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Eric FESSELMEYER
Singapore Management University, efesselmeyer@smu.edu.sg

Haoming LIU

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Dynamic pricing in the Singapore condominium market

Eric Fesselmeyer *, Haoming Liu

Department of Economics, National University of Singapore, Singapore

HIGHLIGHTS

- We find dynamic pricing strategies are used by Singapore condo developers.
- There is no systematic relationship between new sales prices and time of purchase.
- Quality-adjusted price increases and unit quality decreases over the sales period.
- This suggests early buyers purchase high quality units at discounted prices.
- But developers do not extend the price discount to later buyers of low quality units.

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ABSTRACT

Dynamic pricing strategies are likely an important consideration of Singapore condominium developers because of the durability of condominiums, price transparency, and the long sales period. While we do not observe any systematic relationship between the new sale prices and time of purchase, we do find that quality-adjusted price increases and the quality of units purchased decreases over the new sale period. These results suggest that condominium developers allow early buyers to purchase high quality units at discounted prices but do not extend the price discount to later buyers of low quality units.

1. Introduction

While there is compiling evidence that some firms, such as, for example, sellers of perishable goods and airline tickets, use dynamic pricing strategies, evidence of dynamic pricing in other markets is scant.[1] This paper aims to fill this gap by investigating the use of dynamic pricing in the Singapore condominium market. As noted by Stokey (1981), the demand for a durable good depends on both the current price and buyers' expectations of future prices. As such, dynamic pricing may be particularly relevant to condominium developers because of the durability of condominiums, the transparency of prices, and the long sales periods. Underpricing in the early sale stages can potentially stimulate demand by signaling interest in the development, which creates an opportunity to raise prices later.[2] But the ability to increase prices later may be limited since later customers may bargain harder for those low, initial prices. On the other hand, while setting prices high initially may signal a high-quality development, as suggested by Bagwell and Riordan (1991) and Taylor (1999), it could also lead to low sales that keep away potential buyers unsure of the long-term value of the development while at the same time negatively affecting the goodwill generated among the earliest buyers.

We, in fact, do not find any systematic relationship between the new sales price and the time of purchase. Instead, we find that the units sold earliest are of the highest quality and appreciate faster in the resale market than units sold later. In other words, while

* Corresponding author. Tel.: +65 6516 4873; fax: +65 6775 2646.
E-mail address: ecsef@nus.edu.sg (E. Fesselmeyer).

[1] There is a large literature on sequential auctions that is interested in dynamic prices. See below for several examples.

[2] Some support for the speculation that developers increase sales volume initially to signal the valuation of a development comes from the major local newspaper, the Strait Times, and the local evening news. Both often report on the size of the crowds and how many units were sold on the first sales weekend of new developments.

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there is no clear trend in the nominal price, quality-adjusted price increases over the new sales period. This suggests that developers use a different dynamic pricing strategy than that which has been observed in the literature. Namely, they allow early buyers to purchase high quality units at discounted prices but do not extend the price discount to later buyers of low quality units. In doing so, developers can signal a high valuation of their development early on while also earning higher quality-adjusted prices later from customers who find it difficult to compare quality adjusted prices and are thus not able to bargain from a strong position.

2. Market background and data

The developer of a new development begins to sell units early in the construction process. The market for "new sales" (sales between a buyer and a developer) is an active one with most units being sold before the developer obtains a Temporary Occupation Permit (TOP) which allows buyers to take residence and marks the end of the construction period. The market for "resales" (sales between an owner and buyer) is also an actively traded market.

We use data from the Real Estate Information System (REALIS), which contains information on private residential property transactions in Singapore since 1995. Most buyers lodge a caveat with the government within two to three weeks of purchase. Subsequently, the government publishes data from the caveat on REALIS which can then be accessed by real estate agents and potential buyers. The data contains the transaction date, price, floor area, floor level, development name, street address, and property type. Because many developers start to sell their units several years before construction is completed and because some condominiums may not be completely sold out by the completion date, we restrict our sample to condominiums that were completed between 1999 and 2009. For units with multiple transactions, we use information only from the new sale and the first resale. In total, our dataset contains 48,348 new sale and 15,174 resale transactions of units in 237 different developments. About 90% of these resales occurred within 9 years of the initial purchase and about 38% of them were resold within 3 years of the initial purchase. The mean duration between the initial and the resale transaction was about 5 years.

