Realization Utility and Real Estate*

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

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Abstract

Using unique real estate data that allows for accurately-measured capital gains, we examine whether sell propensities and selling prices depend on an owner's capital gain. We find that sell propensities are higher and selling prices are lower for properties with a capital gain, with the sell propensities experiencing a discontinuity at a zero capital gain. Consistent with realization utility (Barberis and Xiong, 2012), larger capital gains are associated with higher sell propensities and lower selling prices. Overall, our evidence provides empirical support for realization utility, while alternative explanations such as financing constraints and informed trading cannot explain our findings.

Keywords: Real Estate, Disposition Effect, Realization Utility

JEL Classification Codes: G2; G11; R21

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

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

§University of San Diego, 5998 Alcala Park, San Diego, CA, 92110, USA. Email: mwarachka@sandiego.edu

1 Introduction

A large literature examines the impact of capital gains on investor decisions. According to the disposition effect, positions with an unrealized capital gain are more likely to be sold than those with an unrealized capital loss (Odean, 1998; Shefrin and Statman, 1985; Weber and Camerer, 1998). This reluctance of investors to realize their losses is commonly known as loss aversion (Barber, Lee, Liu, and Odean, 2007). The usual explanation for the disposition effect is prospect theory (Kahneman and Tversky, 1979). However, Barberis and Xiong (2009) demonstrate that realized gains and realized losses predict the disposition effect more reliably than unrealized gains and unrealized losses. Therefore, Barberis and Xiong (2012) introduce realization utility, a theory in which investors obtain utility from realizing a capital gain and disutility from realizing a capital loss. Furthermore, realizing a large capital gain yields greater utility than realizing a small capital gain in their theory. Although Frydman, Barberis, Camerer, Bossaerts, and Rangel (2014) provide experimental support for realization utility, there exists less empirical support for realization utility.

Tests of the disposition effect typically compare the aggregate sell propensity of all gains, irrespective of their magnitudes, to the aggregate sell propensity of all losses (Odean, 1998). However, Ben-David and Hirshleifer (2012) argue that the disposition effect implies a discontinuity in the sell propensity at a zero capital gain. As illustrated by Figure 1a, this discontinuity indicates a sign realization preference that implies investors prefer to sell positions with a small capital gain rather than a small capital loss. Using the stock trades of individual investors, these authors find no discontinuity in the sell propensity at a zero capital gain. Therefore, Ben-David and Hirshleifer (2012) conclude that stock investors do not have a sign realization preference.

Realization utility theory predicts that the sell propensities experience a discontinuity at a zero capital gain, then increase with the magnitude of a capital gain. Realization utility in Barberis and Xiong (2012) also predicts that the sell propensities are flat over the capital loss region since losses are only realized because of exogenous liquidity shocks. Figure 1b illustrates the sell propensities predicted by their model of realization utility. Comparing Figure 1b to 1a, the sign realization preference is a necessary condition for the disposition effect and realization utility, while the magnitude realization preference provides an additional necessary condition for realization utility.

This paper applies the recently developed sign and magnitude realization preference tests to real estate transactions. Real estate transactions are well suited for these tests because Barberis and Xiong (2012) argue that a real estate investment constitutes an investing episode with a salient reference price and a distinct mental account. With stock transactions, the ability to buy and sell a different number of shares at different prevailing prices at different points in time obscures the reference price. Individual investors may also be more emotionally invested in real estate transactions, which are far larger and less frequent than their stock transactions. Conversely, individual investors have strong incentives to avoid the negative wealth implications of suboptimal real estate decisions. Gan (2010) documents the real estate market's importance to consumption. Real estate transactions, unlike stock transactions, are also conducted during a lengthy escrow period, which affords investors an opportunity to reflect before finalizing their decision. Overall, it is an empirical question as to whether realization utility affects real estate transactions.

The main challenge to studying realization utility and the disposition effect in the real estate market is the accurate measurement of unrealized capital gains since individual properties are often unique and trade in an illiquid market. We overcome these empirical limitations by using over 280,000 transactions in Singapore's condominium market, which is comprised of standardized units within multi-unit condominiums. This standardization allows unit-level market prices, hence capital gains, to be estimated using transactions within the same condominium. Indeed, a simple hedonic model explains nearly 90% of the variation in unit-level transaction prices within a typical condominium. Furthermore, the condominium market in Singapore is liquid. On average, units in our sample are held by their owners for less than five years before being sold. This liquidity is consistent with the condominium market being the primary investment vehicle for individual investors in Singapore.

Following Ben-David and Hirshleifer (2012), our main empirical tests focus on short holding periods since these real estate transactions are more likely to have an investment motive and a salient reference price. We report that units with a capital gain are almost twice as likely to be sold as units with a capital loss. Probit specifications confirm this result by controlling for a multitude of unit-level and market-level characteristics, including quarter and condominium fixed effects. When examining a subset of small capital gains and small capital losses that are within 20% of the purchase price, units with a capital gain have a sell propensity that is 18.6% higher than the average unit's sell propensity. This discontinuity is consistent with investors

having a sign realization preference, and contrasts with the prior literature's findings in the stock market (Ben-David and Hirshleifer, 2012). Moreover, the sell propensities are increasing over capital gains, which offers empirical support for realization utility.

Besides studying sell propensities, the real estate market facilitates a novel empirical test involving the response of selling prices to capital gains. If realizing a capital gain provides utility, then sellers with a capital gain may accept a lower selling price to complete the transaction and immediately obtain this additional utility. This hypothesis cannot be tested in the the stock market where selling prices are largely exogenous with respect to individual sellers.

We find that units with a capital gain sell for lower prices than comparable units with a capital loss. Furthermore, as predicted by realization utility, this disparity increases with the magnitude of a unit's capital gain and is economically important. Comparing the average capital gain with the average capital loss, the selling price difference equals nearly six months of median household income. Moreover, consistent with realization utility, the economic implications associated with the magnitude of an owner's capital gain are comparable to the difference between the average capital gain and average capital loss.

Our empirical support for realization utility is robust to alternative explanations. One alternative explanation for the appearance of realization utility is belief revision. In the stock market, informed investors are predicted to sell an individual stock position once their positive private information has been incorporated into the stock's price and produced a capital gain. A large capital loss also forces investors to revise their beliefs. Ben-David and Hirshleifer (2012) find that sell propensities in the stock market increase with the magnitude of a position's capital gain and, less dramatically, with the absolute magnitude of a position's capital loss. Figure 1c provides a visual illustration of the V-shape associated with belief revision. However, individual property prices in Singapore are less influenced by private information since their fluctuations are highly correlated due to the country's small land area and extensive public transportation. Moreover, the sell propensities in our sample are flat over the loss region, which is inconsistent with the V-shape predicted by belief revision but consistent with Barberis and Xiong (2012)'s theory of realization utility.

Another possible justification for the appearance of realization utility is mean reversion. However, property prices in Singapore do not exhibit negative autocorrelation. Instead, the autocorrelation in property prices is positive over a one quarter horizon and insignificant over longer horizons. Furthermore, real estate investors in Singapore that sell their unit to realize

a capital gain likely reinvest the sale proceeds in another property. In a real estate market where expected returns are highly correlated across individual properties, the realization of a capital gain is difficult to justify without realization utility.

Stein (1995) demonstrates that financing constraints can be an explanation for the higher sell propensity of properties with a capital gain. Specifically, an owner's existing property represents a large fraction of their wealth that is financed with debt. Thus, a rise in its price increases the equity available to finance an upgrade. As an owner's capital gain is a component of their equity, financing constraints predict that the sell propensities increase linearly with the magnitude of their capital gain, as in Figure 1d.[1]

Our estimation procedure includes several proxies for financing constraints to account for their influence on unit-level sell propensities. As mortgages in Singapore are standardized with government-mandated minimum down payments and common mortgage rates, we estimate owner equity by aggregating down payments and subsequent principal payments. This aggregate amount captures the component of owner equity that is not attributable to a unit's capital gain. Thus, conditional on a unit's capital gain, greater owner equity corresponds with weaker financing constraints. Another proxy for financing constraints is unique to Singapore: whether the owner used to reside in public housing. All our empirical results and conclusions regarding realization utility are robust to including these proxies for financing constraints. Moreover, the discontinuity in the sell propensities at a zero capital gain is inconsistent with financing constraints, as are the flat sell propensities over capital losses.

Our study is not the first to examine the importance of capital gains in the real estate market. Genesove and Mayer (2001) report that condominium owners in Boston with a capital loss list their units for sale at higher prices. However, their study cannot explicitly test for the disposition effect or realization utility because listings data is insufficient to estimate sell propensities.[2] Estimating capital gains in Boston is also complicated by unobservable property attributes and renovations that affect a unit's market price. Consequently, the analysis in Genesove and Mayer (2001) is limited to having an indicator function for listed properties

[1] While the average sell propensity of units with a capital gain is higher than the average sell propensity of units with a capital loss in all four panels of Figure 1, only the disposition effect and realization have the sign realization preference.

[2] In addition, listings data may exclude properties with a capital loss since the listing of a property signals the owner's intention to sell. The disposition effect and realization utility both predict that properties with a capital loss are less likely to be sold, and therefore are less likely to be listed.

that likely have a capital loss. In contrast, our data allows capital gain magnitudes to be accurately estimated for nearly the entire condominium market, along with sell propensities conditional on these magnitudes. Thus, we are able to investigate whether the sign realization preference and magnitude realization preference affect real estate transactions.

Our results have important implications regarding the response of investors to unrealized capital gains and unrealized capital losses. Prior studies involving stock market transactions such as Ben-David and Hirshleifer (2012) have not found empirical support for realization utility and the disposition effect due to the lack of empirical support for the sign realization preference. In contrast, our study of real estate transactions finds that investors are more likely to realize capital gains than capital losses, even when their (absolute) magnitudes are small. We also find evidence that a unit's sell propensity increases with the magnitude of its capital gain. This magnitude realization preference is consistent with realization utility. Furthermore, the magnitude realization preference impacts selling prices since owners appear willing to accept a lower selling price if their unit has a capital gain. Overall, our empirical evidence indicates that capital gains and capital losses affect transaction volume and prices in the real estate market in accordance with realization utility.

2 Data

Our data is from Singapore's private 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 but differ in terms of their size and floor level. Indeed, owners require approval to remove any walls, and are not allowed to install windows and doors that alter the condominium's original design. Therefore, unobservable attributes exert a minimal impact on unit-level prices per square foot (PSF).

