices complicates the reference price. Grinblatt and Han (2005) estimate reference prices in the equity market using a combination of prior volume and prices.

unique properties is unobservable. Indeed, even adjacent properties are often too dissimilar to accurately infer a property's current market value. Our unique data from Singapore's condominium market (almost 280,000 transactions) overcomes this problem since condominiums in Singapore consist of standardized units within multi-unit condominiums. This commonality allows unit-level market prices, and hence capital gains, to be estimated using transactions within the same condominium.[2] In our sample, a hedonic model that includes only the size and floor level of each unit explains close to 90% of the variation in unit-level prices within a typical condominium.

Genesove and Mayer (2001) examine 5,785 property listings in Boston from 1990 to 1997, and conclude that condominium owners with a capital loss demand higher prices when listing their unit for sale due to loss aversion.[3] However, this result can also be explained by realization utility without invoking prospect theory. Moreover, there are several important distinctions between our study and Genesove and Mayer (2001). First, their data does not contain condominiums that are not listed for sale. Thus, sell propensities (Odean, 1998) that specifically test the disposition effect cannot be estimated.[4] Second, Genesove and Mayer (2001) do not examine the importance of realization utility. Third, capital gains are difficult to estimate in Boston due to unobservable property attributes and renovations that can alter a unit's market price, and potentially the owner's reference price. Fourth, while Genesove and Mayer (2001) focus on listings, our study examines a comprehensive set of housing decisions including the likelihood of sale, selling prices, and rental prices as well as listing prices. Fifth, residents of the city-state Singapore can change employers without relocating. In contrast, property transactions in the US may be driven by relocations induced by variation in metropolitan labor markets. Chan (2001) as well as Ferreira, Gyourko, and Tracy (2010) examine the relationship between household mobility and property prices.

We first examine a unit's probability of sale conditional on its capital gain. Following Odean (1998), we compute the sell propensity for gains, and then divide this percentage by

[2]Giglio, Maggiori, and Stroebel (2013) also utilize this data in their study of long-term discount rates.

[3]Genesove and Mayer (1997) examine whether homeowner equity in a unit affects the time taken to sell a unit using a smaller sample of Boston condominiums consisting of 2,381 observations from 1990 to 1992.

[4]The majority of properties listed for sale in Genesove and Mayer (2001) had a capital loss. Although this high percentage may be representative of widespread weakness in Boston's housing market during their sample, the disposition effect would predict the majority of condominiums listed for sale had a capital gain.

the sell propensity for losses across the universe of condominium units. In a typical cross-section, units with gains are twice as likely to be sold as those with losses. Probit specifications extend this result by controlling for a multitude of unit-level and market-level characteristics, including quarter and condominium fixed effects.

We then analyze sale prices, listing prices, and rental prices conditional on unit-level capital gains. This analysis is unique to real estate. In the stock market, prices and dividends are largely exogenous with respect to retail investors. However, the selling price and rental income of a property result from owner negotiations with buyers and tenants, respectively. Consequently, we are able to test whether sale and rental prices vary across otherwise comparable units depending on the owner's capital gain.

The disposition effect predicts that owners of a unit with a capital loss demand higher prices than those with a capital gain since the additional dollar obtained by the former results in higher marginal utility. As predicted by the disposition effect, units with capital gains are associated with lower sale prices than those with capital losses. This effect increases with the magnitude of a unit's capital gain, as predicted by realization utility (Barberis and Xiong, 2012) since realization utility predicts a burst of utility from selling an asset with a gain that is proportional to its magnitude.[5] A criticism of realization utility is that consumption depends on a household's level of wealth, not changes in their wealth. However, real estate comprises the majority of household wealth in Singapore but financing consumption with this wealth is difficult due to its indivisibility.[6] Unlike the stock market where dividends or a partial liquidation of one's portfolio can finance consumption, homeowners in Singapore must sell their existing unit and "down-size" to convert real estate wealth into consumption. However, this strategy is limited by small units having significantly higher per square foot prices than large units.

We also compute listing premiums as the percentage that the list price of a unit exceeds its estimated market price. We report that capital gains are negatively related to the listing premium as larger gains are associated with a lower listing premium. Intuitively, owners with a capital loss demand higher prices when listing their unit for sale, and eventually obtain a

[5]Frydman, Barberis, Camerer, Bossaerts, and Rangel (2014) find experimental support for realization utility.

[6]Over 60% of household wealth in Singapore is in real estate with less than 12% in traded securities. Bank deposits and life insurance comprise the remainder of household wealth.

higher selling price than owners of comparable units with a capital gain. The higher prices demanded by owners with a capital loss is consistent with the lower sell propensity of their units.

In general, close to 2% of units with a capital gain are sold each quarter compared to about 1% for those with a capital loss. Although sales are twice as likely for units with a gain, the majority of owners do not sell their unit. Instead, owners either occupy their unit or become landlords.[7] Therefore, we use data on rental contracts to examine if rental income varies according to an owner's capital gain. We report that landlords whose units have a capital loss obtain higher rents. This finding is consistent with the disposition effect as these landlords exhibit risk-seeking behavior by assuming higher vacancy risk. Indeed, landlords with a capital loss appear willing to gamble on finding a tenant willing to pay higher rent instead of accepting a lower rental offer. Conversely, the marginal value of additional rent is lower for landlords whose units have a capital gain given the concavity of their value function.[8]

Our empirical support for the disposition effect in real estate is robust to alternative explanations. In Stein (1995), financing constraints can lead to the appearance of the disposition effect. Specifically, the existing property of a potential repeat buyer represents a large fraction of their wealth that is financed through leverage. With a decline in its price, leverage reduces the equity available to finance an additional property purchase. As mortgages in Singapore are standardized with government-mandated minimum down-payments and common mortgage rates, we estimate a homeowner's paid-in equity by aggregating their initial down-payment with their subsequent principal payments. A larger amount of paid-in equity weakens a household's financing constraint. Another proxy for household financing constraints is unique to Singapore; whether the owner used to reside in public housing. We show that all our results are robust to controlling for these financing constraints proxies.

We also rule out other alternative explanations for the disposition effect such as informed-

[7]In Singapore, the supply of condominium units for rent is provided by individuals, not corporations. In 2012, 20% of the units in our sample had a rental contract within the prior three years.

[8]There is no capital gains tax in Singapore to inhibit the sale of units with capital gains or encourage their owners to find a tenant instead of a buyer. The decision to become a landlord rather than immediately sell a unit with a capital gain does not contradict prospect theory. Realization utility justifies this decision for units whose expected return is sufficiently high. Rents also increase with property prices, allowing a higher rental income to partially realize a unit's larger capital gain.

trading and mean reversion. For stock investments, informed investors sell a stock once their positive private information has been incorporated into its price and produced a capital gain. Unlike the equity market, informed trading and private information in Singapore's real estate market is less important since unit-level prices are determined primarily by market-level prices. In comparison to the equity market, portfolio rebalancing also provides a less credible explanation since housing is indivisible and expected returns are highly correlated among individual units. Moreover, the autocorrelation in market-level returns is positive. Thus, there is no evidence of mean reversion in housing returns that could justify holding units with a capital loss. Instead, short-term price continuation imposes an economic burden on owners with a capital loss that are reluctant to sell.

Our findings have several important economic implications. Despite the importance of housing transactions to household wealth, homeowners exhibit a strong disposition effect. The economic costs of this bias are non-trivial. Compared to owners with a capital loss, owners with a capital gain list their units for-sale at prices that are 10% lower, sell their units at prices that are 5% lower, and rent out their units at prices that are 2% lower. The disposition effect also has implications for transaction volume in the real estate market. In particular, decreasing prices are associated with capital losses that lower transaction volume, inducing a positive price-volume relation in the real estate market as a consequence.

2 Data

Our data is from Singapore's private property (condominium) market. A typical condominium in Singapore consists of 200-300 units located in several high-rise buildings. The average building height is 15 floors in our sample and each unit is approximately 1,300 square feet. Units are largely homogeneous within the same condominium although they can differ in terms of their size and floor level. For example, homeowners require approval to remove any walls, and are not allowed to install windows and doors that differ from the condominium's original design. Therefore, as unobservable attributes exert a minimal impact on unit-level prices per square foot (PSF), we can accurately estimate capital gains based on PSF selling prices within the same condominium.

Sale transactions involving private property are reported to a government agency in Sin-

gapore known as the Urban Redevelopment Authority (URA). URA will list the details on a public website within two weeks. As a result, homeowners can use past transactions in their condominium to infer the market price of their unit and consequently compute its associated capital gain or capital loss.

We obtain sale transactions data from URA's Real Estate Information System, a subscription service known as REALIS. This database records the transaction date, condominium name, transaction price, unit size, street address, floor level, and unit number. Unlike studies of the disposition effect that have to estimate historical purchase prices (e.g., Grinblatt and Han, 2005), the URA data provides a nearly complete set of historical transactions in Singapore.

Our URA data begins in 1995 and ends in 2012. After excluding condominiums with less than 50 transactions in this sample period, a total of 282,920 transactions remain. For certain units, we find a discrepancy in their size when they are transacted on different dates. Therefore, we exclude units with more than a 2% size discrepancy. After this filter, our sample contains 277,856 transactions involving 1,104 condominiums and 185,383 unique units.

We also obtain listings and rental data from the Singapore Real Estate Exchange (SRX). Listings and rental data begin in 2006 and 2008, respectively, with both time series ending in 2012. SRX is a consortium consisting of the following real estate agencies: PropNex, HSR, DWG, OrangeTee, ERA, ECG, C&H, DTZ, ReMax, Savills, and Hutton. The listings and rental data cover the majority of the market because the consortium includes the largest real estate agencies in Singapore. The listings and rental coverage increased over time as agencies joined the consortium in stages. For the listings data, complete data from member companies are provided to SRX since 2011 (fewer members submit listings data to SRX in 2006-2010). We report later in Panel B of Table 2 that SRX member companies collectively cover the majority of rental transactions in Singapore.

The property listing data from SRX has 48,639 observations including both for-sale and for-rent listings. However, only 8,029 listings contain an actual asking price and a detailed address. This is because agents often omit unit numbers from their listings to prevent other agents from approaching their clients. Commonality within each condominium allows agents to advertise their entire inventory of units for sale in the same condominium with a single listing without revealing individual unit numbers. The observations with available unit numbers are

matched to URA's records to obtain 7,180 observations, of which 5,905 are for-sale listings and 1,275 are for-rent listings. We focus our listings analysis exclusively on for-sale listings since they comprise the majority of the listings sample.

Rental contracts in Singapore's condominium market are typically two-year leases signed between individual landlords and tenants. Our rental sample is much larger than our listings sample because unit-level addresses are typically available in rental contracts recorded by real estate agencies. The SRX rental data contains 113,282 transactions within 1,104 condominiums. We remove duplicate entries that are likely due to submissions by both the landlord's agent and the tenant's agent, resulting in 96,520 observations. We then remove observations with monthly rent below $1,000 Singapore dollars (SGD) as well as rent per square foot (RSF) below $1 SGD or above $15 SGD as these observations likely result from erroneous data entry.

