Optimal Pricing Strategy with Price Dispersion: New Evidence from the Tokyo Housing Market

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Abstract

In our multistage search model, the seller's reservation price is affected by the offer price distribution, while the optimal asking price is chosen so as to maximize the return from search. We show that a greater dispersion in offer prices leads to a higher reservation price and a higher optimal asking price, which in turn results in a higher expected transaction price. Under the assumption that offer prices are normally distributed, a higher dispersion of offer prices also reduces time on the market for overpriced properties.

JEL classification: D83; R00; R31.

Keywords: price dispersion; search models; housing markets; time on the market.

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I. Introduction

Violation of the "law of one price" is common even among homogenous products. Sellers and buyers in many markets may possess information on price distributions, rather than knowledge of a unique market determined transaction price. Stigler (1961) was one of the first to articulate the importance of price dispersion to agents' search behavior. However, few subsequent studies have sought to explicitly evaluate the role of offer price dispersion in the determination of optimal seller pricing strategy.

In a perfectly competitive neoclassical world, which assumes a large number of rational buyers and sellers of a homogeneous product, full information, and the absence of transactions costs and capacity constraints, the Nash equilibrium yields a unique market price. Of course, in reality, this "ideal" market is hard to find. Rather, for most goods, a range of prices is observed, instead of a single market price.[1] This observation has generated numerous theoretical models that seek to explain equilibrium price dispersion on the basis of alternative market conditions. Explanations put forth in the literature include spatial competition (Hotelling, 1929; Butters, 1977; Shilony, 1977), heterogeneity of sellers or consumers (Braverman, 1980; Diamond, 1987; Salop and Stiglitz, 1977; Reinganum, 1979; Wilde and Schwartz, 1979; Rob, 1985; MacMinn, 1980; Reitman, 1991; Postel-Vinay and Robin, 2002), product differentiation (Perloff and Salop, 1985; Nishimura. 1995), search friction (Reinganum, 1979; Sorensen, 2000), imperfect information (Nelson, 1970; Varian, 1980; Burdett and Judd, 1983), and seller capacity constrains (Dana, 1999; Arnold, 2000).

[1] The examples include, but are not restricted to, the automobile industry (Stigler, 1961), retail store (Lach, 2002; Pratt et al. 1979; Sorensen, 2000), securities (Garbade and Silber, 1976; Hamilton, 1987), housing (Leung et al. 2006), insurance (Schlesinger and Schulenburg, 1991; Berger et al. 1989; Mathewson, 1983; Dahlby and West, 1986; Seog, 2002), and air travel (Borenstein and Rose, 1994).

These models, however, ignore an important aspect of reality: in many markets, sellers post their asking price. These asking prices are an important source of information for buyers in search of the best seller offer, and thus influence the probability that buyers visit sellers. In markets characterized by non-degenerate buyer offer prices (i.e., there exists a distribution of buyer offer prices), the seller first needs to establish an asking price for the product. Thus, together with the reservation price, the asking price is an important component of an optimal pricing strategy aimed at maximizing the seller's return from search.[2] The outcome of a specific search strategy includes the transaction price and search duration, or time-on-the-market. The goal of a rational seller is to sell her product at the highest price possible and as quickly as possible, so as to maximize the seller's return from search.

The housing market provides an ideal setting to examine the effects of buyer offer price dispersion on sellers' optimal pricing strategy. This concern is particularly timely in light of recent marked cyclical fluctuations in housing evidenced in many US markets. The housing market further provides a substantial volume of asking and transaction price data useful to such analysis. Also, sellers search for potential buyers in neighborhoods characterized by varying degrees of heterogeneity of housing stock and dispersion of prices. Accordingly, it is possible, controlling for characteristics of the housing stock, to parameterize the degree of price dispersion and to test for its differential impacts on pricing and transaction outcomes, both over time and across locations. While we cannot directly observe the seller's reservation price, the availability of other relevant information on search outcomes, including asking price, transaction price, and property's

[2] McCall (1970) provides theoretical discussion of the role of reservation prices. In the case of job search, for example, if the job seeker knows the distribution of potential offers, he will stop searching whenever the arrived offer exceeds his reservation wage. Accordingly, the job search duration depends on an accurate understanding of prevailing wage distributions as well as the job searcher's reservation wage.

time-on-the-market, enables us to well specify and test for the impacts of price dispersion on pricing strategy.