Sale transactions involving condominiums are reported to a government agency in Singapore known as the Urban Redevelopment Authority (URA). URA lists the details of each transaction on a public website, usually within two weeks of a transaction. As a result, property investors can use observed transaction prices within their condominium to infer their unit's market price, and compute its associated unrealized capital gain or unrealized capital

loss.[3] The absence of capital gain taxes in Singapore mitigates the need to examine capital gains after tax.

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. A recent paper by Giglio, Maggiori, and Stroebel (2015) also utilize the URA data in their study of long-term discount rates. Unlike studies of the disposition effect that have to estimate historical purchase prices (Grinblatt and Han, 2005), the URA data provides a nearly complete set of historical purchase prices in Singapore that serve as reference prices in our analysis. Consistent with the liquidity and homogeneity of Singapore's real estate market, transaction costs are relatively low with real estate agents earning a 1-2% fee from sellers.

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 size discrepancy on different transaction dates. After excluding units whose size discrepancy exceeds 2%, our sample contains 277,856 transactions involving 1,104 condominiums and 185,383 unique units.

2.1 Capital Gain Estimation

In order to estimate a unit's capital gain, the unit's most recent purchase price is required. Since URA data begins in 1995, property purchases that occur before 1995 are unobservable. We begin our capital gain estimation procedure in 1998 to ensure that three years of past transactions are available. Table 1 reports the number of units for which past purchase prices are available each quarter from 1998-2012. The available number of units increases over time as more units are sold and enter the URA records. We also compare the number of available units to the entire stock of condominium units in Singapore, and report the relevant sample coverage estimates in Table 1.[4] By the end of 2012, our sample coverage is nearly 83%. This coverage does not reach 100% because some units are purchased before 1995 and are not sold during our sample period. However, the long holding periods associated with these missing units indicate that their owners are unlikely to be property investors. Indeed, to identify real

[3]Real estate transactions in Singapore are often completed without a professional appraisal.

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

estate transactions that are most likely to have an investment motive, our study focuses on units whose holding period is three years or less.

Table 1 reports an upward trend in Singapore property prices that coincides with considerable price volatility. In Han (2010), price uncertainty in the real estate market does not necessarily reduce the demand for property because of incentives to hedge against price increases. These hedging incentives are particulary strong in Singapore due to the high cross-correlation in property prices, desire to upgrade, limited availability of land, and population growth (Han, 2013).

According to Table 1, the average price of a residential condominium unit in a typical quarter is S$1,046,226, which is equivalent to $666,386 using the average exchange rate of 1.57 SGD per USD during the 1998-2012 period. The average PSF equals S$886 (equivalent to $512). Figure 2 plots the average PSF and transaction volume each quarter from 1995 to 2012. The 0.684 correlation between the average PSF and transaction volume highlights the positive price-volume relation in the real estate market.

To measure each unit's capital gain, we estimate a hedonic pricing model within each condominium by regressing unit-level per square foot transaction prices on quarterly dummies. This method controls for condominium-specific characteristics such as location, age, facilities, and quality. Neighborhood characteristics are also accounted for by this methodology.[5] Condominiums that average fewer than two sale transactions per quarter are excluded from the pricing model. An extended pricing model contains each unit's log size (square feet) and floor level to supplement the quarterly dummies

$$\mathrm{PSF}_{i,t} \;=\; \sum_{t=\mathrm{Q1\ 1995}}^{\mathrm{Q4\ 2012}} \beta_t \,\mathrm{Quarter}_t + \beta_{\mathrm{S}} \,\mathrm{Log}(Size)_i + \beta_{\mathrm{f}}\, Floor\ Level_i + \epsilon_{i,t}\,. \qquad (1)$$

The coefficients for both models are estimated within the entire 1995 to 2012 sample period using all units indexed by i having sale transactions in quarter t that are located within the same condominium. We then report the distribution of the coefficients across the condominiums. Table 2 reports an average R^2 of 74% for the simple pricing model that contains only quarterly dummy variables. Hence, a condominium's average quarterly PSF explains nearly three-quarters of the price variation across units within the same condominium.

[5] Agarwal, Rengarajan, and Sing (2014) find that school districts in Singapore impact condominium prices, although their effects are economically small in comparison to the capital gains in our study.

The inclusion of size and floor characteristics in the extended pricing model increases the average R^2 to 88%. According to Table 2, 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. The average β_f coefficient is 7.15 (average t-statistic of 6.13), indicating a price premium for units on higher floors. Overall, the results from Equation (1) demonstrate that unobservable unit-level attributes exert little impact on per square foot prices.

We then use the condominium-level coefficients from the extended hedonic model to estimate unit-level market prices within each condominium. A unit's estimated per square foot price in quarter t, denoted $\hat{\text{PSF}}_{i,t}$, is determined by its size and floor level in addition to the quarterly dummy coefficient for next quarter

$$\hat{\text{PSF}}_{i,t} \quad = \quad \hat{\beta}_{t+1} + \hat{\beta}_S \,\text{Log}(Size)_i + \hat{\beta}_f \, Floor\ Level_i \,. \tag{2}$$

To ensure the accuracy of our hedonic model, we remove condominiums whose R^2 from the hedonic model is below 70%. We use the quarterly dummy coefficient $\hat{\beta}_{t+1}$ for next quarter to avoid underestimating market prices because units are more likely to be sold when market prices are increasing. In particular, for the full sample, the average selling price premium computed later in Equation (5) is nearly zero using the predicted PSF from Equation (2). Nonetheless, our results are similar if the quarterly dummy coefficient $\hat{\beta}_t$ for quarter t replaces $\hat{\beta}_{t+1}$ in Equation (2).

2.2 Financing Constraints

Stein (1995) proposes an alternative explanation for the appearance of the disposition effect based on financing constraints. As an owner's property represents a large fraction of their wealth that is typically debt-financed, price declines tighten their financing constraints by reducing the sale proceeds available to finance a down payment on a more expensive property. Thus, price declines tighten the financing constraints of repeat buyers intending to upgrade. With this tightening being more severe for owners with low equity in their existing property, we proxy for unit-level owner equity by 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 *Paid-In Equity* measure. While *Paid-In Equity* is not directly related to a unit's capital gain, both alleviate financing constraints.

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.[6] 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). The actual mortgage rate is typically one percent above SIBOR. Data on SIBOR is obtained from the Monetary Authority of Singapore (www.mas.gov.sg). Variation in the 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 owners.[7]

To clarify, fixed-rate 30 year mortgages are not available in Singapore. While Agarwal, Liu, Torous, and Yao (2014) report that financial sophistication impacts mortgage selection, this selection decision is not relevant in Singapore where mortgage contracts are standardized. The standardization of mortgages in Singapore enables monthly principal payments to be aggregated depending on each unit's purchase date and the relevant SIBOR time series. The estimation of owner equity in Genesove and Mayer (1997) has similar assumptions regarding the common maturity and borrowing rate underlying mortgages. We begin the loan three months after a unit's purchase date since housing transactions usually require twelve weeks to complete in Singapore.

Another financing constraint proxy available in the URA data is whether the owner previously resided in public housing. A unique feature of Singapore's housing market is its segmentation into public units and private (condominium) units. Public housing units are reserved for low-income households, who usually intend to upgrade to a condominium if their financial circumstances permit. Although our sample does not contain transactions involving public housing units, the data does indicate whether the owner was residing in public housing when they purchased their current private property. Compared to buyers who were residing in a condominium when they purchased their current condominium unit, former residents of public housing are more likely to be financially constrained.

We also include two control variables for the tightness of market-level financing constraints

[6]The Singapore government frequently adjusts the maximum loan-to-value ratio to alter housing prices. We collect data on these policy changes from various government websites and newspaper articles.

[7]Consistent with the sunk-cost fallacy, Agarwal, Green, Rosenblatt, and Yao (2015) find that larger down payments mitigate strategic defaults.

that vary over time instead of across owners; *SIBOR* and the government-mandated minimum down payment (*Down Payment*, expressed as a percentage of the purchase price) in each quarter. In terms of corporate lending, Gan (2007) documents tighter financing constraints following a decline in property prices. Similarly, property price fluctuations can alter financing constraints by influencing financing costs and down payments.

3 Empirical Results

This section describes the results from our empirical tests involving unit-level sale propensities and selling prices. To determine the influence of capital gains on real estate transactions, we examine both the sign and magnitude realization preferences.

3.1 Sell Propensities

Following Odean (1998), we first estimate the following ratio

$$\mathrm{R} \;=\; \frac{PGR}{PLR} \;=\; \frac{\text{Probability of Realizing a Gain}}{\text{Probability of Realizing a Loss}}\,, \tag{3}$$

where PGR represents the probability of a gain being realized, which is defined as the percentage of units with a capital gain that are sold in quarter $t+1$. Similarly, PLR, the probability of a loss being realized, is the percentage of units with a capital loss that are sold in quarter $t+1$. Capital gains and losses are estimated in quarter t using Equation (2).

In unreported results, the ratio R averages 1.765. A t-statistic of 5.13, computed from the distribution of the ratio's time series over the sample period, rejects the null hypothesis that R equals one. Typically, researchers will conclude that this is evidence supporting the disposition effect. However, Ben-David and Hirshleifer (2012) argue that the disposition effect predicts a discontinuity in the sell propensities at a zero capital gain. Conversely, bundling gains of all magnitudes as a group and comparing them with losses of all magnitudes can lead to the spurious conclusion that gains matter more to investors than losses without any actual investor preference for selling capital gains.

As indicated by Figure 1, all four hypotheses (disposition effect, realization utility, belief revision, and financing constraints) have the average sell propensity of gains being higher than the average sell propensity of losses. Therefore, instead of comparing these averages, as in Odean (1998), we implement the sign realization test in Ben-David and Hirshleifer (2012) and

the magnitude realization test. Satisfying the sign realization test provides empirical support for both the disposition effect and realization utility, while providing empirical evidence against belief revision and financing constraints. Satisfying the additional magnitude realization test provides further empirical support for realization utility

Figure 3 plots unit-level sell propensities conditional on *Gain Magnitude*, defined as the percentage change in a unit's estimated market price relative to its purchase price (i.e., the return since purchase). In our main analysis, we focus on units whose holding period is three years or less. A unit's holding period refers to the amount of time that has elapsed since its (most recent) purchase date, not the start of our sample period. Ben-David and Hirshleifer (2012) argue that short holding periods are more appropriate for testing the disposition effect. In our analysis, short holding periods are more likely to identify property owners with investment motives instead of consumption or bequest motives.