We report in Panel B of Table 2 that, on average, this sample covers 53.36% of Singapore's rental market during the 2008-2012 period. This coverage estimate is based on rental summary statistics from URA that list the quarterly number of rental contracts signed for condominiums that have at least ten rental transactions. The condominium's median quarterly RSF in our sample also parallels those reported in URA's summary statistics. Thus, our sample of rental contracts is representative of transactions in the broader market.

2.1 Capital Gain Estimation

To examine if capital gains and capital losses influence homeowner decisions, we measure each unit's capital gain since its most recent purchase date. The simplest method to estimate a unit's capital gain is to use the PSF of recent transactions within the same condominium. This method controls for condominium-specific characteristics such as location, age, facilities, and quality. Neighborhood characteristics are also accounted for by this methodology.[9] To demonstrate the ability of this simple method to accurately price units, we estimate a hedonic pricing model within each condominium by regressing the transaction PSF of all units sold during each quarter on quarterly dummies. A condominium is excluded from the hedonic model if the number of transactions within the condominium is less than twice the number of

[9]For instance, Agarwal, Rengarajan, and Sing (2014) find that school redistricting impacts condominium prices, although the effects in their study are economically smaller than the impact of capital gains in our study.

quarters with available data. In a second specification, each unit's size (square feet) and floor level supplement the quarterly dummies

$$\text{PSF}_{i,t} = \sum_{t=\text{Q1 1995}}^{\text{Q4 2012}} \beta_t \, \text{Quarter}_{i,t} + \beta_{\text{S}} \, \text{Size}_i + \beta_{\text{f}} \, \text{Floor}_i + \epsilon_{i,t} \, . \tag{1}$$

The coefficients for both models are estimated within the entire 1995 to 2012 sample period for each individual condominium i. We then report the distribution of the coefficients across the condominiums. Panel A of Table 1 reports an average R^2 of 74% for the first pricing model, which contains only quarterly dummy variables. Hence, the average price in the condominium explains nearly three-quarters of the variation in unit-level prices.

The inclusion of size and floor characteristics in the second pricing model increases the average R^2 to 88%. The distribution of R^2 is right-skewed as the median is 93% in this specification. According to Panel A of Table 1, the average β_{S} coefficient is -0.13 (average t-statistic of 8.90) across all quarters and condominiums. Thus, large units sell at a discount in terms of their PSF. This discount is consistent with less demand for larger more expensive units due to financial constraints. The average β_{f} coefficient is 7.15 (average t-statistic of 6.13). Thus, there is a price premium for units on higher floors.

Overall, the results from Equation (1) demonstrate that unobservable unit-level attributes exert little impact on property prices since cross-sectional variation in prices is mostly determined by common condominium characteristics.

For the remainder of the paper, we compute capital gains using two methodologies. The baseline approach determines a unit's capital gain using the average PSF of sale transactions within the same condominium during a six-month horizon centered at the quarter-end. For example, a unit's market price at the end of March 1998 is computed using property sales within the same condominium from January 1st to June 30th. The second method uses fitted values from the hedonic model in Equation (1) to predict a unit's PSF based on transactions within the same condominium during the same quarter. To ensure accuracy, condominiums whose R^2 from the hedonic model is below 70% are dropped.

Unreported results confirm the high correlation between unit-level capital gains computed using the two methods.[10] Nonetheless, prices from Equation (1) are utilized in unreported

[10]For capital gains whose absolute magnitude is between 5% and 10% using the first method, this correlation

robustness tests that produce similar results. In some cases, the hedonic model produces stronger results than those reported in later tables.

We start the capital gains estimation on March 31st 1998 for all units that appear in the URA database from January 1st 1995 to March 31st 1998. For units that were sold more than once during this period, we condition on their most recent purchase price to compute the unit's capital gain. Using the baseline approach, the capital gain of a unit is the average PSF of all transactions within the same condominium during a six-month window centered at March 31st 1998, less the unit's most recent purchase PSF.

We then compute each unit's capital gain for the second quarter of 1998 using its most recent purchase price during the January 1st 1995 to June 30th 1998 window. This expanding-window methodology builds our quarterly inventory of capital gain estimates up to 2012. The number of units in our sample increases over time as more units are sold and enter the URA records. Table 2 describes our sample each quarter from 1998 to 2012. We also compare our sample to the complete housing stock in Singapore, and report the relevant sample coverage estimates in Table 2.[11] By the end of 2012, our sample coverage is nearly 83%. Coverage does not reach 100% because of units purchased before 1995 that are not sold between 1995-2012, units that are not yet sold by developers, and condominiums that had no sell transactions within a six-month horizon (thus preventing the estimation of capital gains).

2.2 Prices and Volume in Singapore's Real Estate Market

Figure 1 illustrates the time-series variation of the market-level PSF along with transaction volume. The quarterly market-level PSF is computed by first averaging the PSF of all transactions within each condominium and then averaging these condominium-level PSF averages across all condominiums. Consistent with the well-documented positive price-volume relation in real estate, the correlation between this quarterly market-level PSF and transaction volume is 0.684 in our sample.

We also estimate the autocorrelation of price changes at both the annual and quarterly

equals 0.69, which increases to 0.88 for units whose capital gain is between 10% and 20% in absolute magnitude. For the largest absolute capital gains (above 20%) the correlation is 0.98 between the two methods.

[11] We estimate the total housing stock using the website http://www.propertyguru.com.sg/ that records the total number of units in each condominium.

frequencies in Panel B of Table 1. Price changes are defined as the quarterly percentage changes in the market-level PSFs. At a quarterly frequency, the autocorrelation coefficient for the first lag is positive. For other lags, the coefficients are mostly insignificant. At an annual frequency, no autocorrelations are significant. Thus, market-level price changes in Singapore are not mean reverting. Instead, the positive quarterly autocorrelation implies that selling a unit with a gain or holding a unit with a loss is not optimal.

Figure 1 and Table 2 both illustrate a generally upward trend in Singapore property prices that coincides with considerable price volatility. The average price of a residential condominium unit in a typical quarter is $1,046,226 SGD, which is equivalent to $666,386 USD using the average exchange rate of 1.57 SGD per USD during the 1998-2012 period. The average PSF equals $886 SGD (equivalent to $512 USD).

In Panel B of Table 2, we report summary statistics for our listings and rental sample. The listings and rental observations are matched to our quarterly inventory of units where capital gains can be estimated. Our final listings sample contains 5,431 observations for the 2006-2012 period and 73,413 rental observations for the 2008-2012 period. On average, units are listed for sale at a 10.6% premium above their market PSF estimated at the end of the prior quarter. For the rental sample, the average RSF is $3.57 SGD ($2.27 USD). Thus, for a typical apartment of 1,300 square feet, the rent would be $4,641 SGD ($2,956 USD) per month.

2.3 Financing Constraints

Stein (1995) proposes an alternative explanation for the appearance of the disposition effect based on financing constraints. A repeat buyer's existing property, which is typically debt-financed, represents a large fraction of the buyer's wealth. A price decline in this property reduces the sale proceeds available to finance the down-payment on an upgrade. Thus, the price decline tightens the repeat buyer's financing constraint, especially when the equity in their existing property is low.

We obtain a proxy for household financing constraints by first aggregating the owner's down-payment with their subsequent monthly principal payments. This sum is then normalized by the unit's estimated market price to create a measure of paid-in equity. While paid-in equity is not directly related to unit's capital gain, it can alleviate a repeat buyer's financing

constraint.

We assume that the down-payment on a unit equals the government-mandated minimum based on the prevailing maximum loan-to-value ratio at its purchase date.[12] Mortgages in Singapore are standardized with a maturity of 30 years and an adjustable rate that references the three-month interbank offer rate in Singapore (SIBOR), with the actual mortgage rate typically being one percent above SIBOR.[13] Data on SIBOR is obtained from the Monetary Authority of Singapore (www.mas.gov.sg). This standardization enables monthly principal payments to be aggregated depending on an owner's holding period and the relevant SIBOR time series.[14] We begin the loan three months after the unit's purchase date since housing transactions usually require twelve weeks to complete in Singapore. Although SIBOR is negatively correlated with property prices, variation in the actual mortgage rate above SIBOR is small compared to time-series variation in SIBOR. Indeed, as mortgages in Singapore are recourse and default rates are correspondingly low, the premium above SIBOR is relatively constant across time and across households.[15]

In addition to paid-in equity and SIBOR itself, another financing constraint proxy available in the URA data is whether the household previously resided in public housing. A unique feature of Singapore's housing market is its segmentation into public units and private (condominium) units. Public units are reserved for lower-income households, who usually intend to upgrade to a condominium once their financial circumstances permit.[16] Compared to buyers who were already residing in a condominium when they purchased their current unit, former residents of public housing are more likely to be financially constrained.

[12]The Singapore government frequently adjusts this maximum loan-to-value ratio to inflate or deflate the housing market. We manually collect data on these policy changes from various government websites and newspaper articles.

[13]Fixed-rate mortgages are not available in Singapore.

[14]Genesove and Mayer (1997) make similar assumptions regarding the common maturity and borrowing rate underlying mortgages when estimating homeowner equity.

[15]Agarwal, Liu, Torous, and Yao (2014) report that financial sophistication impacts a household's selection of mortgages and their decision to strategically default. However, mortgage selection and strategic default are less relevant in Singapore because mortgage contracts are standardized and lending is recourse.

[16]Although our sample does not contain the sale of public units, the data indicates whether the owner was residing in public housing when they purchased their current (first) private property.

3 Results

This section describes the results from our empirical tests involving unit-level sale propensities, selling prices, listing prices, and rental prices. Specifically, the influence of gains and losses on homeowner decisions regarding each of these four variables are examined.

3.1 Sale Propensities

As in Odean (1998), the disposition effect is identified by the following ratio

$$\text{R} \;=\; \frac{PGR}{PLR} \;=\; \frac{\text{Probability of Realizing a Gain}}{\text{Probability of Realizing a Loss}}\,. \tag{2}$$

The numerator, PGR, represents the probability of a realized gain, which is defined as the percentage of units with capital gains that are sold in the next quarter. This percentage is computed by normalizing the number of units sold with capital gains by the total number of units in the housing stock with a capital gain. Similarly, the denominator, PLR, represents the probability of a realized loss, which is defined as the percentage of units with capital losses that are sold in the next quarter. While capital gains are estimated at the end of a quarter, PGR and PLR are determined in the subsequent quarter conditional on their sign. In unreported results, R averages 1.70, which indicates the presence of the disposition effect. A t-statistic of 2.43, computed from the distribution of its time series across the sample period, rejects the null hypothesis that R equals one.

Following Ben-David and Hirshleifer (2012), Figure 2 plots the sale probability conditional on GAIN Magnitude. GAIN Magnitude is defined as the percentage change in a unit's estimated market price relative to its purchase price (i.e., the unit's return since purchase). In order to plot these sale probabilities, we sort each quarter-unit observation into capital gain bins of 1%. These bins are imbalanced since smaller capital gains are more frequent. To ensure that there are sufficient observations within each bin to estimate a sale probability, we exclude bins with fewer than 100 observations or observations where GAIN Magnitude exceeds 200%. For each bin, we compute the percentage of the observations that are sold next quarter and plot these sale probabilities.