There exists some prior literature on optimal pricing of housing and time on the market. Most studies acknowledged the importance of seller asking price to an agent's search procedure, as well as the distinction between asking price and reservation price. Stull (1978) and Guasch and Marshall (1985) provide early examples of search models in which asking prices are set. However, those models fail to consider the case where properties are transacted at below asking prices. Chinloy (1980) assumes the seller's reservation price is a constant fraction of the asking price. Horowitz (1992) and Chen and Rosenthal (1996) show that the asking price serves not only as the resource allocation mechanism, but also as an upper bound to the transaction price. Arnold (1999) demonstrates that the asking price influences the rate at which potential customers arrive. However, none of these studies focuses on the role of price dispersion in agents' search and pricing strategy.

In a recent paper, Haurin et al. (2006), advance this literature in assessment of the effects of asking price and reservation price on housing transaction price and time on the market. In that analysis, the authors employ a measure of the housing unit's atypicality to proxy heterogeneity of the housing stock and related house price distributions. However, atypicality is a limited, indirect measure of price dispersion. Further, price dispersion can be captured directly in the second moment of the relevant sub-market transaction price distribution, rather than by a measure of property characteristics. Below we develop a model which suggests that higher offer price dispersion leads to a higher seller's asking price and further results in a higher expected transaction price. Under the assumption that offer prices are normally distributed, a greater offer price dispersion also reduces the time on the market of overpriced properties. We then apply the model using data from the Tokyo condominium re-sale market.

Specifically, in our multistage search model, we assume that the seller possesses full information on the distribution of buyer offer prices. The seller first sets her reservation price and asking price so as to maximize the expected return from search. The reservation price is determined by the seller's costs of search, her minimum required return or opportunity cost, and other market conditions, including the buyer offer price distribution and in particular, the offer arrival rate, of which the seller's asking price is an important determinant. During search, the seller will accept a purchase offer only if it is above her reservation price. On the other hand, the seller's asking price serves as the ceiling of the transaction price (Horowitz, 1992; Chen and Rosenthal, 1996a, 1996b). Our model demonstrates that both the transaction price and asking price are positively related to the degree of offer price dispersion; moreover, for normally distributed offer prices, price dispersion leads to higher transaction prices and to a more rapid sale of overpriced properties.[3]

We use a unique dataset from the Tokyo condominium market for the 1992-2002 period to test these hypotheses. In particular, the empirical analysis seeks to ascertain the effects of local market price dispersion on (1) seller asking price, (2) market transaction price, and (3) time on the market. We use the standard deviation in transaction prices for each sub-market in central Tokyo as a proxy of the offer price dispersion in local markets. Results of regression analysis suggest that a greater dispersion in sub-market offer prices is associated with a higher reservation price and a higher asking price. In addition, estimation of a Cox proportional hazard model indicates that properties in local markets

[3] We use normal distributed offering price to demonstrate the effect of price dispersion in properties time on the market. It can be easily extended to other forms of offering price distributions as well.

characterized by higher price dispersion tend to have a higher likelihood of sale, and in turn experience relatively a shorter time on the market.

This paper is organized as follows. Section II presents a simple search model in a market where sellers post their asking prices. Section III introduces Tokyo condominium resale market dataset. Section IV reports results of empirical evaluation of the search model of Section II. Section V concludes the paper.

II. Theoretical model

Following early works by Mortensen (1970), Gronau (1971), and Moen (1997), in our multi-stage search model, we assume that buyers' offer prices follow a distribution with a known cumulative distribution function, $F(p)$, and are submitted for seller review in accordance to a Poisson process with parameter λ. The continuous discount rate is γ per period. If an offer of price p is accepted, the seller's expected payoff is $S = p - c$, where c is the seller's cost of search to bring forth the purchase offer.

Let P_a be the seller's asking price, which is hereafter called the list price. We assume that the offer arrival rate λ depends on the list price P_a, as will be discussed below.

Let's consider the determination of the seller's reservation price, P_r, given list price P_a. Following Horowitz, (1992), Chen and Rosenthal, (1996a, 1996b), and Arnold, (1999), we assume that P_a is the upper bound of transaction price p, i.e., $p \leq P_a$. If the offer is not accepted, the payoff is $W = b - c + e^{-r/\lambda}E(\max\{p' - c, W'\})$, where b is the value of the property's second best use, or the opportunity cost of sale; p' and W' are the values, respectively, of the subsequent forthcoming offer and the payoff of rejecting that offer. The value of having an offer in hand is

$$O(p) = \max\{S, W\} = \max\left\{p - c, b - c + e^{-r/\lambda} E\left(O(p')\right)\right\} \tag{1}$$