In order to plot these sell propensities, we sort each quarter-unit observation into *Gain Magnitude* bins whose width is 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. For each bin, we then compute the percentage of units sold next quarter. As predicted by realization utility, the top of Figure 3 presents evidence that a larger capital gain increases a unit's sell propensity.

We test for the sign realization preference in a subset of units whose capital gains and capital losses are within 20% of their respective purchase price. The bottom of Figure 3 provides evidence consistent with a sign preference, as small capital gains are more likely to be realized than small capital losses. Although a discontinuity in the sell propensities at a zero capital gain is not visually discernable, later probit estimations detect this discontinuity and consequently support the disposition effect and realization utility. Moreover, the sell propensities increase with the magnitude of capital gains. Indeed, the kink in the sell propensities starting at a zero capital gain is consistent with investors deriving greater utility from realizing larger gains. This magnitude realization preference provides empirical support for realization utility.

The discontinuity in the sell propensities at a zero capital gain in Figure 3 highlights two important results of our analysis. First, given that the sell propensities kink exactly at zero, the unit's purchase price is indeed the reference price utilized by owners. In particular, transaction costs do not appear to alter the reference price. Second, our estimation of unit-level market prices, and therefore capital gains, is accurate.

Consistent with the disposition effect and realization utility, the sell propensities are flat over the loss region. Ingersoll and Jin (2012) extend Barberis and Xiong (2012) by allowing reinvestment to motivate the realization of a loss provided the sale proceeds can be reinvested into another asset with a higher expected return. This extension is important in the stock market where the value of an investor's portfolio reflects multiple transactions and there exists a large cross-section of stocks with different expected returns. However, the assumption in Barberis and Xiong (2012) that loss realizations are due to forced liquidations applies in Singapore's real estate market since mortgage lending is recourse and expected returns are highly correlated across different properties.

To formally examine the relation between unit-level capital gains and sell propensities, we estimate a probit model that controls for several unit-level and market-level characteristics

$$\begin{aligned} 1_{\text{Sale}} &= \Phi\left(\alpha_1 \, \textit{Gain Dummy} + \alpha_2 \, \textit{Gain Dummy} \times \textit{Gain Magnitude} \right. \\ &\quad \left. + \alpha_3 \, \textit{Gain Magnitude} + \gamma \, X\right) . \end{aligned} \tag{4}$$

The dependent variable, 1_{Sale}, equals one if a unit is sold in quarter $t+1$ and capital gains are estimated in quarter t using Equation (2). Unit-level characteristics include an indicator function *Gain Dummy* that equals one if a unit's capital gain is positive to test for the sign realization preference. The interaction between *Gain Dummy* and *Gain Magnitude* is also included to test for the magnitude realization preference, while *Gain Magnitude* by itself tests the financing constraint hypothesis.

Specifically, the coefficient estimates determine which of the four hypotheses illustrated by Figure 1 is best supported by the data. The disposition effect predicts a positive α_1 coefficient. Besides predicting a positive α_1 coefficient, realization utility also predicts a positive α_2 coefficient. In contrast, financing constraints predict a positive α_3 coefficient. Finally, the V-shape pattern predicted by belief revision requires an insignificant α_1 coefficient, positive α_2 coefficient, and negative α_3 coefficient. The coefficients predicted by each of the four competing hypotheses involving sell propensities are summarized below:

	Predicted Coefficients		
Hypothesis	α_1	α_2	α_3
Disposition Effect	Positive	-	-
Realization Utility	Positive	Positive	-
Financing Constraints	-	-	Positive
Belief Revision	-	Positive	Negative

Other independent variables include the length of the unit's *Holding Period* (years since purchase), the log of the unit's square footage (*Size*), and the unit's *Floor Level*. The latter two variables are known to have pricing implications based on the results from Equation (1). For ease of interpretation, the actual floor level is divided by 100, which magnifies its coefficient by 100. Thus, while the *Floor Level* coefficients are often statistically significant, their economic significance is minimal. An indicator function that equals one if the unit's owner lived in public housing at the time of its purchase (*Public Housing*) as well as *Paid-In Equity* provide two unit-level proxies for financing constraints in the cross-section.

Two quarterly proxies for market-level financing constraints are also included in our probit specifications; the *SIBOR* rate in the prior quarter and the minimum required down payment expressed as a percentage (e.g. *Down Payment* of 0.20 denotes a 20% required down payment). For an individual unit, a higher down payment implies *Paid-In Equity* is initially higher. Fluctuations in the minimum down payment stipulated by the government are infrequent, with increases in this minimum usually occurring in response to dramatic property price increases. Monthly principal repayments regularly increase *Paid-In Equity*, with this increase depending on a unit's holding period as well as *SIBOR*.

Table 3 contains the results of the probit based on all capital gains and capital losses for units with short holding periods of three years or less. For continuous independent variables, we report the marginal impact on the sell probability 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 α_1 coefficient for *Gain Dummy* is positive in every specification. Thus,

the sell propensities increase for units with a capital gain. This finding is consistent with the disposition effect as well as realization utility. The specification that includes quarter and condominium fixed effects 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. *SIBOR* and *Down Payment* are omitted from this specification since they are collinear with the quarterly fixed effects. As the *Gain Dummy* coefficient remains positive in the specification with quarter and condominium fixed effects, units with a capital gain are more likely to be sold than those with a capital loss.

For the full sample of capital gains, Table 3 provides weak empirical support for realization utility. However, after conditioning on capital gains and capital losses that are within 20% of a unit's purchase price, we find strong empirical support for realization utility due to the discontinuity in the sell propensity at zero. This discontinuity is also consistent with the disposition effect. Specifically, the α_1 coefficient is positive in every specification. For example, in the specification with all the control variables, α_1 equals 0.16% (t-statistic of 3.55). In terms of economic significance, the 0.0016 coefficient corresponds to 18.6% of the predicted sale probability in this specification, which is 0.862%.

Besides the discontinuity in the sell propensities at zero, the sell propensities increase with the magnitude of a unit's capital gain. In particular, the positive α_2 coefficient is consistent with realization utility. The positive α_3 coefficient also contradicts belief revision as larger capital losses (in absolute value) correspond to lower instead of higher sell propensities. In contrast to Figure 1c and prior evidence in the stock market, the sell propensities in Figure 3 do not exhibit the V-shape predicted by belief revision. Instead, Figure 3 resembles Figure 1b more than the other three panels since the sell propensities are flat over capital losses, discontinuous at a zero capital gain, and increasing with larger capital gains. Thus, realization utility appears to have the strongest empirical support among the four hypotheses.

Although a positive α_3 coefficient is consistent with financing constraints, the significance of the α_1 and α_2 coefficients is difficult to reconcile with financing constraints. An insignificant α_3 coefficient is also not a necessary condition for realization utility in our study since different realization utility theories (Ingersoll and Jin, 2012) do not require the sell propensities to be flat over the loss region. Moreover, the coefficients for the financing constraint proxies offer contradictory interpretations. Consistent with financing constraints, the negative coefficients for *Pubic Housing* suggest that previous residents of public housing, who are more financially

constrained, are less likely to sell their unit. In contrast, the negative coefficients for *Paid-In Equity* and *Down Payment* are inconsistent with financing constraints as more equity in a unit reduces its sell propensity.

In summary, capital gains within 20% of a unit's purchase price exert a significant impact on unit-level sell propensities in a manner that supports realization utility. Indeed, the α_1 and α_2 coefficients provide empirical support for both the sign and magnitude realization preferences, which are necessary conditions for realization utility. Of the four hypotheses illustrated in Figure 1, the sell propensities indicate that realization utility provides the best description of investor behavior.

3.2 Selling Prices

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 real estate investor's capital gain. Selling prices are partially endogenous in real estate transactions as owners decide whether to accept or reject a prospective buyer's offer. Therefore, we examine if a unit's capital gain influences the selling price accepted by its owner.

For each sale transaction, we compute the unit's selling price premium in the previous quarter by subtracting one from the ratio of its observed sale price in quarter $t+1$ normalized by its estimated market price from Equation (2). This selling price premium is the dependent variable in the following empirical specification

$$\begin{aligned} \frac{\text{Selling Price}}{\text{Estimated Price}} - 1 \;\; = \;\; & \alpha_0 + \alpha_1 \, \textit{Gain Dummy} + \alpha_2 \, \textit{Gain Dummy} \times \textit{Gain Magnitude} \\ & + \alpha_3 \, \textit{Gain Magnitude} + \gamma \, X + \epsilon \, . \end{aligned} \tag{5}$$

The X vector includes multiple control variables that appeared in our earlier probit specifications, several of which proxy for financing constraints. We estimate Equation (5) by OLS and the standard errors are clustered by calendar quarter with t-statistics reported in parentheses.

The important prediction of realization utility is the relevance of a capital gain's magnitude. A negative α_2 coefficient supports the magnitude realization preference as owners appear willing to accept a lower selling price in order to realize their capital gain. In contrast to the selling propensities, a discontinuity in the selling prices at a zero capital gain identified

by a negative α_1 coefficient is less important. Indeed, the sign realization preference is more difficult to interpret in selling prices since a small unrealized capital gain can result in a small realized loss if the owner lowers their selling prices too drastically. Nonetheless, realization utility predicts that sellers with a sufficiently large capital gain accept lower selling prices to complete the transaction and immediately obtain the utility from realizing a gain. In contrast, the alternative hypotheses involving financing constraints and belief revision have no selling price predictions.

Before reporting our estimation results, Figure 4 illustrates the univariate relation between selling price premiums and capital gains for short-term units (units whose holding period is three years or less). 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 lower for units with a larger capital gain. We also observe a discontinuity around a zero capital gain. Units with a capital loss sell at a slight premium above their estimated market price, while the selling premium appears to be lower for units with a small capital gain.

The regression coefficients in Table 4 for short-term units confirm the visual evidence in Figure 4. We find strong evidence in favor of realization utility as the α_2 coefficients are consistently negative. Therefore, owners with a capital gain sell their unit for a lower price. This acceptance of a lower price is consistent with the higher likelihood of these owners selling their unit in Table 3. When quarter and condominium fixed effects are added to Equation (5), support for realization utility remains strong.