The top chart of Figure 2 presents evidence that a capital gain increases a unit's sale probability, as predicted by the disposition effect. However, the sale probabilities become scattered

and appear to decline for large capital gains. Ben-David and Hirshleifer (2012) argue that this pattern can arise from large gains being associated with long holding periods. Therefore, the bottom chart of Figure 2 focuses on units held for at most three years. Consistent with their argument, the probability of sale is generally increasing with a unit's capital gain in this short holding period subsample. Overall, the visual evidence in Figure 2 is consistent with the disposition effect. Figure 2 also indicates that a homeowner's purchase price is the appropriate reference price. In particular, the increase in a unit's sell propensity at a capital gain of zero suggests that homeowners do not adjust the reference price to account for transaction costs or inflation.

To formally examine the relation between unit-level capital gains and sell probabilities, we estimate a probit model that controls for several unit-level and market-level characteristics. The dependent variable in these specifications equals one if a unit is sold in the quarter following the estimation of its capital gain.

Unit-level characteristics include the indicator function GAIN Dummy (one if a unit's capital gain is positive and zero otherwise) and GAIN Magnitude. Other independent variables include the length of the unit's holding period (HOLD), the log of the unit's square footage (Size), and the unit's floor level (Floor). The latter two variables are known to have pricing implications based on the results from Equation (1). For ease of interpretation, Floor is the floor level divided by 100, which effectively magnifies its coefficient by 100. Thus, while the Floor coefficients are often statistically significant, their economic significance is far less important. An indicator function that equals one if the unit's owner lived in public housing at the time of its purchase (Public) as well as the unit's paid-in equity (Paid-in Equity) provide two unit-level proxies for household financing constraints. Two market-level proxies for household financing constraints include the SIBOR rate in the prior quarter, and the minimum required down-payment (DOWN) expressed as a percentage (e.g. 0.20 denotes a 20% required down-payment).[17]

Table 3 contains the results of the probit based on the entire sample of units. For continuous independent variables, we report the marginal impact on the probability that a unit is

[17]In unreported results, we also include the unit's original purchase price as an independent variable to proxy for homeowner wealth. However, the inclusion of this control variable does not alter any of our reported results and its coefficients are insignificant.

sold when the variable changes by one standard deviation (half a standard deviation below to half a standard deviation above its mean). For binary independent variables, the reported marginal effect is the difference in the sell probability when this variable changes from zero to one. Standard errors in the estimation are clustered by calendar quarter and z-statistics are reported in parentheses.

Observe that the coefficient for GAIN Dummy is positive in every specification. For example, the GAIN Dummy coefficient of 0.012 (z-statistic of 14.15) indicates that units with a capital gain are 1.2% more likely to be sold than those with a capital loss during the same period. For comparison, the baseline sell propensity is 1.61%. Thus, the sell propensity increases significantly for units with a capital gain. The inclusion of proxies for financing constraints has no influence on the magnitude of the GAIN Dummy coefficient, which remains economically large and statistically significant in every specification. In addition, GAIN Magnitude has an insignificant coefficient in the first four specifications. Thus, owners appear to condition on the sign of their unit's capital gain more than its magnitude.

Finally, we include quarter and condominium fixed effects in the fifth specification.[18] This specification provides the strictest test to establish whether two units in the same condominium have different sell propensities in the same quarter due to differences in their owner's capital gain. We find this difference is significant, as units with a capital gain are more likely to be sold than those with a capital loss within the same condominium and the same quarter. Although the marginal effect of GAIN Magnitude is negative, at -0.50%, Figure 2 and a later robustness test confirm that units with longer holding periods confound the relation between capital gains and selling propensities.[19] Overall, our empirical evidence is consistent with a capital gain generally increasing a unit's sell propensity.

For the control variables in Table 3, the coefficient for HOLD is positive, which indicates that a longer holding period is associated with a greater sell propensity. This finding is consistent with a longer holding period enabling the owner to reduce their mortgage principal, hence weakening their financing constraints when acting as a repeat buyer. Also consistent

[18]Note that the control variables SIBOR and DOWN are omitted in this specification since they are collinear with quarterly fixed effects.

[19]Large capital gains correspond to long holding periods, which may coincide with an inheritance. Units that are inherited are not recorded in our database although the unit's reference price could be increased to reflect its market value at the time of the transfer, thereby lowering its capital gain.

with financing constraints is the result that larger units, which are more expensive, have lower sell propensities. The positive coefficient for SIBOR can be explained by higher mortgage rates corresponding with lower property prices, and therefore lower required down-payments. Indeed, higher down-payments reduce unit-level sell propensities as buyers require more cash to purchase a unit, which accounts for the negative coefficient of DOWN. The negative coefficient for Public is also consistent with financially constrained households having a lower sell propensity since they are less likely to be able to finance a further upgrade. With down-payments accounted for by DOWN, paid-in equity generally exerts an insignificant impact on unit-level sell propensities. A positive coefficient for paid-in equity would be consistent with the financing constraint channel as greater homeowner equity weakens a household's financing constraint and facilitates upgrading.

The predicted market prices from Equation (1) offer an alternative method to estimate unit-level capital gains. Using the full pricing model with size and floor characteristics to estimate capital gains, we re-estimate the probit specification in a smaller subset of condominiums with higher turnover. We exclude condominiums whose hedonic model R^2s are less than 70% and units whose predicted PSF from the hedonic model deviates from average PSF in the baseline method by more than 50%. Unreported results based on the hedonic model parallel those in Table 3. For example the coefficient on GAIN Dummy is 1.1% instead of 1.2% from the first four specifications. This similarity is consistent with the relative homogeneity of housing in Singapore as per square foot prices are largely determined by condominium characteristics.

In summary, gains and losses exert a significant impact on a unit's probability of being sold since units with a capital gain are more likely to be sold than those with a capital loss. Nonetheless, gains and losses cannot completely account for variation in homeowner sell decisions. Indeed, only a small percentage of homeowners each quarter sell their unit, and many of our control variables have coefficients that are consistent with financing constraints being responsible for lower unit-level sell propensities. Moreover, Barberis (2013) cautions that prospect theory alone cannot provide a complete description of investor behavior since wealth levels ultimately determine consumption.

3.2 Selling Prices

We next examine the selling price of units that eventually are sold. Unlike the stock market where selling prices are largely exogenous with respect to the seller, the real estate market enables us to investigate whether selling prices depend on a seller's capital gain or capital loss. Indeed, as homeowners decide whether to accept or reject a prospective buyer's offer, we examine if their gain or loss influences the prices they accept.

For each sale transaction that occurs in the next quarter, we compute the unit's selling price premium by subtracting one from the ratio of its observed sale price normalized by its estimated market price at the end of the current quarter. This selling price premium is the dependent variable in our next empirical specification.

A negative α_1 coefficient in the following unit-level regression

$$\frac{\text{Selling Price}}{\text{Estimated Price}} - 1 \;=\; \alpha_0 + \alpha_1\,\text{GAIN Dummy} + \alpha_2\,\text{GAIN Magnitude} + \gamma\,X + \epsilon \quad (3)$$

is evidence of the disposition effect, which predicts risk-seeking behavior by homeowners with a capital loss. Specifically, the disposition effect causes owners with a capital loss to continue holding the risky asset (condominium) instead of lowering their selling price to realize the loss. This finding is also predicted by realization utility as the homeowner is willing to settle for a lower price to realize a burst of utility induced by the gain. An additional prediction of realization utility is the relevance of a capital gain's magnitude. The inclusion of GAIN Magnitude, which is the percentage change in the unit's estimated market price relative to its purchase price, enables us to test this prediction. Specifically, a negative α_2 coefficient supports realization utility as a larger capital gain leads to a lower selling price. The X vector includes multiple control variables that proxy for financing constraints in our earlier probit specifications. The standard errors in the estimation of Equation (3) are clustered by calendar quarter and t-statistics are reported in parentheses.

Before reporting our estimation results, we first examine visually in Figure 3 the univariate relation between selling price premiums and capital gains. Each point in this figure represents the average selling price premium for a particular capital gain magnitude. The capital gains are divided into 1% bins (bins with fewer than 10 observations are excluded). We observe that selling prices are higher for units with a capital loss in comparison to units with a capital gain.

Our regressions coefficients in Table 4 confirm the visual evidence. The disposition effect and realization utility are both supported as the α_1 and α_2 coefficients are consistently negative. Therefore, owners with a capital loss obtain a higher price for their unit, although they are less likely to sell their unit (a likely consequence of requiring a higher price). Specifically, the -0.010 coefficient (t-statistic of 2.05) for GAIN Dummy in Equation (3) signifies that owners with a capital gain have selling prices that are 1% lower than comparable units with a capital loss. Furthermore, the magnitude of a capital gain is relevant since its -0.065 coefficient (t-statistic of 9.07) is also negative, and larger in absolute magnitude.

When quarter and condominium fixed effects are added to Equation (3), support for the disposition effect strengthens (see specification 5). In particular, the coefficient on GAIN Dummy is -0.020 (t-statistic of 12.45) while the coefficient for GAIN Magnitude is -0.061 (t-statistic of 11.43). For units with a gain in our selling price sample, GAIN Magnitude averages 36.5% while for units with a loss, GAIN Magnitude averages -16.9%. Thus, the coefficients imply that the selling price premium for a typical unit with a gain is 5.26% lower compared a typical unit with a loss ($-0.020 - 0.061 \times [36.5\% + 16.9\%]$). Using our sample's typical selling price of \$666,386 USD, this 5.26% reduction represents a non-trivial dollar amount of \$35,052 USD.

The proxies for financing constraints have coefficients that are generally inconsistent or insignificant across the different specifications. However, larger units sell for a discount while units on higher floors sell for a premium. These findings confirm the results in Panel A of Table 1 for the hedonic model in Equation (1).

3.3 Listing Prices

We next examine our sample of listings that are matched to units where capital gains can be computed. The composition of our listings data is representative of the distribution of capital gains versus capital losses in the broader housing market. In particular, the percentage of units with a capital gain in our listings sample (September 2006 to September 2012) is 84.31% relative to 80.10% for the broader housing inventory during the same period. Therefore, as predicted by the disposition effect, owners with a capital gain appear more willing to list their unit for sale.

Listing premiums are regressed on unit-level capital gains as follows

$$\frac{\text{Listing Price}}{\text{Estimated Price}} - 1 \;=\; \alpha_0 + \alpha_1\,\text{GAIN Dummy} + \alpha_2\,\text{GAIN Magnitude} + \gamma\,X + \epsilon\,, \quad (4)$$

where the listing price premium is computed by subtracting one from the ratio of a unit's listing price in the next quarter normalized by its estimated market price at the end of the current quarter. This regression determines whether owners with a capital loss actually demand a higher selling price when listing their unit for sale. Once again, a negative α_1 coefficient is predicted by both the disposition effect and realization utility, while a negative α_2 coefficient supports the additional prediction of realization utility.

Figure 4 illustrates the sensitivity of the listing premium to GAIN Magnitude. Each point in this figure represents the average listing premium for a particular capital gain, with capital gains divided into 1% bins (bins with fewer than 10 observations are excluded). Figure 4 indicates that listing premiums are higher for units with a capital loss. Overall, units with a capital gain have a lower list price, and subsequently sell for a lower price.