The reservation price is defined as the unique price at which the seller is indifferent between sale of the property and continued search, i.e. $S(P_r) = W$. Accordingly, $P_r = b + e^{-r/\lambda} E\left(O(p')\right)$, or the difference between the reservation price and the value of the property's second best use, is the discounted expected payoff from future search. Therefore, maximizing the return from search is equivalent to maximizing P_r for a specific *b.* Inserting the above formula into equation (1) yields $E\left(O(P)\right) = E\left(\max\{p, P_r\}\right) - E(c)$. Further, we obtain

$$\begin{aligned} P_r &= b + e^{-r/\lambda} \int_0^\infty \max\{p, P_r\} dF(p) - e^{-r/\lambda} c \\ &= b + e^{-r/\lambda} \left(\int_0^{P_r} P_r dF(p) + \int_{P_r}^{P_a} p dF(p) + \int_{P_a}^{\infty} P_a dF(p) - c \right) \end{aligned} \tag{2}$$

As suggested above, if the total cost of search for every period is fixed at *C*, then the average search cost for each offer is $c = C / \lambda$.

As shown in equation (2), the reservation price has two components. One is the value of the property's second best use in the absence of a sale, and the other is the discounted expected return from search. Note that search will not occur if the expected payoff from sale is less than the value of the property's second best use; or, equivalently, if the expected return from search is negative. Hence, $P_r \geq b$. Equation (2) reveals that the higher opportunity cost (from the second best use) is, the higher the reservation price is.[4] Additionally, note that a higher seller's discount rate, γ,[5] is associated with a lower offer arrival rate, λ, and a higher search cost per period, C, will lead to a lower reservation price.[6]

Let us now consider the determination of the list price. We hereafter assume that (a) the offer arrival rate, λ, is a decreasing function of the list price, P_a, and (b) when offer distribution is a normal distribution, the offer arrival rate, λ is an increasing function of the standard deviation σ of the offer distribution.[7]

Previous discussion indicates a dynamic relationship between the reservation price and the list price, P_a. Thus, the seller seeks to maximize her discounted expected return from search by choosing an appropriate list price, taking account of the dependency of the reservation price on the list price. The solution to that maximization problem is implied by the following first order condition:

$$1-F(P_a^*)=-\left[\frac{C}{\lambda^2}+\frac{\gamma}{\lambda^2}\left(G(p)-C/\lambda\right)\right]\frac{\partial\lambda}{\partial P_a^*} \tag{3}$$

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[4] Genesove and Mayer (1997, 2001) provided evidence that equity status and loss aversion both play significant roles in property selling. We can extend the value of the property's second best use as a mix of rational financial valuation, effect of equity constraint, and sentiment factors (loss aversion), etc.

[5] Glower et al. (1988) argued that sellers' level of motivation to sell is important as well.

[6] The impatient seller is represented by higher discount rate. She will consequently select lower list price and lower reservation price, and will enjoy higher offer arrival rate and higher probability of match, and hence it is possible for her to sell faster.

[7] The following consideration presents one rationale of these assumptions. The potential buyers are likely to decide to inspect the property only if it is likely that the transaction price is below buyer's reservation price (B_r). Let us define the "transaction price discount rate" as $\theta = P_s / P_a$. (1) If the buyer knows the prevailing transaction price discount rate ($\overline{\theta}$), and decides to inspect the property only if the list price satisfies $P_a \le B_r / \overline{\theta}$, then a higher list price will result in losing more potential buyers and lead to lower offer arrival rate, and thus we have λ as a decreasing function of P_a. (2) Suppose that the offer follows normal distribution with mean μ and standard deviation σ. Then, the potential buyers can be expressed in this case as $\int_{\overline{\theta}P_a}^{\infty} dF(p) = 1 - F(\overline{\theta}P_a) = 1 - \Phi\left(\frac{\overline{\theta}P_a - \mu}{\sigma}\right)$, which is positively related to σ. This suggests that λ as an increasing function of the standard deviation σ.

where $G(p)=\int_0^{P_r} P_r dF(p)+\int_{P_r}^{P_a} p dF(p)+\int_{P_a}^{\infty} P_a dF(p)$, and $\left(G(p)-C/\lambda\right)$ represents the expected return from search. As shown, the seller's optimal list price is related to market conditions (buyer offer price distribution, offer arrival rate function, and cost of search), the seller's discount rate, and the expected return from search. Note that the value of the property's second best use is irrelevant to the choice of an optimal list price.