3. Model and results

To determine whether developers follow a dynamic pricing strategy, we compare the new sales price with the price observed in the competitive resale market. We model the new sales price of unit i sold in year t, j years from the TOP year, as

$$\ln p_{ijt} = \alpha_0 + X_i\alpha_X + \beta_j T_j + \lambda_t + \eta_i + \epsilon_{it}, \quad (1)$$

where X_i is a vector of housing characteristics such as floor area, floor number, and location, T_j is a year-relative-to-TOP dummy, λ_t is a year fixed effect, η_i is time-invariant quality, and ϵ_{it} is a random error term. Note that we index a new unit by j to indicate the number of years before or after the TOP year that it sold. Since developers typically sell units from four years before the TOP year until two years after, j starts at -4 and stops at 2, with the reference group, units sold in the TOP year, having $j = 0$. For example, the year-relative-to-TOP dummy for four years before the TOP year is T_{-4} and the year-relative-to-TOP dummy for two years after is T_2.[3] Note, because j and T are perfectly correlated within each development, we cannot control for condominium fixed effects.

The coefficients β reflect the pricing strategy of the developer. A decline in price over time corresponds to β_j decreasing in j. Such a finding would be consistent with the perishable goods papers Sweeting (2012) and Lee et al. (2012) and much of the literature on sequential auctions (e.g., Ashenfelter, 1989; Ashenfelter and Genesove, 1992; Beggs and Graddy, 1997).[4] An increase in prices over time corresponds to β_j increasing in j, which is consistent with dynamic pricing of airfares (e.g., McAfee and te Velde, 2006) and the literature that finds that IPOs are underpriced (Welch, 1992). Another strand of literature (e.g., Chakraborty et al., 2006), suggests that developers may sell their better units first. If this is the case, then early buyers purchase units with a higher value of η, i.e., $E(\eta \mid T_m = 1) > E(\eta \mid T_n = 1)$ if $m < n$. If indeed a unit's quality is systematically related to the time it was sold, e.g., if developers release units for sale in order of quality or if the initial buyers choose high quality units, η_i is correlated with the year the unit was sold. Better units being sold first suggests that OLS estimates of β in Eq. (1) are upward biased, with the size of the bias likely decreasing in j. In any case, if we estimate Eq. (1) without controlling for η_i, we might not detect a systematic relationship between $\hat{\beta}_j$ and j, and the estimates would not reveal the developers' marketing strategy.

The resale price can be modeled as

$$\ln p_{ij\tau} = \alpha_0 + X_i\alpha_X + \delta_j T_j + \pi_1 A_i + \pi_2 A_i^2 + \lambda_\tau + \eta_i + \epsilon_{ij\tau}, \quad (2)$$

where X_i contains the same variables as in Eq. (1) and A is the age of the unit, which captures any depreciation. The resale market is a competitive market of many individual buyers and sellers, and there should not be any remnants of the developers' pricing strategy. As such, the resale price should not depend systematically on the year of purchase relative to the TOP so that $\delta_j = 0, \ \forall j$. However, similar to the estimates of β of Eq. (1), the OLS estimates of δ would be biased by any correlation between η_i and the year in which the unit was initially sold. Therefore, the presence of a strong correlation between j and η_i implies that the OLS estimates of β and δ should be subject to the same bias. A lack of correlation between these two estimates would suggest that either η_i is not systematically related to j, which challenges the prediction of Chakraborty et al. (2006), or that the pattern of omitted variable bias caused by the quality ordering of sales is offset by the pricing strategy of the developers. Note that unlike for the case of new sales, owners in the same development sell their units in different years so that it is possible to include development fixed effects in Eq. (2).