Our regression estimates confirm the lower listing premiums for units with a capital gain. For listing prices, both the sign of a unit's capital gain and its magnitude are influential. In Table 5, the 0.198 intercept indicates that homeowners with a capital loss list their units at a 19.8% premium, while those with a capital gain list at a smaller 9.2% premium, after subtracting the -0.106 coefficient (t-statistic of 10.05) for GAIN Dummy. In the specification that includes all the control variables, the coefficient for GAIN Dummy remains economically important at -0.080 (t-statistic of 6.53) while GAIN Magnitude has a coefficient of -0.070 (t-statistic of 4.48). Furthermore, with quarter and condominium fixed effects, these coefficients continue to be negative. Their economic significance is also large as the coefficients equal -0.068 and -0.066 for GAIN Dummy and GAIN Magnitude, respectively, in this specification. As the average capital gain in our listings sample is 38.9% and the average capital loss is -10.7%, these coefficients imply a 10.1% reduction in the listing price premium for a typical unit with a capital gain compared to a typical unit with a capital loss ($-0.068 - 0.066 \times [38.9\% + 10.7\%]$).

3.4 Rental Prices

Beginning in 2008, we are able to identify investment properties using the rental contracts sample provided by SRX. Specifically, we match rental agreements with specific units and

compute a unit's rent premium by subtracting one from the ratio of its actual monthly rent per square foot (RSF) in the next quarter normalized by its estimated market RSF in the current quarter. This rent premium becomes the dependent variable in our next regression specification

$$\frac{\text{Actual RSF}}{\text{Estimated RSF}} - 1 \;=\; \alpha_0 + \alpha_1 \,\text{GAIN Dummy} + \alpha_2 \,\text{GAIN Magnitude} + \gamma\, X + \epsilon\,. \quad (5)$$

A unit's market RSF is estimated with the fitted values of a pricing model that parallels the specification in Equation (1) for monthly per square foot rent

$$\text{RSF}_{i,t} \;=\; \sum_{t=\text{Q1 1995}}^{\text{Q4 2012}} \beta_t \,\text{Quarter}_{i,t} + \beta_{\text{S}}\,\text{Size}_i + \beta_{\text{f}}\,\text{Floor}_i + \epsilon_{i,t}\,. \quad (6)$$

This pricing model is estimated within each condominium and the average (median) R^2 is 58.33% (60.38%). We then remove units located in condominiums whose R^2 from the above hedonic model is below 50%, and units whose predicted RSF deviates from its current RSF by more than 50%. These filters ensure that the estimated market rents are accurate.

As in previous specifications, a negative α_1 coefficient in Equation (5) supports the disposition effect and realization utility, while a negative α_2 coefficient provides additional support for realization utility. Specifically, risk-seeking behavior causes landlords with a capital loss to bear greater vacancy risk by requiring higher rental income.

Figure 5 illustrates the relation between the rent premium and GAIN Magnitude. Each point in this figure represents the average rent premium (in percent) for a particular capital gain, with capital gains divided into 1% bins (bins with fewer than 10 observations are excluded). Observe that rent premiums are lower for units with a capital gain, with this effect strengthening for larger capital gains.

The results in Table 6 are consistent with the plot in Figure 5 and support the disposition effect. Focusing on the fifth specification, landlords with a capital gain obtain -1.5% less RSF (GAIN Dummy coefficient equals -0.015 with a t-statistic of 4.78). The negative GAIN Magnitude coefficient of -0.013 (t-statistic of 2.42) indicates a further RSF reduction of -1.3%. Thus, both the disposition effect and realization utility operate in the rental market. To gauge the economic significance of these coefficients, the average capital gain in this regression is 41.2% and the average capital loss is -9.4%. Thus, the coefficients imply that units with capital gains have a 2.16% lower rent premium compared units with a capital loss ($-0.015 -$

$0.013 \times [41.2\% + 9.4\%]$). This represents an annual loss of $766 USD in rental income, given the average rent of $2,956 USD per month.

Our evidence regarding selling, listing, and rental prices is consistent. Owners with a capital gain list their unit for-sale at a lower price and accept a lower selling price compared to owners with a capital loss. Furthermore, landlords with a capital gain accept less rent. As predicted by realization utility, these effects are stronger for larger capital gains.

4 Robustness Tests

We conduct two robustness tests that isolate the potential influence of the disposition effect using subsamples containing units with short holding periods and units with small gains or losses. Alternative explanations for our results are also discussed.

4.1 Holding Period

We first investigate whether there is a difference between units with short versus long holding periods. As housing is a consumption asset, a longer holding period may signify that an owner has a stronger attachment to their unit. Conversely, units with short holding periods are more likely to constitute a distinct investment episode. As Barberis and Xiong (2012) suggest, realization utility is more applicable when investors categorize their investments into separate investment episodes. A more recent purchase price due to the shorter holding period is also likely to serve as a more salient reference price for homeowners.

We define a variable SHORT that equals one if the unit has been held for three years or less. This dummy variable is interacted with GAIN Dummy and GAIN Magnitude to examine if their economic effects are stronger for units with short holding periods. For brevity, Table 7 reports the results for specifications involving all the previous control variables both with and without fixed effects for each quarter and condominium.

We first consider the sell propensities of units with short holding periods. The negative coefficient for SHORT indicates that units with short holding periods are less likely to be sold. The interaction between SHORT and GAIN Dummy either has a positive or insignificant coefficient. Thus, units that have increased in value over a short horizon are often more likely to be sold. Furthermore, the coefficient for the interaction between SHORT and GAIN Magnitude

is positive, and much larger, with marginal effects between 1.6% to 1.9%. Intuitively, owners with a short holding period are more willing to sell their unit if it has appreciated by a large amount.

For the specifications involving the selling price premium, listing premium, and rent premium, interactions between SHORT and GAIN Dummy as well as GAIN Magnitude generally have negative coefficients. Consequently, the effect of a capital gain, especially a large capital gain, is to further reduce the selling price, listing price, and rent of units held over a short horizon. Provided homeowners are more likely to classify their property purchases into distinct investing episodes if the unit has a short holding period, the results in Table 7 provide empirical support for realization utility.

4.2 Sign Test

Ben-David and Hirshleifer (2012) argue that there should be a discontinuity in the sell propensities at a zero capital gain. As small gains and losses are economically similar, any difference in investor behavior around zero would stem from a preference for selling assets with a capital gain. Ben-David and Hirshleifer (2012) do not find evidence of a sign preference in their analysis of retail equity investors.

We test whether the sign preference exists in our residential real estate sample by searching for a discontinuity at zero in a subsample of units whose small capital gains and capital losses are within 5% of their purchase price. This bandwidth is appropriate since these gains and losses are economically small. Thus, any difference in investor behavior can be attributed to a sign preference.

For sell propensities, the unreported coefficients for GAIN Dummy remain positive, while the coefficients for GAIN Magnitude become positive in the small gain and loss subsample. Thus, consistent with a sign preference, units with a small gain are more likely to be sold than units with a small loss. However, when quarter and condominium fixed effects are included in the probit, these results weaken. Therefore, we find limited evidence that homeowners have a sign preference for realizing small gains.

We then repeat this subsample analysis using the selling price premium, listing premium, and rent premium as the dependent variable. In contrast to the sell propensities, we find little evidence of a discontinuity in each of these three tests. Therefore, while homeowners have a

preference for selling their unit if it has a capital gain, the selling and rental prices they accept are less sensitive to whether their unit has a small gain or loss.

Overall, our results indicate that the magnitude of a unit's capital gain is more relevant to homeowner decisions. For small gains and losses, there is little empirical support for homeowners having a sign preference. This lack of support suggests that realization utility provides a more complete description of homeowner decisions than the disposition effect.

4.3 Alternative Explanations

Several alternative explanations for our results are less plausible than our conclusion that homeowner decisions are influenced by the disposition effect and realization utility.

One possible alternative explanation for our results is a belief in mean reversion. However, empirically, at an annual horizon, the autocorrelation in market-level prices is insignificant while only the first lag is positive at a quarterly horizon (Panel B of Table 1). Thus, there is no evidence of mean reversion in housing returns that could justify holding units with a capital loss. Price continuation in the Singapore housing market implies that homeowners who have a capital gain should not immediately sell their unit.

Informed trading (speculative motivation for trading) provides another explanation for the appearance of the disposition effect offered by Ben-David and Hirshleifer (2012).[20] However, unlike the equity market in their study, informed trading in Singapore's real estate market is less important since the overall market PSF, not private information regarding an individual unit, dominates any unit's PSF. Indeed, unit-level prices are highly correlated. Portfolio rebalancing also cannot explain the presence of the disposition effect in our sample since housing is indivisible and expected returns are highly correlated among individual units in Singapore.

Finally, the consumption value of home ownership does not confound our test of the disposition effect. The high correlation among units in Singapore implies that low property prices enable improved consumption value. Indeed, a homeowner is not disadvantaged by

[20] Crane and Hartzell (2010) examine the property investments of 266 Real Estate Investment Trusts (REITs) and find that REIT managers are subject to the disposition effect. However, their results regarding professional managers in commercial real estate are more difficult to disentangle from informed trading, especially by REIT managers with a broad investment mandate and portfolios containing multiple properties.

selling their current unit at a capital loss to purchase another unit with a similar expected return that better suits their housing preferences.

5 Conclusion

The disposition effect and realization utility are both motivated by prospect theory. Prospect theory posits that investors are concerned with changes in their wealth, hence gains and losses. In contrast, expected utility theory operates on terminal wealth levels.

The disposition effect predicts that assets with a capital gain are more likely to be sold than assets with a capital loss. Using data from Singapore's condominium market, where capital gains can be accurately estimated, we find evidence that gains and losses exert a significant impact on homeowner decisions. Homeowners with a capital gain are almost twice more likely to sell their homes compared to those with a capital loss. These findings support the disposition effect. Indeed, despite the economic importance of housing transactions to household wealth, and the non-trivial amount of time and effort spent on these transactions, homeowners appear susceptible to the disposition effect.

Real estate transactions also enable us to investigate the prices that homeowners accept when selling or renting their property. While prices are exogenous for retail investors in the stock market, transaction prices in real estate depend on the offer a homeowner accepts from a prospective buyer or tenant. We find that homeowners with a capital gain accept lower selling prices and rents than those with a capital loss. Homeowners with a capital gain also list their property for-sale at a lower price. Furthermore, consistent with realization utility, these findings strengthen for homeowners with larger gains. While the disposition effect focuses on the sign of a unit's return since its purchase, realization utility in Barberis and Xiong (2012) allows the magnitude of this return to influence homeowner decisions. As predicted by realization utility, our results indicate that homeowners often condition their decisions on the magnitude of their unit's gain or loss. Thus, the disposition effect alone does not fully describe the impact of gains and losses on real estate transactions.