We now examine the implications of price dispersion for the seller's optimal strategy under the assumption that the buyer offer distribution is normal with mean μ and standard deviation σ, by taking the following derivatives: $\frac{\partial P_a^*}{\partial \sigma}$ and $\frac{\partial P_r}{\partial \sigma}$. As shown in Appendix A, we find that $\frac{\partial P_a^*}{\partial \sigma}>0$, and $\frac{\partial P_r}{\partial \sigma}>0$, that is, both the optimal list price and the reservation price are positively associated with the degree of price dispersion.[8]

Let us now consider the effect of price dispersion on the expected transaction price. The expected transaction price is a conditional expectation based on the acceptance of an offer in excess of the reservation price. Following McCall (1970), since offers are independently drawn, we have

$$E(P_s)=E(p \mid p \geq P_r)=\frac{\int_{P_r}^{P_a} p dF(p)+\int_{P_a}^{\infty} P_a dF(p)}{1-F(P_r)} \tag{4}$$

As show in Appendix A, $\frac{\partial E(P_s)}{\partial \sigma}>0$. In other words, a higher expected transaction price is associated with higher price dispersion.

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8 $\frac{\partial P_r}{\partial \sigma}>0$ is derived under certain assumptions of the discount rate between two adjacent offers. E.g. the discount rate between two expected offers is confined to $0.5 \leq e^{-\gamma/\lambda} \leq 1$, as in Appendix A.

In general, price and duration for sale are related outcomes. Although the seller's goal is to sell the house for as high a price as possible and as quickly as possible, the higher price is generally associated with a longer time on the market. As discussed by Belkin et al. (1976), time on the market is an important descriptor of market behavior. Consistent with the conventional search model (McCall, 1970), the probability of match given the arrival of an offer is $M = 1 - F(P_r)$. Assuming offer arrivals follow a geometric distribution, the probability of sale at the *n*th offer is $(1-M)^{n-1}M$, and the expected number of offers before sale is $E(n) = \frac{1}{M}$. As mentioned above, if we assume there are λ offers arriving in each period, then the expected number of periods that the house is on the market is

$$E(N) = \frac{1}{\lambda M} = \frac{1}{\lambda\left(1 - F(P_r)\right)} \tag{5}$$

Assume that the buyer offer price follows a normal distribution $N(\mu, \sigma)$, the impact of price dispersion on time on the market is,

$$\begin{aligned} \frac{\partial E(N)}{\partial \sigma} &= \left\{1/\left[\lambda\left(1 - F(P_r)\right)^2\right]\right\}\left[\partial F(P_r)/\partial \sigma\right] \\ &= -\frac{P_r - \mu}{\sigma^2}\varphi(z)\left\{1/\left[\lambda\left(1 - F(P_r)\right)^2\right]\right\} \\ &= \begin{cases} < 0 & \text{if } P_r > \mu \\ > 0 & \text{if } P_r < \mu \end{cases} \end{aligned} \tag{6}$$

A higher price dispersion facilitates a more rapid sale of "over-priced" properties when the seller's reservation price exceeds the market value of the property; on the contrary, a higher price dispersion delays the successful transaction of an "under-priced" properties.

Hence results of our derivations lead to the following testable hypotheses: (I) following equation (3) and as shown in the appendix, higher price dispersion leads to higher list prices;[9] and (II) a property's transaction price increases with the dispersion in offer prices; (III) as shown in equation (6), for over-priced properties, a higher offer price dispersion is associated with reduced time on the market. In the empirical analysis below, we apply a rich and uniquely suited data base from the Tokyo condominium resale market data to test those hypotheses.

III. Data

Our empirical study focuses on the condominium resale market in the central Tokyo metropolitan area from 1994-2002. As shown in Figure 1, this period was characterized by some fall-back in the condominium prices, in the wake of prior substantial run-up in Japanese asset values during the1986–1990 "bubble economy".[10] The slowdown in the Japanese economy over the study period was broadly evidenced in a variety of indicators.[11]

Our transactions data on the Tokyo condominium market derives from *Recruit Co.* Recruit publishes *Shukan Jutaku Jouhou (Weekly Housing Information).*[12] The magazine is published weekly and contains information on residential property listings. The

[9] Due to lack of availability of reservation price information, we cannot conduct the direct test on the relation between price dispersion and the reservation price.

[10] As indicated in the Figure 1, our study timeframe can be divided into three distinct sub-periods. The first, from January 1994 – September 1995, reflects the significant downward adjustments to house prices that occurred in the immediate aftermath of the "Bubble Economy". A subsequent but less dramatic easing in condominium prices occurred between July 1997 and December 2000 in the wake of the Asian financial crisis. As similarly evidenced in Figure 1, the remaining sampled months, the control group in our empirical analysis (below), were characterized by relative price stability.