Although the evidence in Table 4 indicates that owners with a capital gain are willing to accept a lower selling price, this evidence does not indicate that these owners sell their unit below its market price. Across all the sale transactions in our sample, the average capital gain is approximately 30%. As the selling price premium is negatively associated with capital gains and the selling price premium has a mean of zero for the whole sample, units with a capital gain below 30% sell with a positive selling price premium on average, while units with a capital gain above 30% sell with a negative selling price premium on average. This is apparent from Figure 4 where the selling premiums are mostly positive (negative) when *Gain Magnitude* is below (above) 30%. This visual evidence is confirmed by the regression coefficients in Table 4. For an owner with a 30% capital gain, the coefficients predict a selling price premium near

0%.[8]

To understand the economic importance that capital gains exert on selling prices, we calculate the average selling premium for three different groups of owners who sold their respective unit within three years of its purchase. The first group consists of owners with a capital loss. In this first group, an average selling premium of 2.54% is computed from the sample data underlying Table 4. This premium is determined by the difference between the average capital loss and the average capital gain. The dollar-denominated price implication corresponding to the 2.54% difference in the selling premium is equivalent to S$26,574 based on the average transaction price of S$1,046,226 in our sample. For comparison, the median annual income of Singaporean households is approximately S$57,000 per annum or S$4,750 per month during our sample period (www.singstat.gov.sg). Thus, the price difference constitutes nearly six months of median household income.

As realization utility differentiates between small versus large capital gains, the second group consists of owners with a relatively small capital gain while the third group consists of owners with a relatively large capital gain. For units with a short holding period, the median capital gain of 24% differentiates between owners with a small versus a large capital gain. The average selling premium for owners in these groups are 1.19% and –0.62%, respectively, according to the sample data underlying Table 4. These percentages correspond to dollar-denominated amounts of S$12,450 and –S$6,487, respectively for owners in the second group and third group. The S$18,937 difference in these amounts illustrates the economic importance of a capital gain's magnitude since this magnitude-dependent difference is nearly as large as the S$26,574 sign-dependent difference. Compared to owners in the first group, owners with a large capital gain forfeit about seven months of median household income, while owners with a small capital gain forfeit about three months of median household income.

Conditioning on small capital gains and small capital losses within 20% of the purchase price also provides strong evidence in favor of realization utility. In particular, the negative α_2 coefficients in Table 4 indicate that selling prices decline with the magnitude of a unit's capital gain. Overall, selling prices reveal strong empirical support for realization utility as larger capital gains are associated with lower selling prices.

By implication, during a period of increasing property prices, a higher number of units

[8]For example, according to the coefficients of model 2 in Table 4, the selling price premium equals –0.0134+(–0.0826×0.3)+(0.0352×0.3)+0.0296 = 0.00198, which is close to zero.

with a capital gain implies higher sell propensities and therefore higher transaction volume. Consequently, our empirical support for realization utility is able to explain the positive price-volume relation in real estate.

3.3 Holding Period Length

We repeat our analyses of the sell propensities and selling prices over holding periods whose length is greater than three years but not more than five years (medium term) and longer than five years (long term). A longer holding period may indicate a property is being held for consumption rather than investment.

Comparing the number of observations in Tables 3 through 5 reveals that unit-level holding periods are bimodal. For example, there are more than twice as many units held for 0–3 years than for 3–5 years. This means that units are either held for a short or long period, with the medium holding period serving as a transition between these periods. Intuitively, property purchases intended as an investment are likely to be sold within three years, with realized returns determined by *Gain Magnitude* rather than rental yields. Conversely, the consumption motive is more likely for units with a long holding period.

Table 5 reports weaker support for realization utility based on sell propensities for units whose holding period exceeds three years. In particular, as the α_2 coefficients are not positive, the selling propensities do not increase with the magnitude of a unit's capital gain. Similarly, Table 6 reports weaker support for realization utility based on selling prices for units whose holding period exceeds three years.

In summary, evidence of realization utility in real estate transactions is strongest in units with short holding periods. This finding is consistent with the purchase and sale of these properties having investment instead of consumption motives.

3.4 Robustness of Discontinuity

As a robustness test, we vary the range of returns over which discontinuities in the sell propensities are estimated. Recall that a discontinuity at a zero capital gain is critically important for differentiating between financing constraints and either the disposition effect or realization utility. Our baseline analysis uses capital gain magnitudes that, in absolute value, are within 20% of the purchase price. Since the choice of 20% might be arbitrary, we repeat this analysis

for units whose absolute capital gain is within 15% and 25% of their purchase price.

The estimated coefficients in Table 7 continue to find a discontinuity in the sell propensities at a zero capital gain, with the sell propensities also increasing with the magnitude of a unit's capital gain. In the specification with quarter and condominium fixed effects, the coefficients for *Gain Dummy* are 0.0009 (t-statistic of 2.91) and 0.0014 (t-statistic of 3.51), respectively, for units whose absolute *Gain Magnitude* is within 15% and 25%. Thus, the discontinuity in the sell propensities that supports the disposition effect and realization utility is not driven by a specific estimation window around zero.

Furthermore, in the same subset of units, Table 8 indicates that selling prices trend downward as the magnitude of a unit's capital gain increases. For the specification with quarter and condominium fixed effects, the α_1 coefficients are -0.0095 (t-statistic of 2.73) and -0.0097 (t-statistic of 4.31), respectively, for units whose absolute capital gain is within 15% and 25% of their purchase price. These negative coefficients continue to provide empirical support for realization utility.

4 Alternative Explanations

Several alternative explanations for our results were evaluated. However, these alternatives are less plausible than our conclusion that real estate transactions are influenced by realization utility.

4.1 Belief Revision

Informed trading (speculative motivation for trading) provides an alternative explanation for the appearance of the disposition effect. Informed trading can explain the high selling propensities of stock investors once the stock price has incorporated their good private information and created a capital gain.[9] Informed trading can also explain the delay in selling positions with a capital loss, and may motivate further purchases at a lower price, provided good private

[9]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.

information is eventually expected to increase the stock price.[10]

However, unlike the stock market, informed trading in Singapore's real estate market is less important since private information does not determine unit-level market prices. Instead, unit-level prices in Singapore's real estate market are driven by market-level price fluctuations. Thus, belief revision is less relevant to the relation between sell propensities and capital gains in our sample than in Ben-David and Hirshleifer (2012)'s study of the stock market. Moreover, owners that sell their unit to realize a capital gain likely reinvest the sale proceeds in another property with a similar expected return. While owners of multiple properties may attempt to rebalance their real estate portfolio, this rebalancing is also ineffective because of the high cross-correlation between unit-level property prices. Thus, in a market with homogeneous expected returns, realization utility offers a better explanation than belief revision for the realization of capital gains.

4.2 Mean Reversion

Another alternative explanation for our results is an expectation of mean reversion in property prices. Table 9 reports the autocorrelation in market-level price changes at both an annual and quarterly frequency. These price changes are defined as the percentage change in the market-level PSF over a specific horizon.

At an annual horizon, the autocorrelation in market-level prices is insignificant. At a quarterly horizon, only the first lag is positive as the coefficients are mostly insignificant for additional lags. Thus, market-level price changes in Singapore are not mean reverting. Instead, the positive quarterly autocorrelation implies that selling a unit with a capital gain or continuing to hold a unit with a capital loss are suboptimal decisions.

In summary, there is insufficient evidence of mean reversion in property prices to justify holding units with a capital loss.

4.3 Financing Constraints

Our results are robust to several proxies for financing constraints at both the owner level (cross-section) and market level (time series). The coefficients for these control variables

[10] As our data does not contain investor-level identifiers, we cannot test whether owners with a capital loss purchase another property.

offer interpretations that are often inconsistent with financing constraints. Moreover, the α_3 coefficients for *Gain Magnitude* that identify financing constraints in the sell propensities are often insignificant. The discontinuities in the unit-level sell propensities at a zero capital gain are also inconsistent with financing constraints. Overall, financing constraints do not appear to be responsible for the greater willingness of investors with a capital gain to sell their property or accept a lower selling price.

In unreported results, we also include a unit's original purchase price as an independent variable to proxy for owner wealth. A higher purchase price is likely associated with a wealthier, and therefore less financially constrained, property investor. However, the inclusion of this control variable does not alter any of our reported results and its coefficients are generally insignificant.

4.4 Consumption Motive

The consumption motive underlying property ownership is unlikely to confound our results, especially for units with a short holding period where investment motives are more relevant. Furthermore, the high correlation between unit-level prices in Singapore implies that an owner is not disadvantaged by selling their unit at a loss when property prices are low to purchase another unit with a similar expected return that better suits their consumption preferences.

Unlike the stock market where dividends or partial liquidations can finance consumption, owners in Singapore must sell their unit and "downsize" to convert its capital gain into consumption. However, this strategy is limited by smaller units having higher per square foot prices. Moreover, relocating to a less expensive (geographically remote) real estate market is less feasible given Singapore's small land area.

5 Conclusion

The preference of investors to sell assets with a capital gain compared to those with a capital loss is often attributed to the disposition effect. Instead of conditioning exclusively on the difference between capital gains and capital losses, realization utility (Barberis and Xiong, 2012) incorporates their magnitude into investor decisions. Intuitively, realization utility asserts that the larger a capital gain, the greater the utility associated with its realization.

We find that capital gains and capital losses exert a significant impact on the decisions of real estate investors. Investors with a capital gain are more likely to sell their property, and accept a lower selling price, than investors with a capital loss. Consistent with realization utility, these findings strengthen for investors with a larger capital gain. Thus, neither the disposition effect nor loss aversion (Genesove and Mayer, 2001) fully describe the impact of capital gains on real estate transactions.

In summary, our empirical evidence demonstrates that the likelihood a property is sold and its selling price are both influenced by realization utility. Intuitively, higher property prices are likely to induce selling activity, and consequently transaction volume. While data from Singapore's real estate market ensures the accuracy of our capital gain estimates, our support for realization utility can be generalized to other markets where transactions involve salient reference prices and distinct mental accounts.

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Table 1: Quarterly Inventory of Units and Summary Statistics

This table reports summary statistics for the historical inventory of condominium units in Singapore from 1998-2012 according to URA data. Statistics regarding the historical sale price, square footage (Size), price per square foot (PSF), years held (Holding Period), and number of condominiums (Condos) are included. Sample coverage is estimated by comparing the units in our sample with the total number of units in all condominiums. We estimate the total number of units using the website http://www.propertyguru.com.sg/ that records the number of units in each condominium. The second set of columns pertain to descriptive statistics for sale transactions in the URA data. The average SGD exchange rate is 1.57 SGD per USD during the 1998-2012 period.