While real estate data from Singapore has several advantages over US data, our results can be generalized to residential real estate markets in other locations. Indeed, in every country, real estate transactions are large relative to household wealth, involve salient purchase prices,

and are endogenous with respect to owner preferences. Our evidence demonstrates that the likelihood a property is sold, hence transaction volume, is influenced by the disposition effect. Thus, broad gains in the overall housing market are likely to induce selling activity and increase transaction volume. Intuitively, the price-volume relation in real estate markets can be attributed to the disposition effect.

Our findings also have important household wealth implications. The average capital gain reduces the selling price by approximately 5% compared to the average capital loss. Using the price of the average home in our sample, this decline represents a significant dollar amount in excess of $35,000 USD. The average capital gain also reduces rents by approximately 2% on average compared to the average capital loss. This represents an annual loss in rental income in excess of $700 USD.

References

Agarwal, S., C. Liu, W. Torous, and V. Yao, 2014, Financial decision making when buying and owning a home. Working Paper, National University of Singapore.

Agarwal, S., S. Rengarajan, and T. F. Sing, 2014, Values of proximity to schools: An experiment with school relocation events in Singapore. Working Paper, National University of Singapore.

Barberis, N., 2013, Thirty years of prospect theory in economics: A review and assessment. Journal of Economic Perspectives 27, 173-196.

Barberis, N., and W. Xiong, 2012, Realization utility. Journal of Financial Economics 104, 251-271.

Barberis, N., and W. Xiong, 2009, What drives the disposition effect? An analysis of a long-standing preference-based explanation. Journal of Finance 64, 751-784.

Ben-David, I., and D. Hirshleifer, 2012, Are investors really reluctant to realize their losses? Trading responses to past returns and the disposition effect. Review of Financial Studies 25, 2485-532.

Chan, S., 2001, Spatial lock-in: Do falling house prices constrain residential mobility? Journal of Urban Economics 49, 567-586.

Crane, A., and J. Hartzell, 2010, Is there a disposition effect in corporate investment decisions? Evidence from real estate investment trusts. Working Paper, University of Texas at Austin.

Ferreira, F., J. Gyourko, and J. Tracy, 2010, Housing busts and household mobility. Journal of Urban Economics 68, 34-45.

Frydman, C., N. Barberis, C. Camerer, P. Bossaerts, and A. Rangel, 2014, Using neural data to test a theory of investor behavior: An application to realization utility. Journal of Finance 69, 907-946.

Genesove, D., and C. Mayer, 1997, Equity and time to sale in the real estate market. American Economic Review 87, 255-269.

Genesove, D., and C. Mayer, 2001, Loss aversion and seller behavior: Evidence from the housing market. Quarterly Journal of Economics 116, 1233-1260.

Giglio, S., M. Maggiori, and J. Stroebel, 2013, Very long-run discount rates. Working Paper, University of Chicago.

Grinblatt, M., and B. Han, 2005, Prospect theory, mental accounting, and momentum. Journal of Financial Economics 78, 311-339.

Kahneman, D., and A. Tversky, 1979, Prospect theory: An analysis of decision under risk. Econometrica 47, 263-291.

Odean, T., 1998, Are investors reluctant to realize their losses? Journal of Finance 53, 1775-1798.

Shefrin, H., and M. Statman, 1985, The disposition to sell winners too early and ride losers too long: Theory and evidence, Journal of Finance 40, 777-790.

Stein, J., 1995, Prices and trading volume in the housing market: A model with down-payment effects. Quarterly Journal of Economics 110, 379-406.

Weber, M., and C. Camerer, 1998, The disposition effect in securities trading: An experimental analysis. Journal of Economic Behavior and Organization 33, 167-184.

Table 1: Correlation of Prices within Condominiums and Autocorrelation in Market Returns

Panel A summarizes the results from the pricing model in Equation (1) from 1995 to 2012 based on quarterly indicator variables, size, and floor level, $\text{PSF}_{i,t} = \sum_t \beta_t \text{Quarter}_{i,t} + \beta_\text{S} \text{Size}_i + \beta_\text{f} \text{Floor}_i + \epsilon_{i,t}$. This pricing model is estimated for every condominium. Each observation is a sale of unit i in a condominium during quarter t. Sale transactions are from the URA REALIS database for condominiums in Singapore. Average coefficients across all 1,014 condominiums are reported along with the distribution of their R^2s. Panel B contains the results from regressing market-level returns on lagged returns where returns are based on percentage changes in the market-level PSF every quarter. The quarterly market-level PSF is computed by averaging all transactions within each condominium during a quarter, and then averaging these condominium-level PSF averages across all condominiums. In Panel B, t-statistics are in parentheses with *, **, and *** representing the statistical significance of the estimated coefficients at the 10%, 5%, and 1% levels, respectively.

Panel A: Pricing model summary

Number of condominiums	1,014	1,014
Quarterly indicator variables	Yes	Yes
Average size coefficient		-0.13
Average t-statistic		(8.90)
Average floor coefficient		7.15
Average t-statistic		(6.13)
Adjusted R^2 Percentiles		
1%	0.004	0.363
10%	0.182	0.716
25%	0.666	0.864
Median	0.872	0.930
75%	0.928	0.958
90%	0.956	0.973
99%	0.980	0.988
Mean	0.738	0.880

Panel B: Autocorrelation in property market returns

	Quarterly horizon				Annual horizon			
Return t-1	0.590***	0.714***	0.694***	0.694***	0.160	0.208	0.251	0.454
	(6.03)	(5.93)	(5.61)	(5.47)	(0.61)	(0.75)	(1.04)	(1.35)
Return t-2		-0.209*	-0.139	-0.135		-0.256	-0.250	-0.316
		(1.74)	(0.92)	(0.88)		(0.92)	(1.05)	(1.18)
Return t-3			-0.105	-0.115			0.330	0.385
			(0.85)	(0.74)			(1.33)	(1.38)
Return t-4				0.013				-0.172
				(0.10)				(0.59)
Intercept	0.005	0.006	0.006	0.006	0.036	0.047	0.056	0.043
	(0.78)	(0.97)	(0.96)	(0.90)	(0.88)	(1.06)	(1.43)	(0.93)
Observations	70	69	68	67	16	15	14	13
Adjusted R^2	0.339	0.358	0.358	0.346	-0.044	-0.060	-0.017	-0.063

Table 2: Quarterly Inventory of Units and Summary Statistics

Panel A reports summary statistics for the historical inventory of units from 1998-2012 where capital gains can be estimated using the 1995-2012 URA data on Singapore's condominium market. Statistics regarding the historical sale price, square footage (Size), price per square foot (PSF), years held (HOLD), and number of condominiums are included. Our coverage is estimated by comparing the units in our sample with the total number of units in each condominium. The second set of columns pertain to sale transactions in the URA data. Panel B reports summary statistics regarding for-sale price listings and rental data from SRX, which begin in 2006 and 2008, respectively. The listing premium is the percentage the listing price exceeds the market price based on the average PSF within each unit's condominium. RSF is the monthly rent per square foot. The rental coverage is estimated by comparing our total number of observations with URA's quarterly rental data.

Panel A: Description of property inventory and sale transactions

	Historical inventory								Sales		
Date	Avg. Price	Avg. Size	Avg. PSF	Avg. HOLD	Condos	Units	Housing inventory	Sample coverage	Avg. Price	Avg. PSF	Units
03/31/1998	$1,051,727	1,368	$752	1.71	296	25,143	74,516	33.74%	$915,655	$646	715
06/30/1998	$1,032,603	1,366	$741	1.85	323	26,949	77,326	34.85%	$772,547	$579	1,653
09/30/1998	$1,019,267	1,367	$731	2.02	340	28,283	79,855	35.42%	$731,918	$520	1,404
12/31/1998	$981,121	1,369	$701	2.02	364	31,870	82,611	38.58%	$623,927	$469	3,628
03/31/1999	$958,907	1,368	$689	2.07	393	35,630	85,739	41.56%	$724,518	$530	3,389
06/30/1999	$939,276	1,370	$676	2.01	412	40,685	88,023	46.22%	$825,383	$589	5,694
09/30/1999	$937,945	1,372	$675	2.08	407	42,990	88,562	48.54%	$934,080	$676	3,450
12/31/1999	$941,532	1,372	$678	2.24	399	44,035	88,328	49.85%	$1,069,815	$747	2,169
03/31/2000	$938,453	1,376	$675	2.39	391	44,789	88,414	50.66%	$1,004,589	$714	1,960
06/30/2000	$935,370	1,378	$672	2.52	385	45,686	90,077	50.72%	$975,417	$685	1,949
09/30/2000	$941,905	1,380	$675	2.64	390	47,059	93,036	50.58%	$1,010,087	$720	2,379
12/31/2000	$935,637	1,380	$670	2.81	370	46,779	91,292	51.24%	$988,088	$685	1,712
03/31/2001	$931,134	1,377	$669	3.00	370	47,638	92,432	51.54%	$790,127	$589	1,439
06/30/2001	$927,397	1,381	$664	3.13	392	49,267	94,011	52.41%	$828,095	$595	1,769
09/30/2001	$916,256	1,377	$658	3.24	384	50,081	93,728	53.43%	$756,361	$572	2,456
12/31/2001	$916,851	1,372	$663	3.39	429	52,834	99,891	52.89%	$766,025	$567	1,647
03/31/2002	$898,802	1,368	$652	3.32	459	59,460	105,266	56.49%	$721,795	$558	5,385
06/30/2002	$895,175	1,367	$650	3.43	446	60,776	106,287	57.18%	$813,313	$605	2,665
09/30/2002	$885,027	1,364	$644	3.52	447	61,994	105,461	58.78%	$774,995	$583	3,138
12/31/2002	$883,883	1,364	$644	3.71	435	61,918	105,266	58.82%	$787,355	$574	1,971
03/31/2003	$883,958	1,366	$642	3.90	429	62,006	105,237	58.92%	$752,932	$547	857
06/30/2003	$876,354	1,360	$640	4.01	476	66,085	112,050	58.98%	$708,454	$580	1,738
09/30/2003	$869,964	1,360	$636	4.12	468	67,404	111,940	60.21%	$740,709	$565	2,845
12/31/2003	$861,791	1,360	$630	4.26	450	66,865	110,306	60.62%	$739,946	$546	1,574
03/31/2004	$870,933	1,364	$634	4.44	471	68,542	111,291	61.59%	$794,985	$563	1,686
06/30/2004	$868,276	1,362	$634	4.53	487	71,306	115,439	61.77%	$799,313	$574	2,020
09/30/2004	$866,531	1,358	$635	4.66	515	73,874	118,957	62.10%	$771,742	$570	1,970
12/31/2004	$861,485	1,362	$629	4.76	501	74,599	119,600	62.37%	$860,473	$648	2,543
03/31/2005	$865,484	1,367	$629	4.89	499	75,506	122,090	61.85%	$826,040	$596	1,726
06/30/2005	$868,187	1,367	$632	4.95	533	79,349	126,513	62.72%	$853,361	$634	3,092
09/30/2005	$867,566	1,367	$631	4.98	567	83,375	129,694	64.29%	$891,882	$624	3,659
12/31/2005	$874,098	1,366	$638	5.02	574	85,735	130,597	65.65%	$1,024,978	$741	3,568
03/31/2006	$878,802	1,367	$640	5.10	608	88,695	134,348	66.02%	$997,848	$677	3,028
06/30/2006	$886,403	1,367	$644	5.11	634	91,629	135,723	67.51%	$1,127,044	$726	4,258
09/30/2006	$896,503	1,368	$648	5.13	652	94,307	137,350	68.66%	$1,225,009	$804	4,266
12/31/2006	$920,511	1,370	$661	5.06	685	99,567	141,590	70.32%	$1,283,071	$866	6,682
03/31/2007	$946,744	1,370	$678	5.00	720	104,355	144,653	72.14%	$1,396,710	$920	6,631
06/30/2007	$990,053	1,369	$706	4.76	745	110,232	148,649	74.16%	$1,403,768	$967	11,437
09/30/2007	$1,032,989	1,365	$738	4.69	733	113,144	148,692	76.09%	$1,626,858	$1,183	8,327
12/31/2007	$1,034,115	1,357	$743	4.80	669	110,574	144,901	76.31%	$1,624,330	$1,124	3,877
03/31/2008	$1,044,978	1,359	$750	4.94	662	109,491	143,833	76.12%	$1,289,644	$993	2,386
06/30/2008	$1,046,241	1,362	$749	5.09	673	110,234	144,428	76.33%	$1,300,444	$958	2,875
09/30/2008	$1,026,189	1,351	$747	5.22	632	109,173	142,509	76.61%	$1,224,799	$916	3,595
12/31/2008	$1,023,065	1,355	$743	5.43	559	103,747	137,774	75.30%	$1,056,463	$891	1,375
03/31/2009	$1,038,205	1,356	$751	5.56	734	116,614	154,979	75.25%	$841,425	$775	2,860
06/30/2009	$1,063,930	1,358	$767	5.48	830	124,997	163,397	76.50%	$1,135,040	$890	7,733
09/30/2009	$1,087,631	1,354	$786	5.28	843	130,665	167,945	77.80%	$1,310,650	$991	10,586
12/31/2009	$1,106,006	1,352	$804	5.32	849	132,844	171,235	77.58%	$1,364,717	$1,065	5,638
03/31/2010	$1,122,747	1,348	$821	5.28	869	136,638	173,590	78.71%	$1,416,260	$1,147	7,561
06/30/2010	$1,148,100	1,345	$844	5.19	890	141,466	177,475	79.71%	$1,439,551	$1,155	8,517
09/30/2010	$1,149,175	1,332	$856	5.19	886	143,285	179,633	79.77%	$1,289,427	$1,129	7,043
12/31/2010	$1,167,766	1,330	$873	5.18	892	146,318	182,752	80.06%	$1,393,502	$1,211	7,292
03/31/2011	$1,178,641	1,322	$889	5.19	910	149,464	190,918	78.29%	$1,345,184	$1,197	6,074
06/30/2011	$1,194,108	1,315	$908	5.16	920	153,371	191,472	80.10%	$1,350,494	$1,217	8,026
09/30/2011	$1,199,482	1,309	$918	5.21	890	153,745	192,440	79.89%	$1,351,511	$1,175	6,325
12/31/2011	$1,194,563	1,300	$924	5.26	871	156,113	194,138	80.41%	$1,292,239	$1,177	6,062
03/31/2012	$1,187,465	1,292	$927	5.34	911	161,714	200,706	80.57%	$1,087,204	$1,149	6,116
06/30/2012	$1,202,069	1,284	$945	5.32	973	169,696	210,450	80.64%	$1,274,543	$1,194	8,412
09/30/2012	$1,215,034	1,282	$955	5.38	980	172,968	212,817	81.28%	$1,346,656	$1,202	6,891
12/31/2012	$1,217,082	1,271	$966	5.35	840	168,021	202,519	82.97%	$1,400,292	$1,245	7,505
Overall	$991,691	1,355	$726	4.21	598	89,693	131,913	64.32%	$1,046,226	$886	249,228