[11] From 1994 to 2002, the average annual growth rate of GDP was about 1.2 percent. During the latter half of the 1990s, Japan's unemployment rate trended up by about 2 percentage points to reach approximately 5 percent in late 2001. Average monthly household income moved up at a relatively stable 1.6 percent annual rate from 1994-1997, then declined by about 10 percent through the end of 2001. As would be expected, CPI fluctuations were well contained at an annualized average rate of about 0.06 percent over the course of the 1994 - 2002 study period. Finally, the Tokyo area experienced moderate population growth of about 1 percent per annum during this period.

[12] Recruit Co. publishes *Shukan Jutaku Jouhou* in seven areas in Japan, including the Tokyo Metropolitan Area.

advertisements are classified into four categories: new detached houses, resale detached houses, new condominiums, and resale condominiums. Each property listing published by Recruit includes information on the location and a brief description of the property, the list price, and the name of the seller or the broker.[13] The coverage of this *Recruit Co.* data set is comprehensive, especially for resale condominiums.[14]

According to *Shukan Jutaku Jouhou*, there were 91,037 condominium properties listed for sale in central Tokyo from January 1994 - June 2002. Of these properties, 37,110 were sold, 51,442 were cancelled without sale, and 2,485 remained in the market (and hence were censored) at the end of June 2002 (Table 1). Each record contains the date of listing and the date of delisting, initial list price and delisting price, ward, distance to major/minor train station, average access time to metropolitan sub-centers, unit size, top floor or ground floor, date of construction, real estate agent type (small, medium, or large brokerage organization), structure type (steel framed or ferroconcrete), and an indicator of eligibility for government financing. We hereafter refer to the delisting price for those condominiums sold at delisting as their transaction price.[15]

As shown in Table 1, the average list price of sampled condominiums declined post-1994 and reached bottom in 2001. In the wake of Asian financial crisis, average time on the market increased and list prices declined for re-sale condominiums in 1997 and 1998. After 1999 and subsequent to significant downward adjustment in property

[13] As regards key institutional characteristics, note that sellers in the Japanese property market are supposed to make their property vacant prior to listing it on the market; otherwise, sellers suffer a sizable discount. Moreover, the Japanese existing home market is characterized by relatively lower turnover rates comparing with the United States. Housing transactions are subject to a series of taxes accounting for approximately 3 percent of property value, exclusive of capital gains taxation.

[14] In the central Tokyo area (23 special wards), the *Jutaku Tochi Toukei Chousa* (Housing and Land Survey) of the General Administration Agency of the Japanese Government estimated that there were 9,333 condominium resale transactions in 1998, whereas Recruit Co. reported 10,636. The Government figure is an estimate from a sample survey, while the Recruit figure is based on actual transactions reported through *Shukan Jutaku Jouhou*.

[15] A follow-up survey conducted by Recruit Co. revealed that delisting prices for sold properties were in fact transaction prices, although there were some exceptions.

prices, the data indicates some decline in duration of listing. As the economy began to revive, more units came into the market, and more were finally sold as well.

As regards the sampling algorithm, we deleted those properties with extreme initial asking and delisting prices (i.e. the upper and lower 1 percentage of the observations). As the study focuses on the resale condominium market, new units are also excluded. We further confined our dataset on the multifamily properties with more than 5 units in the complex. Our final dataset have 83,165 observations, of which 34,129 units were sold, 46,843 units were cancelled without sale, and 2,193 units otherwise (*i.e.*, remained on the market at the end of the sample period).

Figure 2 provides a histogram of property time on the market as measured in the number of weeks, for all properties in our final data set. For sold units, time on the market follows a lognormal distribution. Properties have the highest tendency to be sold at around 4 weeks after initial listing. More than 90 percent of the units de-listed without sale are cancelled within the first 28 weeks, or within about half a year after initial listing. Sellers are more likely to discontinue their listing at around week 4 (end of first month), week 14 (after three months), and week 27 (after six months).