	Historical inventory								Sales		
Date	Avg. SGD Price	Avg. Size	Avg. SGD PSF	Avg. Holding period	Number of condos	Number of units	Housing inventory	Sample coverage	Avg. SGD Price	Avg. SGD PSF	Number of 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

Table 2: Price Correlation within Condominiums

This table summarizes the results from the pricing model in Equation (1) from 1995 to 2012 based on quarterly indicator variables, size, and floor level, $\text{PSF}_{i,t} = \sum_t \beta_t \text{Quarter}_{i,t} + \beta_\text{S} \text{Size}_i + \beta_\text{f} \text{Floor Level}_i + \epsilon_{i,t}$. This pricing model is estimated for each individual condominium. Condominiums that average fewer than two sale transactions per quarter are excluded from the pricing model. Each observation i represents the sale of a unit in a particular 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^2.

Number of condominiums	1,014	1,014
Quarterly indicator variables	Yes	Yes
Average Size coefficient		-0.13
Average t-statistic		(8.90)
Average Floor Level 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

Table 3: Unit-level Sell Propensities for Short Holding Periods

This table records the marginal effects from a probit panel estimation that examines unit-level sell probabilities for units with short holding periods less than or equal to 3 years in each quarter of our 1998-2012 sample. The dependent variable equals one if a unit is sold in quarter $t+1$ after its capital gain is estimated. A unit's capital gain is estimated by subtracting its purchase price from its estimated market price. A unit's market price is determined using the hedonic model in Equation (2) provided the R^2 in the condominium exceeds 0.70. *Gain Dummy* equals one if the unit's capital gain is positive and zero otherwise. *Gain Magnitude* is the percentage change in a unit's market price relative to its purchase price. The unit's *Holding Period*, 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). Unit-level control variables for financing constraints include a *Public Housing* indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase 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 *Down Payment*, the prevailing minimum required percentage down payment. 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.

	Short Holding Period					Short Holding Period, Capital Gain within |20%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	0.0166***	0.0131***	0.0107***	0.0094***	0.0065***	0.0093***	0.0014**	0.0063***	0.0016***	0.0010***
	(12.13)	(11.39)	(9.47)	(10.63)	(10.46)	(10.91)	(2.36)	(8.36)	(3.55)	(2.72)
Gain Dummy × Gain Magnitude		0.0215**		-0.0134	-0.0085		0.0803***		0.0234***	0.0182***
		(2.41)		(1.40)	(1.50)		(6.47)		(2.68)	(3.09)
Gain Magnitude		-0.0032		0.0226**	0.0068		0.0004		0.0241***	0.0151***
		(0.40)		(2.00)	(1.30)		(0.05)		(3.38)	(4.02)
Holding Period			0.0066***	0.0052***	0.0071***			0.0064***	0.0048***	0.0060***
			(11.71)	(5.54)	(17.56)			(11.30)	(8.12)	(23.23)
Log(Size)			-0.0075***	-0.0071***	-0.0085***			-0.0050***	-0.0042***	-0.0064***
			(12.12)	(10.98)	(11.27)			(10.38)	(8.79)	(8.81)
Floor Level			0.0097***	0.0074***	0.0051***			0.0039**	0.0016	0.0026*
			(3.49)	(3.46)	(3.29)			(2.49)	(1.17)	(1.78)
Public Housing			-0.0032***	-0.0032***	-0.0017***			-0.0026***	-0.0026***	-0.0016***
			(6.40)	(6.52)	(5.39)			(7.86)	(8.66)	(6.78)
Paid-In Equity			-0.0548***	0.0072	-0.0616***			-0.0418***	0.0204	-0.0341***
			(2.74)	(0.28)	(8.39)			(2.95)	(1.23)	(6.52)
Lag(SIBOR)			0.0012	0.0015*				0.0001	0.0005	
			(1.59)	(1.82)				(0.31)	(1.29)	
Down Payment			-0.0496**	-0.1029***				-0.0422***	-0.0951***	
			(2.40)	(3.78)				(2.72)	(5.49)	
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	1,964,907	1,964,907	1,878,999	1,878,999	1,857,706	1,298,169	1,298,169	1,236,763	1,236,763	1,213,790

Table 4: Selling Prices for Short Holding Periods

This table records the results from a regression whose dependent variable is a unit's selling price premium for units with short holding periods less than or equal to 3 years 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 market price. The selling premium is computed by subtracting one from the ratio of a unit's selling price in quarter $t+1$ normalized by its estimated market price. A unit's market price is estimated using the hedonic model in Equation (2) provided the R^2 in the condominium exceeds 0.70. Unit-level capital gains are then estimated by comparing market prices with purchase prices. *Gain Dummy* equals one if the unit's capital gain is positive and zero otherwise. *Gain Magnitude* is the percentage change in a unit's market price relative to its purchase price. The unit's *Holding Period*, 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). Unit-level control variables for financing constraints include a *Public Housing* indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase 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 *Down Payment*, the prevailing minimum required percentage down payment. 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.

	Short Holding Period					Short Holding Period, Capital Gain within |20%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	-0.0225***	-0.0134***	-0.0091***	-0.0141***	-0.0187***	-0.0128***	-0.0062**	-0.0141***	-0.0072**	-0.0082***
	(9.11)	(4.66)	(3.15)	(5.10)	(7.08)	(5.47)	(2.04)	(5.58)	(2.52)	(3.11)
Gain Dummy × Gain Magnitude		-0.0826***		-0.0919***	-0.0506**		-0.1334***		-0.1222***	-0.1207***
		(4.53)		(3.63)	(2.02)		(3.53)		(2.85)	(3.36)
Gain Magnitude		0.0352**		0.0439	-0.0381		0.0433		0.0113	-0.0828**
		(2.18)		(1.62)	(1.52)		(1.40)		(0.29)	(2.61)
Holding Period			-0.0113***	-0.0044***	0.0006			-0.0147***	-0.0115***	-0.0059***
			(14.52)	(2.80)	(0.48)			(8.22)	(5.58)	(3.62)
Log(Size)			-0.0030	-0.0039	-0.0122			-0.0061*	-0.0076**	-0.0153**
			(0.61)	(0.80)	(1.18)			(1.93)	(2.45)	(2.15)
Floor Level			0.0047	0.0136	0.0273*			0.0045	0.0084	-0.0315***
			(0.53)	(1.32)	(1.87)			(0.50)	(0.94)	(2.82)
Public Housing			-0.0015	-0.0014	-0.0008			-0.0007	-0.0003	0.0012
			(1.66)	(1.41)	(0.78)			(0.43)	(0.20)	(0.80)
Paid-In Equity			0.2633***	0.0199	-0.0363*			0.1148*	-0.0262	-0.1299***
			(5.81)	(0.27)	(1.68)			(1.87)	(0.37)	(5.93)
Lag(SIBOR)			-0.0002	0.0011				-0.0004	-0.0008	
			(0.18)	(1.04)				(0.27)	(0.49)	
Down Payment			-0.2440***	-0.0478				-0.1634***	-0.0385	
			(6.67)	(0.77)				(2.84)	(0.59)	
Constant	0.0254***	0.0296***	0.0485	0.0664*	0.0855	0.0271***	0.0304***	0.0992***	0.1154***	0.1416***
	(10.46)	(9.69)	(1.31)	(1.94)	(1.13)	(11.35)	(8.68)	(4.62)	(5.45)	(2.81)
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	35,285	35,285	33,898	33,898	33,898	16,085	16,085	15,287	15,287	15,287
Adjusted R^2	0.0113	0.0282	0.0240	0.0329	0.0592	0.0065	0.0109	0.0325	0.0378	0.1042

Table 5: Unit-level Sell Propensities for Medium and Long Holding Periods

This table records the marginal effects from a probit panel estimation that examines unit-level sell probabilities for units with medium and long holding periods in each quarter of our 1998-2012 sample. The medium holding period is greater than three years but not more than five years, and the long holding period is greater than five years. The dependent variable equals one if a unit is sold in quarter $t+1$ after its capital gain is estimated. A unit's capital gain is estimated by subtracting its purchase price from its estimated market price. A unit's market price is determined using the hedonic model in Equation (2) provided the R^2 in the condominium exceeds 0.70. *Gain Dummy* equals one if the unit's capital gain is positive and zero otherwise. *Gain Magnitude* is the percentage change in a unit's market price relative to its purchase price. The unit's *Holding Period*, 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). Unit-level control variables for financing constraints include a *Public Housing* indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase 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 *Down Payment*, the prevailing minimum required percentage down payment. 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.

Panel A: Probit involving medium-term holding period

	Medium Holding Period					Medium Holding Period, Capital Gain within |20%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	0.0176***	0.0099***	0.0133***	0.0089***	0.0023***	0.0123***	-0.0003	0.0096***	-0.0004	-0.0008
	(11.31)	(5.71)	(6.02)	(5.72)	(3.30)	(7.00)	(0.27)	(4.80)	(0.39)	(1.07)
Gain Dummy × Gain Magnitude		-0.0482***		-0.0432***	-0.0273***		0.0047		-0.0046	-0.0071
		(6.81)		(4.97)	(5.11)		(0.44)		(0.42)	(0.91)
Gain Magnitude		0.0489***		0.0447***	0.0207***		0.0562***		0.0588***	0.0246***
		(7.95)		(4.14)	(4.08)		(7.17)		(5.57)	(5.03)
Holding Period			-0.0018*	-0.0022***	-0.0009*			-0.0007	-0.0018	0.0010*
			(1.88)	(2.78)	(1.78)			(0.56)	(1.51)	(1.85)
Log(Size)			-0.0078***	-0.0072***	-0.0055***			-0.0037***	-0.0025***	-0.0045***
			(13.87)	(11.68)	(9.76)			(4.85)	(2.93)	(4.22)
Floor Level			0.0075***	0.0062**	0.0081**			0.0066*	0.0008	0.0035
			(2.80)	(2.11)	(2.48)			(1.92)	(0.24)	(0.99)
Public Housing			-0.0035***	-0.0037***	-0.0018***			-0.0055***	-0.0053***	-0.0034***
			(6.00)	(6.29)	(3.83)			(7.52)	(7.43)	(7.16)
Paid-In Equity			-0.0228*	0.0064	-0.0251***			-0.0149	0.0278	-0.0192*
			(1.68)	(0.26)	(2.94)			(0.98)	(1.41)	(1.91)
Lag(SIBOR)			0.0030***	0.0032**				0.0020**	0.0026***	
			(2.60)	(2.56)				(2.07)	(2.85)	
Down Payment			-0.0564**	-0.0838***				-0.0655***	-0.1093***	
			(2.23)	(3.12)				(2.61)	(4.42)	
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	859,114	859,114	834,157	834,157	833,116	372,836	372,836	361,201	361,201	358,573