Panel B: Description of listings and rental data

	Listings		Rental		
Date	Units	Listing premium	Units	RSF	Coverage
09/30/2006	99	8.00%			
12/31/2006	94	12.57%			
03/31/2007	129	15.84%			
06/30/2007	271	25.11%			
09/30/2007	373	15.55%			
12/31/2007	314	10.88%			
03/31/2008	271	8.01%	2,426	$ 3.54	50.19%
06/30/2008	249	10.90%	2,609	$ 3.59	43.64%
09/30/2008	159	6.69%	2,166	$ 3.29	38.44%
12/31/2008	83	8.51%	2,564	$ 3.00	43.59%
03/31/2009	108	12.81%	3,003	$ 2.86	47.16%
06/30/2009	242	14.05%	2,947	$ 3.09	43.01%
09/30/2009	213	10.94%	2,812	$ 3.18	37.97%
12/31/2009	206	10.20%	3,129	$ 3.33	48.91%
03/31/2010	216	9.64%	3,674	$ 3.41	49.89%
06/30/2010	240	8.89%	4,028	$ 3.61	48.19%
09/30/2010	191	6.99%	3,702	$ 3.59	55.62%
12/31/2010	176	7.41%	4,832	$ 3.72	55.21%
03/31/2011	334	9.96%	5,054	$ 3.80	68.61%
06/30/2011	544	10.32%	4,995	$ 3.97	63.74%
09/30/2011	267	6.56%	4,344	$ 3.93	56.99%
12/31/2011	107	7.90%	4,987	$ 3.92	64.23%
03/31/2012	137	7.37%	5,434	$ 3.93	69.37%
06/30/2012	215	8.23%	5,883	$ 4.08	67.38%
09/30/2012	193	10.54%	4,824	$ 4.04	61.65%
Overall	5,431	10.55%	73,413	$ 3.57	53.36%

Table 3: Unit-level Probit for Sell Propensity

This table records the marginal effects from a probit panel regression that examines unit-level sell probabilities in each quarter of our 1998-2012 sample. The dependent variable Sale equals one if a unit is sold in the quarter after its capital gain is estimated. A unit's capital gain is estimated by subtracting its purchase price from its estimated market price, which is determined from the average selling price per square foot within the same condominium during a six-month interval centered at the end of the quarter. GAIN Dummy equals one if the unit's capital gain is positive and zero otherwise. GAIN Magnitude is the percentage change in the unit's price relative to its purchase price. The unit's holding period (HOLD), defined as the number of years since its purchase, is also included in the probit along with the unit's square footage (Size) and floor level (divided by 100) due to their impact on prices in Equation (1). Unit-level control variables for financing constraints include an indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase (Public) and paid-in equity, which is defined as the sum of a unit's down-payment and cumulative principal repayments normalized by its market price at the quarter-end. Market-level financing constraints include the prevailing three-month interbank offer rate in Singapore (SIBOR), which underlies monthly mortgage payments, and the prevailing minimum required percentage down-payment (DOWN). Standard errors are clustered by calendar quarter and z-statistics are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: Sale Indicator Next Quarter				
Independent Variables	(1)	(2)	(3)	(4)	(5)
GAIN Dummy	0.012***	0.012***	0.012***	0.012***	0.006***
	(14.15)	(14.45)	(11.61)	(12.18)	(15.29)
GAIN Magnitude		0.000		0.001	-0.005***
		(0.24)		(0.53)	(3.67)
HOLD			0.001***	0.000***	0.001***
			(3.55)	(3.00)	(7.63)
Log(Size)			-0.007***	-0.007***	-0.007***
			(12.93)	(12.89)	(12.55)
Floor			0.012***	0.012***	0.008***
			(4.84)	(5.04)	(5.65)
Public			-0.002***	-0.002***	-0.002***
			(4.13)	(4.19)	(6.27)
Paid-in Equity			0.002	0.005	-0.029***
			(0.39)	(0.84)	(4.63)
Lag(SIBOR)			0.002**	0.002**	
			(2.01)	(1.98)	
DOWN			-0.084***	-0.086***	
			(9.80)	(13.66)	
Observations	5,213,558	5,213,558	5,012,776	5,012,776	4,964,008
Quarter & Condo Fixed Effects	No	No	No	No	Yes

Table 4: Selling Prices

This table records the results from a regression whose dependent variable is a unit's selling price premium based on quarterly observations from 1998-2012. This premium is computed by subtracting one from the ratio of a unit's selling price normalized by its estimated price based on the average per square foot price of all units sold within the same condominium during a six-month interval centered at the end of the prior quarter. A unit's capital gain is then estimated by comparing this price with the unit's purchase price. GAIN Dummy equals one if a unit's capital gain is positive and zero otherwise. GAIN Magnitude is the percentage change in the unit's estimated price relative to its purchase price. The unit's holding period (HOLD), defined as the number of years since its purchase, is also included in the probit along with the unit's square footage (Size) and floor level (divided by 100) due to their impact on prices in Equation (1). Unit-level control variables for financing constraints include an indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase (Public) and paid-in equity, which is defined as the sum of a unit's down-payment and cumulative principal repayments normalized by its market price at the quarter-end. Market-level financing constraints include the prevailing three-month interbank offer rate in Singapore (SIBOR), which underlies monthly mortgage payments, and the prevailing minimum required percentage down-payment (DOWN). Standard errors are clustered by calendar quarter and t-statistics are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: Selling Price Premium				
Independent Variables	(1)	(2)	(3)	(4)	(5)
GAIN Dummy	-0.024***	0.003	-0.015***	-0.010**	-0.020***
	(5.94)	(0.95)	(2.84)	(2.05)	(12.45)
GAIN Magnitude		-0.050***		-0.065***	-0.061***
		(14.44)		(9.07)	(11.43)
HOLD			-0.002***	0.004***	-0.001*
			(4.13)	(5.84)	(1.91)
Log(Size)			-0.058***	-0.055***	-0.134***
			(13.13)	(12.91)	(16.86)
Floor			0.190***	0.193***	0.415***
			(15.42)	(15.23)	(36.15)
Public			-0.001	-0.001	-0.001
			(1.22)	(1.08)	(0.73)
Paid-in Equity			0.050**	-0.170***	-0.053***
			(2.49)	(5.82)	(3.55)
Lag(SIBOR)			0.006	0.005	
			(1.36)	(1.12)	
DOWN			-0.078***	0.079***	
			(3.68)	(2.69)	
Intercept	0.039***	0.030***	0.426***	0.421***	0.916***
	(7.80)	(6.10)	(12.95)	(13.21)	(16.13)
Observations	88,399	88,399	85,394	85,394	85,394
Adjusted R^2	0.011	0.032	0.093	0.109	0.288
Quarter & Condo Fixed Effects	No	No	No	No	Yes