We then stratified the listed units among sub-markets on the basis of key property characteristics including geographic area, proximity to rapid transit (train) stations, unit size, and structure age.[16] In so doing, we constrained the minimum size of valid sub-

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[16] As regards geography, the 23 special wards in central Tokyo are self-governing, special municipalities in the central and most populous part of Tokyo. Geographically, those wards can be divided into three areas. Area I covers CBD; while Area II, or the west segment, is another relatively more expensive residential component. Area I includes Chiyoda, Chuo, Minato, Shinjuku, Bunkyo, Taito, Shibuya, and Toshima; Area II includes Shinagawa, Meguro, Ota, Setagaya, Nakano, Suginami, and Nerima; Area III includes Sumida, Koto, Kita, Arakawa, Itabashi, Adachi, Katsushika, and Edogawa. Given the vital nature of mass transit to mobility in central Tokyo, we further note whether the unit is within walking distance to the train station. Properties between 25 and 85 square meters are categorized as “family-type” condominiums; more than 80 percent of the listed properties fall into this category. Properties smaller than 25 square meters in

samples to 30 observations.[17] Then, for each submarket, we calculated transaction price dispersion (*i.e.*, the standard deviation of delisting prices for condominiums actually sold), which we used as a proxy for buyer offer price dispersion in the particular submarket. Similarly, sub-market thickness is represented by the number of listings in that area. We use these proxies in the empirical analysis below.

Table 2 presents the means and standard deviations of selected characteristic continuous variables of condominiums that we examine. The average condominium time on the market was 12.8 weeks, whereas sold units had shorter average duration of 10.7 weeks. Both the initial list price and the final delisting price of the sold units (i.e., transaction prices) averaged 9 percent lower than prices for cancelled units. The mean and the standard deviation of the buyer offer price dispersion of the submarket to which a particular condominium belongs are also shown for four categories (all, sold, cancelled without sale and other), with the standard deviation of transaction prices of the submarket assumed to proxy for the buyer offer price dispersion. The sold properties were more likely to be located in the submarkets with lower buyer offer price dispersion,[18] though the difference in the value of this indicator between sold and cancelled-without-sale units was only about 4 percent. The average age of the units (for the "all" category) was 186 months (15.5 years) at listing. Sold units were older than cancelled listings by just 5 months. The average travel time to the 40 busiest rail stations (from among the 1,600 stations in the Tokyo metropolitan area) was 24.9 minutes for the full sample. This travel time is slightly longer among the sold units. The average size of unit was 59 square

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size are largely studios; whereas units in excess of 85 square meters are high-end condominiums. Age of the structure is another important characteristic. Certain buyers, called as "the new property runners", are known to often trade up to new properties. Because of physical depreciation, homeowners often are required to pay higher maintenance fees for structures older than 10 years

[17] There are 43 submarkets in the final sample.

[18] To make it clear, we use the phrase "Standard deviation in transaction prices of the submarket to which the particular condo belongs" for this entry in Table 2.

meters. Cancelled-without-sale properties were relatively larger compared to the sold units, and those still in the market (i.e., in the "other" category) were the largest among the three status groups.[19]

We merged the transaction records with Japanese macroeconomic indicators and Tokyo condominium market information. Table 3 displays the means and standard deviations of selected time-varying covariates. Consistent with the economic slowdown during our sample period, the Nikkei 225 index was on average higher at initial listing than at de-listing. This difference was more significant among the cancelled-without-sale properties. Similarly, average monthly household income was also higher at listing than at de-listing. Further, the sold units were associated with less of a drop in household income than the cancelled listings (497 yen vs. 766 yen). The condominium price index also was generally higher at initial listing than at de-listing.

Table 4 provides the frequencies of selected discrete variables. Area I, Area II, and Area III comprise 27.4, 44.1, and 28.4 percent of the central Tokyo condominium market, respectively. The transaction rate varies from a low of 36.1 percent in Area I to 46.1 percent in Area III. The vast majority of listed properties were within walking distance of a train station (98.6 percent), but those properties also have a lower transaction rate compared to other properties (42.3 vs. 49.3 percent). Over the course of the listing period, about one-third of sellers adjusted their list price; among them, 98 percent reduced the list price.[20] Further, the transaction rate for price-adjusted properties is lower than those without any price adjustment units (40 vs. 45 percent). Also, 92.6

[19] The statistics for the "other" or the censored lists indicate that as the market starts picking up, the more recent lists are relatively bigger and more expensive.
[20] As Horowitz (1992) mentioned, the increase in list price rarely happens. It may happen when the seller receives multiple offers at the same time. Under those conditions, auction theory may be applied.

percent of listed properties were in thick markets (defined as 1000+ listed properties). The transaction rate in thick markets was higher than in other markets (41 vs. 39 percent).