Panel B: Probit involving long-term holding period

	Long Holding Period					Long Holding Period, Capital Gain within |20%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	0.0087***	0.0062***	0.0123***	0.0078***	0.0046***	0.0078***	0.0017	0.0087***	0.0016	0.0011
	(7.92)	(3.86)	(8.73)	(6.30)	(5.17)	(6.99)	(1.46)	(8.30)	(1.42)	(1.06)
Gain Dummy × Gain Magnitude		-0.0310***		-0.0420***	-0.0145***		-0.0588***		-0.0535***	-0.0265***
		(4.78)		(5.74)	(4.35)		(5.42)		(5.33)	(3.71)
Gain Magnitude		0.0246***		0.0437***	0.0075*		0.0592***		0.0798***	0.0153**
		(4.11)		(5.88)	(1.82)		(6.76)		(6.34)	(2.25)
Holding Period			0.0001	-0.0007***	-0.0000			0.0007	-0.0007	0.0002
			(0.53)	(3.23)	(0.30)			(1.37)	(1.02)	(0.99)
Log(Size)			-0.0050***	-0.0036***	-0.0042***			-0.0040***	-0.0019	-0.0067***
			(5.36)	(3.99)	(4.84)			(2.65)	(1.36)	(3.93)
Floor Level			-0.0021	-0.0042**	0.0051**			-0.0005	-0.0068*	0.0126***
			(0.82)	(2.06)	(2.47)			(0.12)	(1.65)	(3.25)
Public Housing			-0.0012***	-0.0014***	-0.0011***			-0.0019***	-0.0020***	-0.0017***
			(3.33)	(4.31)	(4.53)			(3.53)	(3.73)	(3.72)
Paid-In Equity			0.0080	0.0384***	-0.0107***			0.0146	0.0610***	-0.0364***
			(1.12)	(5.36)	(2.72)			(0.93)	(2.87)	(4.13)
Lag(SIBOR)			0.0028**	0.0021				0.0025	0.0023	
			(2.15)	(1.63)				(1.49)	(1.49)	
Down Payment			-0.0004	-0.0284***				0.0249	-0.0250	
			(0.04)	(4.27)				(1.19)	(1.04)	
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	1,788,992	1,788,992	1,733,357	1,733,357	1,732,446	541,340	541,340	520,945	520,945	518,649

Table 6: Selling Prices for Medium and Long Holding Periods

This table records the results from a regression whose dependent variable is a unit's selling price premium for units with medium and long holding periods based on quarterly observations from 1998-2012. The medium holding period is greater than three years but not more than five years, and the long holding period is greater than five years. The selling premium is computed by subtracting one from the ratio of a unit's selling price in quarter $t+1$ normalized by its estimated market price. A unit's market price is estimated using the hedonic model in Equation (2) provided the R^2 in the condominium exceeds 0.70. Unit-level capital gains are then estimated by comparing market prices with purchase prices. *Gain Dummy* equals one if the unit's capital gain is positive and zero otherwise. *Gain Magnitude* is the percentage change in a unit's market price relative to its purchase price. The unit's *Holding Period*, 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). Unit-level control variables for financing constraints include a *Public Housing* indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase 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 *Down Payment*, the prevailing minimum required percentage down payment. 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.

Panel A: Probit involving medium-term holding period

	Medium Holding Period					Medium Holding Period, Capital Gain within |20%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	-0.0139***	-0.0090***	-0.0132***	-0.0117***	-0.0203***	-0.0118***	-0.0053	-0.0123***	-0.0064	-0.0079*
	(10.61)	(3.39)	(6.21)	(4.64)	(6.31)	(7.26)	(1.40)	(5.70)	(1.67)	(1.96)
Gain Dummy × Gain Magnitude		-0.0167		-0.0040	0.0127		-0.0077		-0.0197	-0.0324
		(1.20)		(0.26)	(0.54)		(0.24)		(0.57)	(0.77)
Gain Magnitude		0.0042		-0.0174	-0.0597**		-0.0301		-0.0255	-0.1865***
		(0.31)		(1.00)	(2.37)		(1.17)		(0.87)	(5.06)
Holding Period			-0.0006	0.0027**	0.0050**			-0.0026	-0.0018	0.0004
			(0.60)	(2.13)	(2.66)			(1.36)	(0.86)	(0.17)
Log(Size)			-0.0060*	-0.0071**	-0.0235***			0.0043	0.0033	-0.0133**
			(1.90)	(2.24)	(3.68)			(1.28)	(1.04)	(2.08)
Floor Level			-0.0197***	-0.0144**	-0.0086			-0.0494***	-0.0463***	-0.0455**
			(2.96)	(2.29)	(0.57)			(3.71)	(3.59)	(2.01)
Public Housing			-0.0022	-0.0020	-0.0012			-0.0008	-0.0008	0.0010
			(1.36)	(1.21)	(0.79)			(0.28)	(0.30)	(0.37)
Paid-In Equity			0.0413**	-0.0626**	-0.1209***			0.0227	-0.0049	-0.2610***
			(2.13)	(2.04)	(2.81)			(0.53)	(0.09)	(6.27)
Lag(SIBOR)			-0.0016**	-0.0029***				-0.0000	-0.0004	
			(2.43)	(3.59)				(0.02)	(0.34)	
Down Payment			-0.0655**	0.0305				-0.0922*	-0.0637	
			(2.63)	(1.03)				(1.82)	(1.04)	
Constant	0.0101***	0.0107***	0.0611***	0.0696***	0.1748***	0.0109***	0.0081***	0.0046	0.0092	0.1380***
	(9.83)	(5.08)	(2.73)	(3.08)	(4.12)	(8.62)	(3.24)	(0.17)	(0.34)	(3.08)
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	17,754	17,754	17,262	17,262	17,262	6,305	6,305	6,126	6,126	6,126
Adjusted R^2	0.0075	0.0096	0.0113	0.0140	0.0234	0.0080	0.0085	0.0134	0.0140	0.0565

Panel B: Probit involving long-term holding period

	Long Holding Period					Long Holding Period, Capital Gain within |20%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	-0.0070***	-0.0026	-0.0054***	-0.0042*	-0.0067***	-0.0030**	-0.0001	-0.0046*	-0.0001	-0.0009
	(9.85)	(1.33)	(2.73)	(1.85)	(4.14)	(2.43)	(0.04)	(1.98)	(0.05)	(0.44)
Gain Dummy × Gain Magnitude		-0.0001		0.0107	0.0427***		-0.0221		-0.0296	-0.0164
		(0.02)		(0.82)	(3.10)		(0.82)		(1.10)	(0.73)
Gain Magnitude		-0.0063		-0.0254	-0.0817***		-0.0035		-0.0227	-0.0881***
		(0.98)		(1.63)	(4.70)		(0.20)		(1.13)	(4.13)
Holding Period			-0.0008***	0.0003	-0.0013**			-0.0002	0.0009	-0.0030***
			(3.33)	(0.58)	(2.27)			(0.21)	(0.79)	(3.77)
Log(Size)			-0.0025	-0.0036	-0.0130*			0.0021	0.0006	-0.0005
			(0.59)	(0.90)	(1.68)			(0.42)	(0.14)	(0.05)
Floor Level			-0.0214**	-0.0146*	-0.0343***			-0.0472***	-0.0421***	-0.1051***
			(2.45)	(1.68)	(2.77)			(4.91)	(4.03)	(9.57)
Public Housing			-0.0015***	-0.0017***	-0.0005			-0.0017	-0.0017	-0.0001
			(2.75)	(3.05)	(0.70)			(1.49)	(1.50)	(0.05)
Paid-In Equity			0.0102	-0.0425*	-0.0523**			-0.0208	-0.0597	-0.0383
			(1.21)	(1.96)	(2.45)			(0.76)	(1.52)	(1.02)
Lag(SIBOR)			-0.0009***	-0.0012***				-0.0010	-0.0010	
			(3.13)	(3.31)				(1.21)	(1.24)	
Down Payment			0.0170	0.0502**				0.0712*	0.1066**	
			(1.22)	(2.36)				(1.89)	(2.19)	
Constant	0.0022***	0.0008	0.0230	0.0368	0.1225**	0.0025**	0.0022	-0.0081	0.0021	0.0221
	(3.87)	(0.48)	(0.77)	(1.30)	(2.30)	(2.44)	(1.01)	(0.21)	(0.06)	(0.31)
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	32,087	32,087	31,091	31,091	31,091	10,743	10,743	10,392	10,392	10,392
Adjusted R^2	0.0026	0.0035	0.0038	0.0058	0.0148	0.0005	0.0006	0.0044	0.0052	0.0313

Table 7: Discontinuity in Sell Propensities of Short-term Units for Different Gain Magnitudes

This table records the marginal effects from a probit panel estimation that examines unit-level sell probabilities for units with short holding periods less than or equal to 3 years in each quarter of our 1998-2012 sample. In this analysis, the absolute value of each unit's capital gain is bounded by either 15% or 25%. The dependent variable equals one if a unit is sold in quarter $t+1$ after its capital gain is estimated. A unit's capital gain is estimated by subtracting its purchase price from its estimated market price. A unit's market price is determined using the hedonic model in Equation (2) provided the R^2 in the condominium exceeds 0.70. *Gain Dummy* equals one if the unit's capital gain is positive and zero otherwise. *Gain Magnitude* is the percentage change in a unit's market price relative to its purchase price. The unit's *Holding Period*, 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). Unit-level control variables for financing constraints include a *Public Housing* indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase 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 *Down Payment*, the prevailing minimum required percentage down payment. 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.