Subtracting Eq. (1) from Eq. (2), and assuming $\delta_j = 0$, yields

$$\Delta \ln p_{ijt,\tau} = -\beta_j T_j + \pi_1 A_i + \pi_2 A_i^2 + \lambda_\tau - \lambda_t + \upsilon_{it} \quad (3)$$

where $\Delta \ln p_{ijt,\tau} = \ln p_{ij\tau} - \ln p_{ijt}$ is the change in the log price of unit i bought in year t, j years from the year of the TOP, and sold in year τ, and $\upsilon_{it} = \epsilon_{ij\tau} - \epsilon_{ijt}$. The term $\lambda_\tau - \lambda_t$ captures any price appreciation due to changes in market conditions from the year of the initial sale to the year of resale. If υ_{it} is not correlated with j, the OLS estimates of β should reveal the developers' dynamic pricing strategy. However, if some developers use certain static pricing strategies this assumption may be violated resulting in estimates that seemingly show evidence of dynamic pricing even if none exists.[5] For example, suppose some developers sell all their units at a discount to shorten the sales period. The units in these developments will sell out quickly and appreciate more in the resale market than units from other developments that sell without a discount and over a longer period of time. As such we would observe that units sold near the TOP year appreciate less than other units which is the prediction of a dynamic pricing strategy in which developers increase price over time. Since this bias is driven by between-development differences in the new

[3] We exclude a limited number of units, 402, that sold 5 years before or 3 years after the TOP year.

[4] One exception is Raviv (2006)'s study of used car auctions that finds rising prices.

[5] We thank an anonymous referee for identifying this potential bias and for suggestions on how to test for its existence.

Table 1
The relationship between price and order of sales.

	New sale price		Resale price		Differenced prices	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Years relative to TOP					
2 years after the TOP	0.007	0.045	0.035	−0.001	0.057**	0.009
	(0.024)	(0.039)	(0.026)	(0.026)	(0.024)	(0.031)
1 year after the TOP	0.024***	0.022***	0.001	−0.003	0.076***	0.050***
	(0.005)	(0.008)	(0.010)	(0.007)	(0.011)	(0.010)
1 year before the TOP	0.011***	0.007*	−0.005	0.006*	0.027***	−0.010**
	(0.003)	(0.004)	(0.004)	(0.003)	(0.005)	(0.005)
2 years before the TOP	−0.0003	−0.007*	−0.009**	0.013***	−0.011**	−0.034***
	(0.002)	(0.004)	(0.004)	(0.003)	(0.005)	(0.005)
3 years before the TOP	0.025***	0.006	0.011**	0.026***	−0.059***	−0.058***
	(0.003)	(0.005)	(0.005)	(0.004)	(0.007)	(0.006)
4 years before the TOP	0.016***	0.001	0.043***	0.026***	−0.074***	−0.077***
	(0.003)	(0.006)	(0.008)	(0.007)	(0.012)	(0.011)
Unit fixed effects	No	No	No	No	Yes	Yes
Development fixed effects	No	No	No	Yes	No	No
Observed characteristics	Yes	Yes	Yes	Yes	No	Yes
Obs.	48,348	15,174	15,174	15,174	15,174	15,174
R^2	0.808	0.799	0.857	0.931	0.613	0.709
	Panel B: Sale order quintile					
Fourth quintile	0.013***	0.014***	0.014***	0.011***	−0.005	−0.009**
	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
Third quintile	0.011***	0.006*	0.012***	0.010***	−0.014***	−0.030***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
Second quintile	0.011***	0.012***	0.019***	0.018***	−0.015***	−0.023***
	(0.002)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)
First quintile	0.018***	0.018***	0.026***	0.020***	−0.024***	−0.031***
	(0.002)	(0.004)	(0.005)	(0.004)	(0.006)	(0.005)
Unit fixed effects	No	No	No	No	Yes	Yes
Development fixed effects	No	No	No	Yes	No	No
Observed characteristics	Yes	Yes	Yes	Yes	No	Yes
Obs.	48,348	15,174	15,174	15,174	15,174	15,174
R^2	0.807	0.799	0.857	0.931	0.603	0.706

Notes: Robust standard errors are reported in parentheses.
The dependent variable in columns (1) and (2) is new sales price, in columns (3) and (4) resales price, and in columns (5) and (6), resales price—new sales price.
The sample used in column (1) consists of all new sales while the sample used in columns (2) to (6) consists of units that have been resold during the sample period.
The observed characteristics include a second-order polynomial of floor area, floor number, property type, and 34 location dummies.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

sales price and the rate of new sales, using a within-development sales sequence rather than years to TOP to measure the sales stages should be less susceptible to bias introduced by such static pricing strategies. Hence, we also estimate Eqs. (1)–(3) with T_j defined as the within-development sales order quintile, where the first quintile consists of the first 20% of units sold, the second quintile consists of the next 20% of units sold, etc.