Among other regularities in the data, note that agents affiliated with small and mid-size firms had less than a 40 percent market share, but succeeded in selling almost half their listings, well in excess of the sales rate among agents affiliated with large firms. More properties were listed in the spring and summer than in the fall and winter. Further, a majority of listed properties were "family-type" condominiums, of size between 25 and 85 square meters. The mid-sized properties also had relatively higher transaction rates compared to both studios and luxury units (41.8 vs. 34.7 and 35.4 percent, respectively). More than half of the listed properties were between 10 and 22 years old; those properties also had the highest transaction rate (42.5 percent). The newer structures, between 1 and 4 years old, had the lowest transaction rates (33.8 percent).

We turn now to estimation of the market value of each condominium in question. Because only one-third of the listed properties were ultimately sold, while another two-thirds were cancelled without sale, we used the Heckman two-step procedure to correct for sample selection in the estimation of each condominium's market value. In the first step, we used the full sample to estimate a probit model of the probability of transaction and in so doing also estimated an inverse Mill's Ratio.[21] In the second step, the estimated inverse Mill's Ratio was included as an additional explanatory variable in the OLS regression on property value. The expected market value for each property was estimated accordingly, controlling for well-established structural, locational, and time of sale characteristics. Results of this set of estimations are contained in Appendix B-2.[22]

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[21] Heckman step one estimation results are presented in Appendix B-1.

[22] The number of monthly transactions in our sample period varies from 25 to 524, mostly above 200. The adjusted R-squares for the monthly OLS regressions are higher than 0.7. The logarithm of transaction price

IV. Empirical Results

List prices and Transaction Prices

According to equation (3) above, sellers' choice of optimal list price varies with market conditions including buyer offer price distribution, buyer offer arrival rate,[23] sellers' cost of search, and the expected returns from search. Further, as shown in Appendix A, the optimal list price is an increasing function of the offer price dispersion. Also as indicated in Appendix A, the expected transaction price defined in equation (4) increases with the price dispersion. The following analysis focuses on tests of these hypotheses.

Both the list price and the transaction price are closely related to the property's fundamental value as represented by the property's estimated quality-adjusted market value. Further, the market conditions, including price dispersion and market thickness, as well as indications of seller behavior (adjustment of list price and selection of real estate agent) may have an impact on the list price selection and the final transaction price.

Table 5 displays results of OLS regressions of the log of the list price for the full sample. Panel (a) shows results at initial listing, whereas panel (b) presents results at de-listing. Model 1 in panel (a) provides a parsimonious specification in which the list price is regressed on the quality adjusted market value (as explained in the previous section). As expected, the property's estimated market value is positive and highly significant in the determination of the initial list price. Model 2 includes a proxy for the measure of

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is negatively related to the average travel time to 40 busiest stations (Access) and the age of the building, but positively related to property's size. A unit located in central business district (CBD) is associated with higher transaction price as well.

[23] It should be noted that the offer arrival rate is a function of the list price. Thus it is more precise to refer to "parameters determining offer arrival rate function" than simply "offer arrival rate" here. However, to avoid cumbersome terminology, we hereafter use "offer arrival rate" instead of "parameters determining offer arrival rate function".

offer price dispersion, which is the standard deviation of transaction prices in the relevant submarket. Results here are highly significant and indicate that a 1 percent increase in the standard deviation of the sub-market transaction price dispersion results in an approximate 0.22 percent increase in the initial list price. Accordingly, empirical findings support our theoretical assertion that the list price is higher in a market with greater price dispersion.

Model 3 further expands on the specification to include a control for thick markets. As suggested by Lazear (1986), prices may vary with sub-market thickness, as proxied by the number of listed properties. After controlling for both condominium estimated market value and sub-market price dispersion, results of model 3 indicates a pricing premium of 0.06 percent in thick markets. Model 4 provides a control for whether the seller adjusts the list price. In that regard, various authors have suggested that some sellers may experiment with a higher list price early on and then subsequently adjust that price upon learning more about the market (see, for example, Taylor, 1999; Chade and Serio, 2002; Sass, 1988). Model 5 additionally considers the effects of different of real estate agents affiliated with firms of different sizes. Agents affiliated with both small and mid-size firms appear to be less aggressive than those affiliated with larger entities. Model 3 to Model 7 show that the price dispersion effects are robust.

Subsequent iterations of the model provide additional controls for macroeconomic and housing market conditions. Indeed, the annual de-list fixed effects (Model 6) are highly significant in the determination of list prices. Finally, Model 7 further considers interactions of the price dispersion term with categorical controls for the two sub-periods in which the condominium price index recorded a significant downward adjustment. Both interactive terms were negative and insignificant.