	Short Holding Period, Capital Gain within |15%|					Short Holding Period, Capital Gain within |25%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	0.0070***	0.0009*	0.0050***	0.0011***	0.0009***	0.0114***	0.0022***	0.0073***	0.0023***	0.0014***
	(9.59)	(1.83)	(8.27)	(2.94)	(2.91)	(11.62)	(3.35)	(8.26)	(4.72)	(3.51)
Gain Dummy × Gain Magnitude		0.0827***		0.0264***	0.0219***		0.0746***		0.0185*	0.0135**
		(6.64)		(3.21)	(3.57)		(5.65)		(1.92)	(2.20)
Gain Magnitude		-0.0011		0.0203***	0.0120***		0.0013		0.0270***	0.0164***
		(0.12)		(2.91)	(2.78)		(0.13)		(3.37)	(4.07)
Holding Period			0.0057***	0.0047***	0.0056***			0.0068***	0.0047***	0.0062***
			(10.64)	(8.68)	(22.95)			(10.79)	(6.85)	(21.83)
Log(Size)			-0.0040***	-0.0035***	-0.0057***			-0.0059***	-0.0050***	-0.0071***
			(8.22)	(7.16)	(7.48)			(10.72)	(8.89)	(9.42)
Floor Level			0.0035**	0.0019	0.0028*			0.0056***	0.0027*	0.0032**
			(2.55)	(1.50)	(1.82)			(3.10)	(1.81)	(2.22)
Public Housing			-0.0024***	-0.0024***	-0.0016***			-0.0027***	-0.0028***	-0.0016***
			(8.73)	(9.14)	(7.05)			(7.58)	(8.72)	(6.70)
Paid-In Equity			-0.0216	0.0172	-0.0314***			-0.0537***	0.0271	-0.0366***
			(1.63)	(1.14)	(6.47)			(3.35)	(1.43)	(6.50)
Lag(SIBOR)			0.0001	0.0003				0.0003	0.0007*	
			(0.30)	(0.99)				(0.58)	(1.66)	
Down Payment			-0.0551***	-0.0884***				-0.0365**	-0.1043***	
			(3.82)	(5.62)				(2.13)	(5.22)	
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	1,078,434	1,078,434	1,026,293	1,026,293	997,734	1,470,467	1,470,467	1,402,166	1,402,166	1,379,535

Table 8: Discontinuity in Selling Prices of Short-term Units for Different Gain Magnitudes

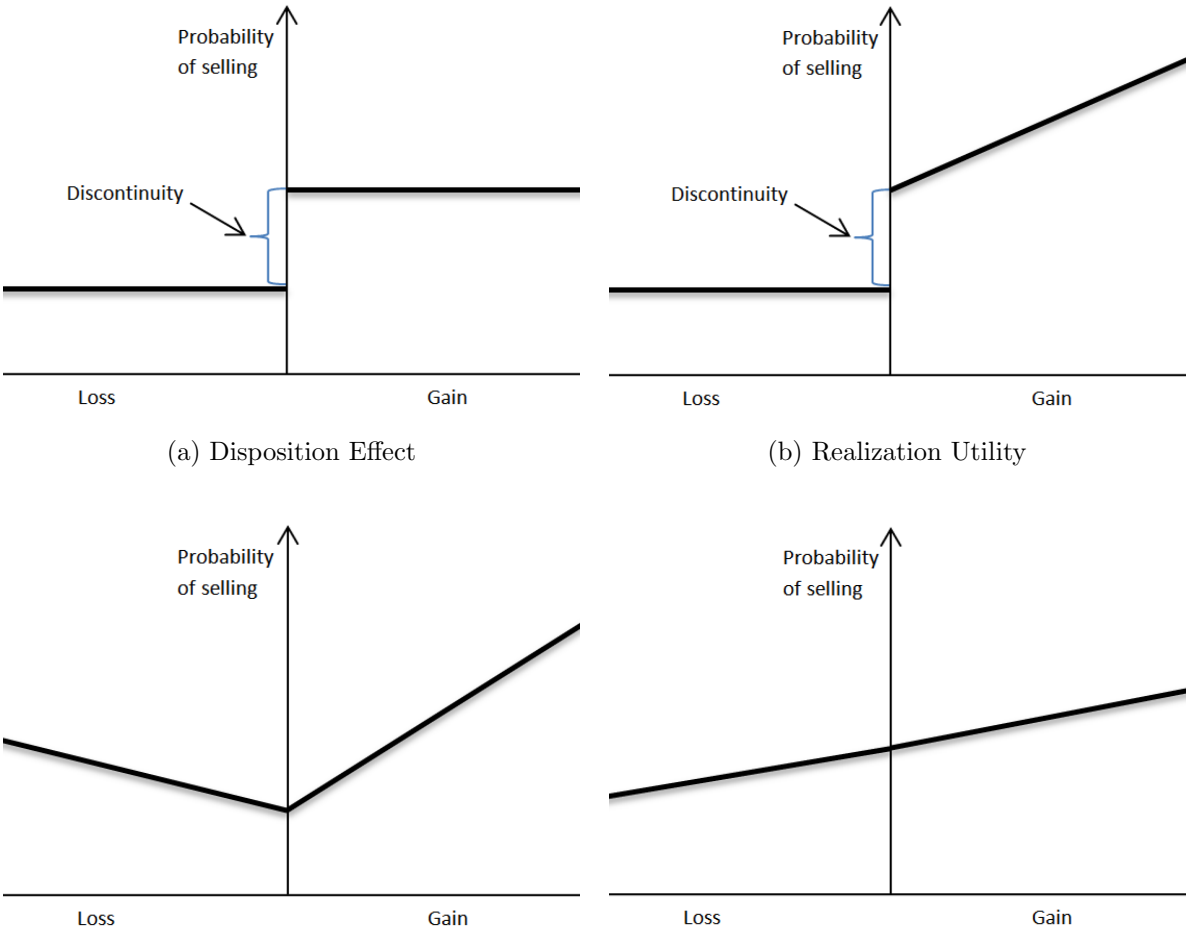
This table records the results from a regression whose dependent variable is a unit's selling price premium for units with short holding periods less than or equal to 3 years based on quarterly observations from 1998-2012. In this analysis, the absolute value of each unit's capital gain is bounded by either 15% or 25%. The selling premium is computed by subtracting one from the ratio of a unit's selling price in quarter $t+1$ normalized by its estimated market price. A unit's market price is estimated using the hedonic model in Equation (2) provided the R^2 in the condominium exceeds 0.70. Unit-level capital gains are then estimated by comparing market prices with purchase prices. *Gain Dummy* equals one if the unit's capital gain is positive and zero otherwise. *Gain Magnitude* is the percentage change in a unit's market price relative to its purchase price. The unit's *Holding Period*, 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). Unit-level control variables for financing constraints include a *Public Housing* indicator variable that equals one if the unit's owner was a resident of public housing at the time of its purchase 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 *Down Payment*, the prevailing minimum required percentage down payment. 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.

	Short Holding Period, Capital Gain within |15%|					Short Holding Period, Capital Gain within |25%|				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gain Dummy	-0.0102***	-0.0087**	-0.0152***	-0.0087**	-0.0095***	-0.0141***	-0.0073***	-0.0140***	-0.0083***	-0.0097***
	(4.47)	(2.57)	(5.67)	(2.50)	(2.73)	(5.38)	(2.79)	(5.45)	(3.34)	(4.31)
Gain Dummy × Gain Magnitude		-0.1165**		-0.1123*	-0.1219**		-0.1620***		-0.1462***	-0.1363***
		(2.17)		(1.81)	(2.21)		(5.29)		(4.27)	(4.55)
Gain Magnitude		0.0564		0.0028	-0.0744		0.0677**		0.0361	-0.0588**
		(1.30)		(0.05)	(1.41)		(2.65)		(1.11)	(2.27)
Holding Period			-0.0137***	-0.0116***	-0.0078***			-0.0134***	-0.0094***	-0.0039***
			(6.74)	(5.06)	(4.56)			(9.02)	(5.16)	(2.68)
Log(Size)			-0.0067**	-0.0079**	-0.0120*			-0.0062*	-0.0078**	-0.0152*
			(2.05)	(2.45)	(1.68)			(1.86)	(2.31)	(1.92)
Floor Level			0.0116	0.0147	-0.0341**			0.0006	0.0057	-0.0246**
			(1.04)	(1.34)	(2.28)			(0.07)	(0.69)	(2.48)
Public Housing			-0.0010	-0.0008	0.0016			-0.0007	-0.0002	0.0013
			(0.57)	(0.45)	(0.95)			(0.42)	(0.10)	(0.84)
Paid-In Equity			-0.0041	-0.0981	-0.1117***			0.1330**	-0.0324	-0.1344***
			(0.06)	(1.22)	(4.25)			(2.28)	(0.48)	(7.10)
Lag(SIBOR)			-0.0003	-0.0006				-0.0005	-0.0007	
			(0.15)	(0.30)				(0.34)	(0.43)	
Down Payment			-0.0664	0.0176				-0.1724***	-0.0301	
			(1.00)	(0.24)				(3.22)	(0.49)	
Constant	0.0275***	0.0310***	0.1114***	0.1224***	0.1119**	0.0257***	0.0318***	0.0945***	0.1145***	0.1388**
	(11.46)	(7.87)	(4.74)	(5.28)	(2.17)	(10.46)	(9.62)	(4.16)	(5.03)	(2.50)
Fixed Effects										
Quarter	No	No	No	No	Yes	No	No	No	No	Yes
Condominium	No	No	No	No	Yes	No	No	No	No	Yes
Observations	11,770	11,770	11,147	11,147	11,147	20,125	20,125	19,175	19,175	19,175
Adjusted R^2	0.0043	0.0055	0.0368	0.0395	0.1117	0.0073	0.0156	0.0274	0.0360	0.0936

Table 9: Autocorrelation in Property Market Returns

This table 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. *t*-statistics are in parentheses with *, **, and *** representing the statistical significance of the estimated coefficients at the 10%, 5%, and 1% levels, respectively.

	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



(a) Disposition Effect

(b) Realization Utility

(c) Belief Revision

(d) Financing Constraints

Figure 1 This figure illustrates the sell propensities based on the predictions of the disposition effect (a), realization utility (b), belief revision (c), and financing constraints (d).