Table 1 reports the estimation results. Panel A contains estimates using years relative to the TOP year as a measure of the sales stages, with units bought in the year of the TOP being the reference group. There is no systematic relationship between the year of purchase and price either for the entire new sales sample (column (1)) or a sub-sample of new units that were later resold after the TOP year (column (2)). The lack of systematic relationship between $\hat{\beta}_j$ and j could be due to the bias introduced by the correlation between η_i and j. If η_i and j are indeed strongly negatively correlated, then the OLS estimates of δ of Eq. (2) should be decreasing in j.

Column (3) reports the estimated relationship between resale price and the years from the TOP year when the initial owners bought the units from the developers.[6] Units bought 4 years before the TOP year confer a 4.3% price premium on the resale market, and those bought 3 years before the TOP year confer 1.1% price premium, which suggests that the quality of the units bought in the early stage tends to be higher than other units. However, the estimates do not show any significant quality difference among units bought within two years of the TOP year. The correlation coefficient between the estimates reported in columns (2) and (3) is 0.38, which is not statistically different from 0 even at the 10% level. Column (4) reports the estimates after adding development fixed effects. The results still suggest that units bought in the early stage tends to have better quality than other units. The correlation coefficient between the estimates reported in columns (2) and (4) is 0.28. This weak relationship suggests that while the unobserved quality might indeed be correlated with j, β_j might be related to j as well.

Because we are only able to control for limited observed characteristics of the units, such as transaction year, floor area, floor level, and planning area, the coefficient on the year-relative-to-TOP dummy could reflect either price differentials or quality differentials, and, as such, we cannot draw any definite conclusions on developers' pricing behavior simply based on the results reported in columns (1) to (4). Column (5) reports the estimated β's using Eq. (3). The results show a clear pattern. Except for units sold "2-years after the TOP year", the magnitude of the price appreciation is a monotonic increasing function of years to the TOP year. Namely,

6 That is, we only include the first resale of units that have been resold multiple times.

the earlier the initial transaction, the larger is the magnitude of price appreciation. For instance, while units sold 4 years before the TOP year appreciated 7.4% points more than those sold in the TOP year, units sold 1 year after the TOP year appreciated 7.6% points less. In column (6) we relax the assumption that price appreciation does not depend on housing characteristics by including control variables in Eq. (3). The coefficients on year-relative-to-TOP dummies follow the same pattern as those reported in column (5).

Overall, the results reported in Panel A are consistent with both a dynamic pricing strategy in which developers increase quality-adjusted prices over time, and static pricing in which some developers discount all their units. A possible implication of the latter strategy is that even if quality adjusted prices do not vary with the time of sale within each development, we would still observe a negative correlation between years to TOP and quality adjusted price since discounted developments sell out faster. Fortunately, these two strategies have different predictions regarding the coefficients on the within-development sales order. Under the dynamic strategy we should observe a similar pattern if we replace years-to-TOP with the within-development sales order. In contrast, under the static price strategy, appreciation should not depend on the within-development sales order. The results reported in Panel B show that although buyers paid a price premium if they bought their units in the early sales stages, they received an even higher price premium in the resale market. Therefore, the evidence supports the dynamic pricing strategy over the static pricing strategy.[7]

4. Conclusion

Using a transaction dataset of Singapore condominium sales, we find that the earlier new units are purchased the faster they appreciate in the resale market and that the unobserved quality of early units are higher than later units. However, we do not find any clear relationship between the nominal new sales price and the timing of a new sale. Our results suggest that property developers try to increase sales volume by allowing early buyers to purchase the best units which results in a lower quality-adjusted price at the initial launching stage. Since the systematic relationship between the quality-adjusted price and the timing of the transaction is masked by quality variation, developers can gradually increase the quality-adjusted price without antagonizing later buyers.

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7 Including development fixed effects has no substantive effect on the estimates.