Table 5: Listing Prices

This table records the results from a regression whose dependent variable is a unit's quarterly listing premium from 2006-2012. This premium is computed by subtracting one from the ratio of a unit's listing price normalized by its estimated price based on the average per square foot price of all units sold within the same condominium during a six-month interval centered at the end of the prior quarter. A unit's capital gain is then estimated by comparing this price with the unit's purchase price. GAIN Dummy equals one if a unit's capital gain is positive and zero otherwise. GAIN Magnitude is the percentage change in the unit's estimated price relative to its purchase price. The unit's holding period (HOLD), defined as the number of years since its purchase, is also included in the probit along with the unit's square footage (Size) and floor level (divided by 100) due to their impact on prices in Equation (1). Unit-level control variables for financing constraints include an indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase (Public) and paid-in equity, which is defined as the sum of a unit's down-payment and cumulative principal repayments normalized by its market price at the quarter-end. Market-level financing constraints include the prevailing three-month interbank offer rate in Singapore (SIBOR), which underlies monthly mortgage payments, and the prevailing minimum required percentage down-payment (DOWN). Standard errors are clustered by calendar quarter and t-statistics are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: Listing Premium				
Independent Variables	(1)	(2)	(3)	(4)	(5)
GAIN Dummy	-0.106***	-0.075***	-0.078***	-0.080***	-0.068***
	(10.05)	(7.12)	(6.66)	(6.53)	(6.38)
GAIN Magnitude		-0.062***		-0.070***	-0.066***
		(6.41)		(4.48)	(4.41)
HOLD			-0.003**	0.004*	-0.001
			(2.44)	(1.85)	(0.36)
Log(Size)			-0.059***	-0.055***	-0.129***
			(8.12)	(7.86)	(5.87)
Floor			0.208***	0.207***	0.408***
			(4.99)	(4.38)	(8.44)
Public			-0.014***	-0.014***	-0.010*
			(3.02)	(2.87)	(2.05)
Paid-in Equity			0.131**	-0.195*	-0.036
			(2.17)	(1.82)	(0.66)
Lag(SIBOR)			0.013	0.013	
			(1.21)	(1.21)	
DOWN			-0.060	0.160*	
			(1.04)	(1.88)	
Intercept	0.198***	0.191***	0.563***	0.557***	1.031***
	(14.82)	(14.32)	(9.08)	(9.09)	(6.73)
Observations	5,431	5,431	5,207	5,207	5,207
Adjusted R^2	0.068	0.083	0.110	0.117	0.264
Quarter & Condo Fixed Effects	No	No	No	No	Yes

Table 6: Rental Prices

This table records the results from a regression whose dependent variable is the rent premium per square foot (RSF) of a unit in percentage terms. Rent premium is computed by subtracting one from the unit's actual rent normalized by its estimated rent. Estimated rent is the fitted value from the hedonic model in Equation (6). The sample of quarterly observations is from 2008-2012. Condominiums whose R^2 from the rental model in Equation (6) are below 0.50 and units whose predicted RSF deviates by more than 50% from the average RSF in the condominium are excluded from the analysis. A unit's capital gain at a quarter-end is determined by its estimated market price relative to the unit's purchase price. A unit's market price is estimated based on the average per square foot price of all units sold within the same condominium during a six-month interval centered at the end of the prior quarter. GAIN Dummy equals one if a unit's capital gain is positive and zero otherwise. GAIN Magnitude is the percentage change in the unit's price relative to its purchase price. The unit's holding period (HOLD), defined as the number of years since its purchase, is also included in the probit along with the unit's square footage (Size) and floor level (divided by 100) due to their impact on prices in Equation (1). Unit-level control variables for financing constraints include an indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase (Public) and paid-in equity, which is defined as the sum of a unit's down-payment and cumulative principal repayments normalized by its market price at the quarter-end. Market-level financing constraints include the prevailing three-month interbank offer rate in Singapore (SIBOR), which underlies monthly mortgage payments, and the prevailing minimum required percentage down-payment (DOWN). Standard errors are clustered by calendar quarter and *t*-statistics are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: Rent premium				
Independent Variables	(1)	(2)	(3)	(4)	(5)
GAIN Dummy	-0.029***	-0.019***	-0.019***	-0.021***	-0.015***
	(7.03)	(5.25)	(6.04)	(5.61)	(4.78)
GAIN Magnitude		-0.020***		-0.025***	-0.013**
		(7.95)		(5.27)	(2.42)
HOLD			-0.002***	0.001*	-0.001*
			(6.27)	(1.76)	(2.05)
Log(Size)			-0.045***	-0.045***	-0.098***
			(5.18)	(5.17)	(5.27)
Floor			0.012	0.014	0.087***
			(0.78)	(0.87)	(3.80)
Public			0.002	0.002	0.002
			(1.41)	(1.27)	(1.26)
Paid-in Equity			0.049***	-0.076***	-0.018
			(3.37)	(2.95)	(0.84)
Lag(SIBOR)			0.003*	0.002	
			(1.87)	(1.39)	
DOWN			-0.051**	0.039**	
			(2.30)	(2.35)	
Intercept	0.032***	0.030***	0.344***	0.353***	0.708***
	(9.76)	(9.11)	(5.49)	(5.61)	(5.40)
Observations	48,626	48,626	46,715	46,715	46,715
Adjusted R^2	0.003	0.004	0.009	0.009	0.027
Quarter & Condo Fixed Effects	No	No	No	No	Yes

Table 7: Short Holding Periods

This table examines the impact of unit-level capital gains on selling propensities, selling prices, listing prices, and rental prices over a short holding period defined as less than or equal to three years. SHORT is a dummy variable indicating that the unit has been held for three years or less by the current owner. First, the marginal effects from a probit panel regression that examines the unit-level sell probability each quarter of our 1998-2012 sample are recorded. The dependent variable Sale in this probit equals one if a unit is sold in the quarter after its capital gain is estimated. The next three analyses have selling price premium, listing premium, and rental premium as the dependent variable, respectively, in an OLS regression specification. A unit's capital gain is estimated by subtracting its purchase price from its estimated market price, which is determined from the average selling price per square foot within its condominium during a six-month interval centered at the end of the relevant quarter. GAIN Dummy equals one if the unit's capital gain is positive and zero otherwise. GAIN Magnitude is the percentage change in the unit's price relative to its purchase price. The unit's holding period (HOLD), defined as the number of years since its purchase, is also included in the various specifications along with the unit's square footage (Size) and floor level (divided by 100) due to their impact on prices in Equation (1). Unit-level control variables for financing constraints include an indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase (Public) and paid-in equity, which is defined as the sum of a unit's down-payment and cumulative principal repayments normalized by its market price at the quarter-end. Market-level financing constraints include the prevailing three-month interbank offer rate in Singapore underlying monthly mortgage payments (SIBOR) and the prevailing minimum required percentage down-payment (DOWN). Standard errors are clustered by calendar quarter and t-statistics (z-statistics for probit) are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively.

Independent Variables	Sell propensity		Selling price		Listing premium		Rent premium	
GAIN Dummy	0.010***	0.004***	-0.001	-0.012***	-0.007	-0.030***	0.008	0.005
	(10.53)	(7.04)	(0.19)	(5.99)	(0.52)	(3.03)	(1.72)	(1.48)
GAIN Magnitude	-0.005***	-0.010***	-0.037***	-0.045***	-0.002	-0.036***	-0.011*	-0.014**
	(2.82)	(10.20)	(6.49)	(14.86)	(0.07)	(3.13)	(1.74)	(2.72)
SHORT	-0.005***	-0.008***	0.025***	0.024***	0.118***	0.074***	0.031***	0.019***
	(3.51)	(8.66)	(3.54)	(5.41)	(5.86)	(4.26)	(5.85)	(3.69)
GAIN Dummy × SHORT	0.002*	-0.003**	-0.006	-0.010***	-0.100***	-0.059***	-0.034***	-0.029***
	(0.02)	(1.76)	(0.97)	(2.78)	(5.45)	(3.03)	(7.47)	(7.19)
GAIN Magnitude × SHORT	0.019***	0.027***	-0.071***	-0.068***	-0.075***	-0.068***	-0.023**	-0.002
	(5.72)	(11.68)	(5.40)	(8.47)	(2.96)	(3.29)	(2.31)	(0.24)
HOLD	0.001***	0.001***	0.002***	-0.002***	-0.003	-0.003**	-0.002*	-0.002**
	(4.20)	(9.84)	(3.76)	(3.00)	(1.30)	(2.09)	(1.91)	(2.46)
Log(Size)	-0.007***	-0.008***	-0.054***	-0.130***	-0.051***	-0.122***	-0.044***	-0.096***
	(13.94)	(13.86)	(13.02)	(17.62)	(8.30)	(6.25)	(5.14)	(5.25)
Floor	0.013***	0.010***	0.188***	0.402***	0.213***	0.408***	0.010	0.083***
	(5.52)	(7.81)	(14.01)	(32.80)	(4.38)	(8.71)	(0.66)	(3.68)
Public	-0.002***	-0.001***	-0.001	-0.001	-0.013**	-0.011**	0.002	0.001
	(4.57)	(6.00)	(0.65)	(1.02)	(2.64)	(2.09)	(1.54)	(1.17)
Paid-in Equity	-0.015***	-0.039***	-0.070***	-0.015	0.238*	0.106*	0.048	0.007
	(2.66)	(7.76)	(3.11)	(1.10)	(1.87)	(1.89)	(1.32)	(0.30)
Lag(SIBOR)	0.002*		0.007		0.019*		0.004***	
	(1.81)		(1.40)		(1.76)		(2.88)	
DOWN	-0.064***		-0.016		-0.165*		-0.062***	
	(9.64)		(0.64)		(1.83)		(3.23)	
Intercept			0.394***	0.855***	0.426***	0.914***	0.314***	0.681***
			(12.64)	(15.47)	(7.38)	(6.53)	(5.10)	(5.20)
Observations	5,012,776	4,964,008	85,394	85,394	5,207	5,207	46,715	46,715
Adjusted R^2			0.119	0.298	0.134	0.273	0.010	0.027
Quarter & Condo Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes