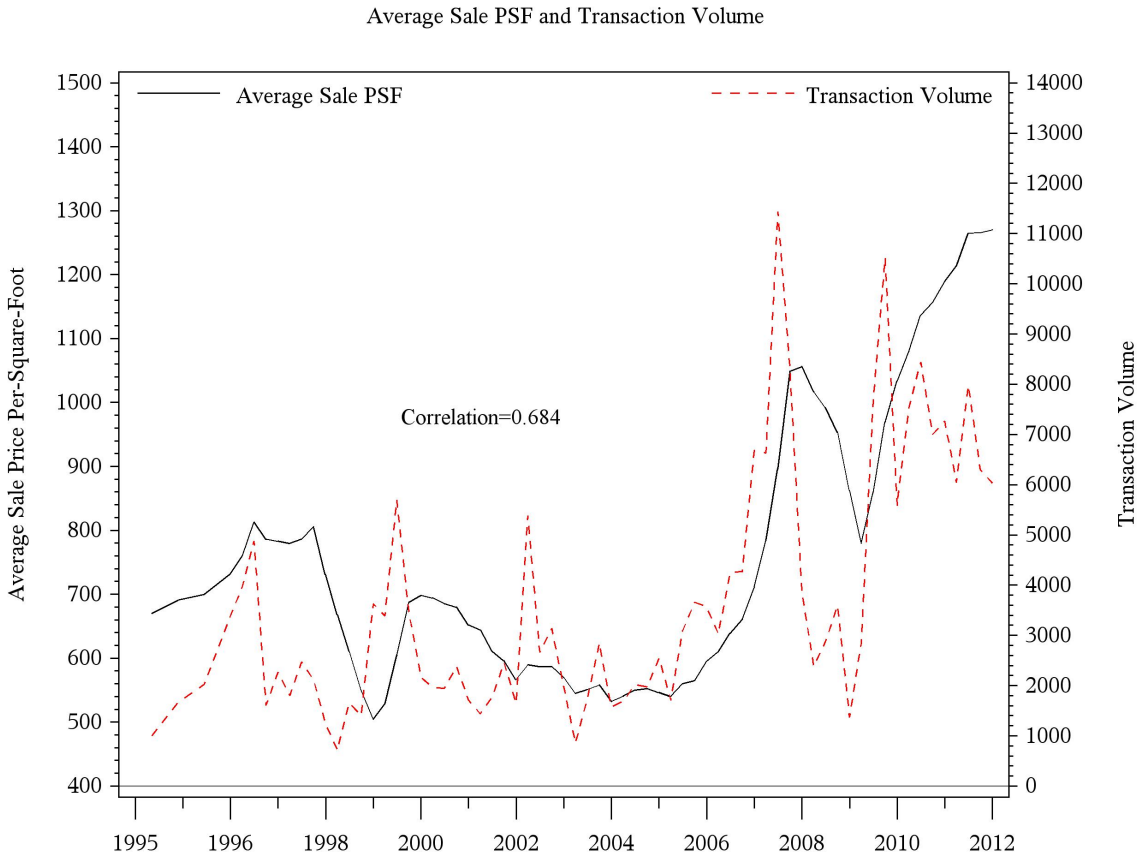


Figure 2 This figure illustrates the price and volume dynamics in Singapore's real estate market during our sample period. The market-level price per square foot (PSF) of sale transactions and the corresponding transaction volume are reported every quarter. The market-level PSF is computed by first averaging the PSF of all sale transactions within each condominium, and then averaging these condominium-level averages across all condominiums.

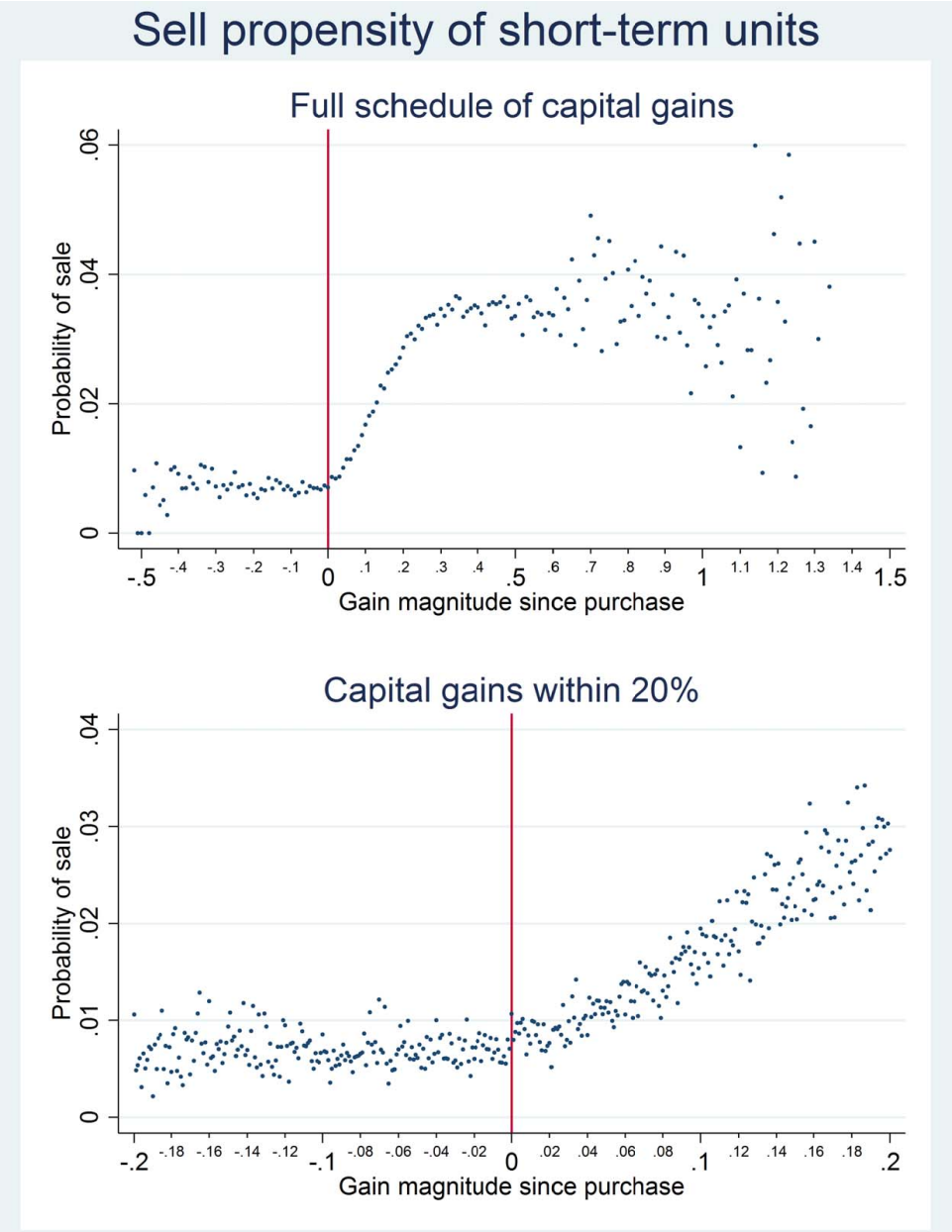


Figure 3 The top figure plots the sell propensity against the magnitude of a unit's capital gain for all units whose holding period is less than or equal to three years. The bottom figure plots these sell propensities for units whose capital gain (return since purchase) is between -20% and 20%. Each quarter-unit observation is sorted into 1%-bins. We exclude bins with fewer than 100 observations.

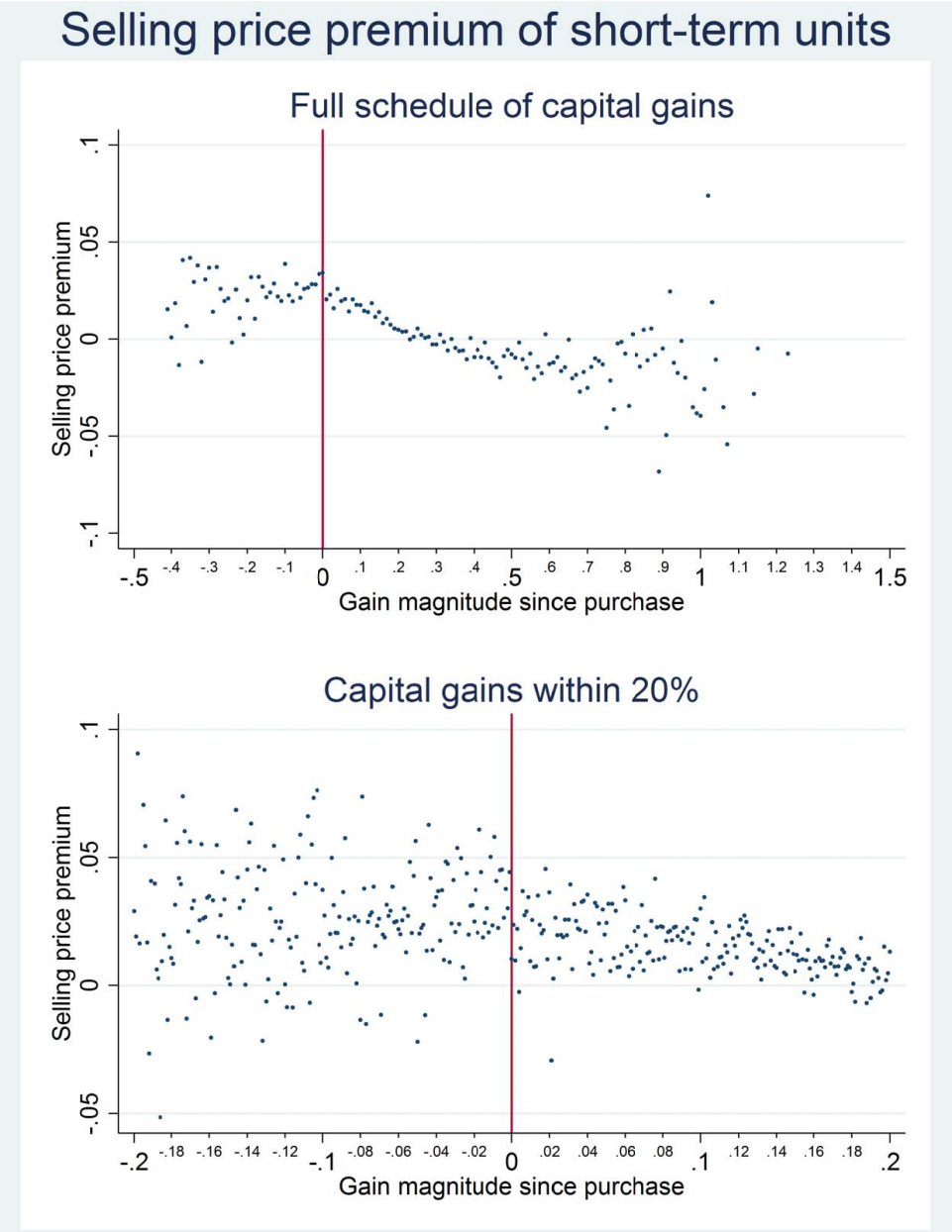


Figure 4 This figure plots the selling price premium against the magnitude of a unit's capital gain for all units whose holding period is less than or equal to three years. The bottom figure plots this premium for units whose capital gain (return since purchase) is between -20% and 20%. Each quarter-unit observation is sorted into 1%-bins. We exclude bins with fewer than 10 observations.