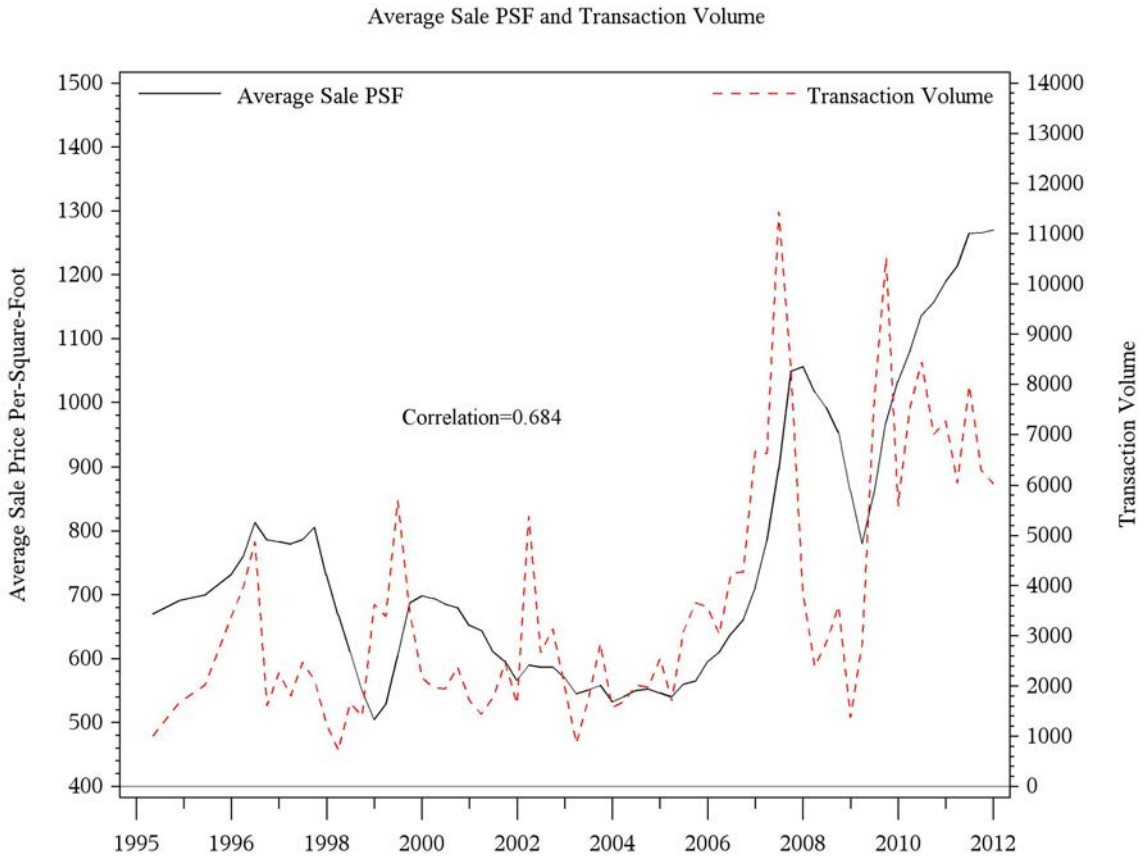

Figure 1 This figure illustrates the price and volume dynamics in Singapore's condominium market during our sample period. Both the quarterly market-level price per square foot (PSF) of sale transactions and the sale transaction volume are reported. The quarterly market-level PSF is computed by first averaging the PSF of all sale transactions within each condominium in a quarter, and then averaging these condominium-level averages across all condominiums. Sale transaction data is obtained from the URA REALIS database.

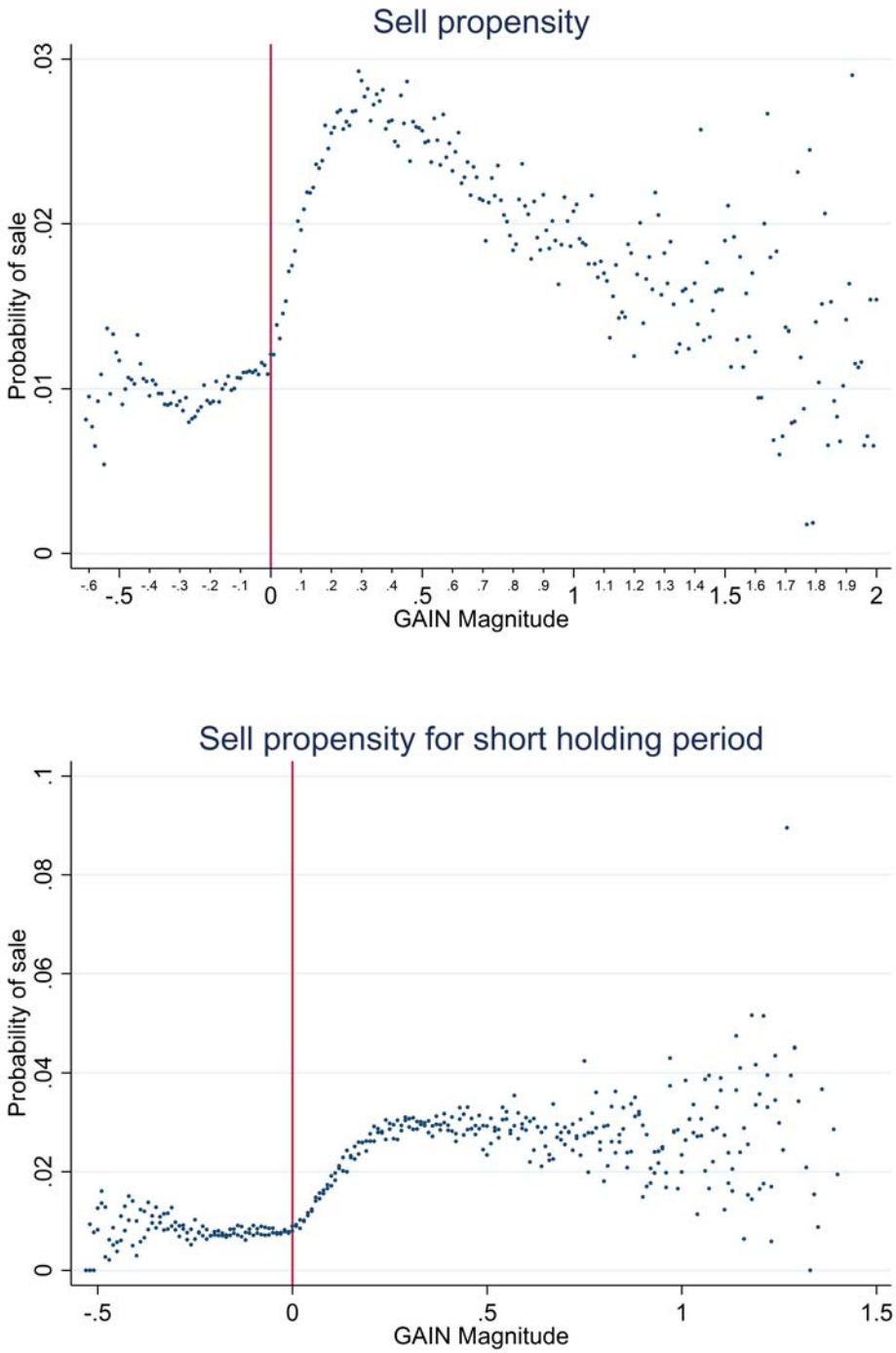

Figure 2 The top figure plots the sale probability of condominium units conditional on the magnitude of their capital gain. The bottom figure plots the sale probability of units that have been held for at most three years (short holding period). The average PSF in the condominium is used to compute each unit's capital gain. Each quarter-unit observation of GAIN Magnitude is sorted into 1%-bins. To ensure sufficient observations within a bin to compute the sale probabilities, we exclude bins with fewer than 100 observations or observations of GAIN Magnitude that exceed than 200%. For each bin, the percentage of the observations that are sold next quarter are plotted as the sale propensities.

Figure 3 This figure plots the selling price premium of condominium units over their estimated price conditional on the magnitude of their capital gain. The average PSF in the condominium is used to compute each unit's capital gain. Each quarter-unit observation of GAIN Magnitude is sorted into 1%-bins. We exclude bins with fewer than 10 observations. For each bin, the average selling price premium is plotted.

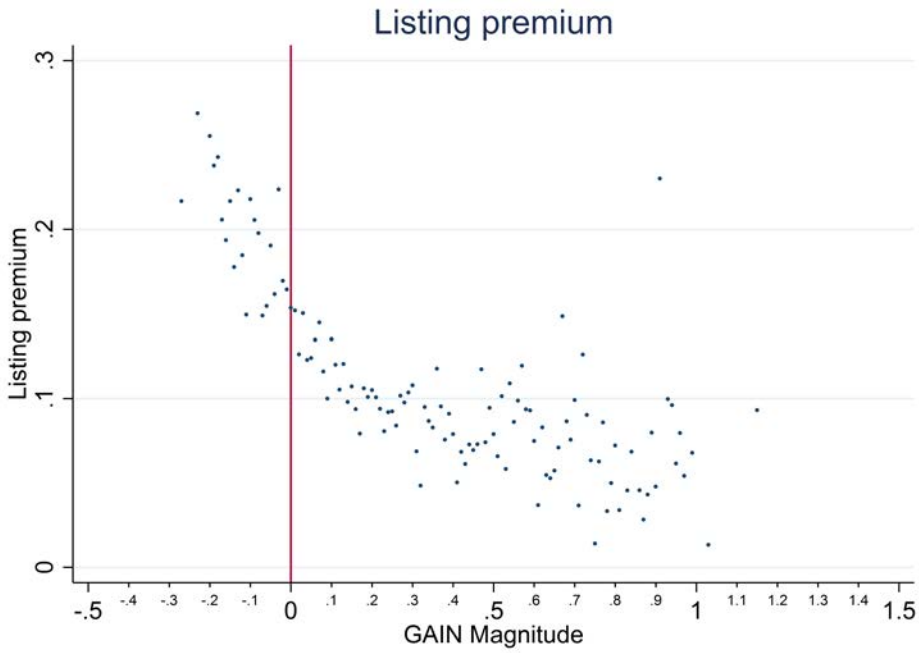

Figure 4 This figure plots the listing premium of condominium units over their estimated price conditional on the magnitude of their capital gain. The average PSF in the condominium is used to compute each unit's capital gain. Each quarter-unit observation of GAIN Magnitude is sorted into 1%-bins. We exclude bins with fewer than 10 observations. For each bin, the average listing price premium is plotted.

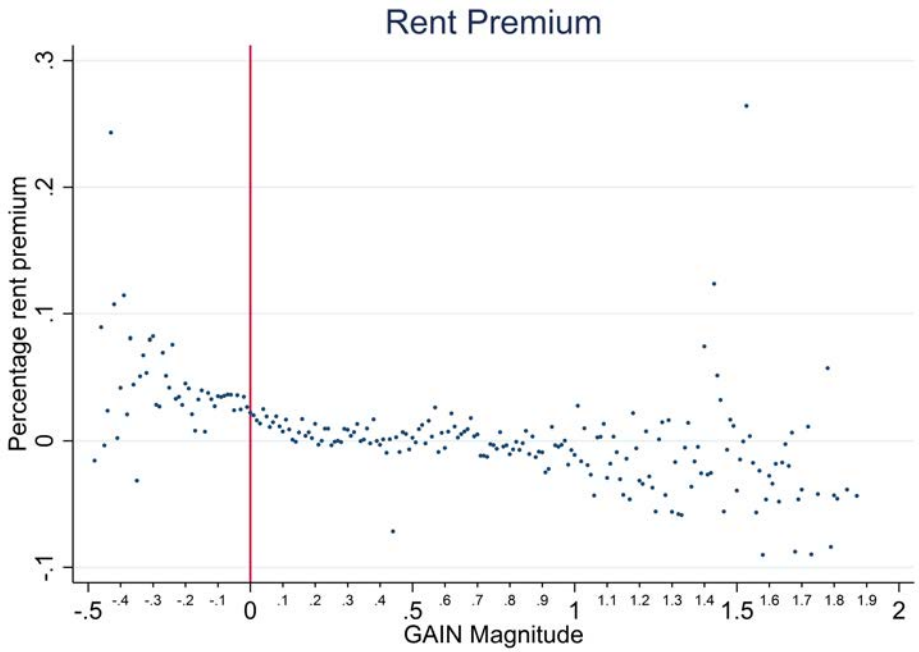

Figure 5 This figure plots the rent premium of condominium units conditional on the magnitude of their capital gain. Rent premium is the percentage a unit's actual monthly rental exceeds its estimated rent from the hedonic model in Equation (6). Each quarter-unit observation of GAIN Magnitude is sorted into 1%-bins. We exclude bins with fewer than 10 observations. For each bin, the average rent premium is plotted.