Panel (b) displays results of similar specifications of the log of list price at the time of de-listing (including both sold and withdrawn properties). Results here are similar to those in panel (a). As expected, the de-listing price is positively related to the estimated market value of the property, price dispersion in the sub-market, and an indicator of thick markets. Similarly, units listed with agents affiliated with large firms are also more likely to be de-listed at a higher price. Note, however, that *ex ante* less informed sellers who "post high and adjust later" do not necessarily de-list their property at a higher price.

As described above, only 41 percent listed properties are ultimately sold. In Table 6, we report on results of above specifications for a sample that includes only sold units, so as to assess robustness of results to sample selection. As is evident, results are largely similar to those contained in Table 5. Of importance to our theory, the price dispersion effects are quite robust; a 1 percent increase in the standard deviation of transaction price in the submarket leads to an approximate 0.2 percentage increase in the list price. Similarly, results here reveal negative and significant coefficients for the interaction of the degree of price dispersion with controls for periods of decline in the condominium price index. Results then suggest damped effects of the price dispersion term during periods of market weakness.

Time on the market: estimating the hazard rate of sale

In this section, our empirical analyses focus on the estimation of a property's time on the market. As discussed above, time on the market is another important outcome of search. Equation (5) expresses the expected time on the market as a function of the offer arrival rate, the seller's reservation price, and the offer price distribution. Assuming the offer price follows normal distribution, equation (6) shows that the expected time on the market for an overpriced property (with a reservation price in excess of the property's market value) is reduced in a market with higher levels of price dispersion. To the extent that most of the mis-priced properties in the marketplace tend to be overpriced, then shorter average time on the market or higher probability of sale should be expected in sub-markets with higher price dispersion. We test this hypothesis below.

Our empirical models are estimated based on the Cox Partial Likelihood approach (Cox, 1975). As is well appreciated, the hazard function in the Cox model is defined as the product of a baseline hazard function and a set of proportional factors such that

$$h\left(t_{ij}; z_j\left(t_{ij}\right)\right) = h_{0j}\left(t_{ij}\right)\exp\left(z_j\left(t_{ij}\right)'\beta_j\right), \quad j = 1, 2, \tag{7}$$

where $h_{0j}\left(t_{ij}\right)$ is a baseline hazard function that describes the overall shape of time on the market of the listed properties, i.e., list termination risks by sale or cancellation.[24] j indicates sale (if j = 1), withdrawal from the market without sale or censored listing (if j = 2 or 3, respectively). The hazard rate of termination is the probability that a listed property is sold or cancelled at any given time t, given that it has not been sold or cancelled prior to t.

$z_j\left(t_{ij}\right)$ is a vector of proportional factors capturing time-varying or time-invariant covariates. In our empirical example, $z_j\left(t_{ij}\right)$ includes a measure of the degree of offer price dispersion in the relevant submarket, represented by the logarithm of transaction

[24] Green and Shoven (1986) are among the first to apply the Cox model to study mortgage outcomes. Since then, researchers have developed more sophisticated and realistic applications of the Cox proportional hazard model in assessment of mortgage termination behaviors (See Schwartz and Torous, 1989, and Deng et al., 2000, for more recent applications). In housing market analysis, Zuehlke (1987) employed a Weibull hazard model to examine the relationship between probability of sale and market duration in housing markets. Kluger and Miller (1990) developed a liquidity measure for real estate based on the Cox proportional hazard technique. More recently, Genesove and Mayer (2001) applied the Cox proportional hazard model to study the determinants of properties' time on the market.

price dispersion in the corresponding submarket, as before. Also included among proportional factors in the estimating equation are (1) the logarithm of the list price, serving to be proxy for the offer arrival rate;[25] (2) the degree of overpricing and an indicator of whether the seller revises her list price, to proxy variations in seller behavior; (3) the real estate agent affiliation type, representing different opportunities of search assistance and varying knowledge of the local market; and (4) economic and household conditions, including indicators of thick markets, month/year of delisting, index of stock values, average household income, condominium price index, and the like. These latter factors may also affect the offer arrival rate, and in turn influence the property's time on the market.

Estimates of a number of specifications of the proportional hazard model are presented in Table 7. Model 1 includes the logarithm of the list price, a control for overpricing of the property (the ratio between the list price and the estimated market value), and a control for price dispersion in the local market. Results suggest that a higher list price results in a longer time on the market, or a lower likelihood of sale; a larger deviation of the list price form the estimated market value results in a longer time on the market. Also, consistent with modeled hypotheses as shown in equation (6): the estimated coefficient on the price dispersion term was positive and significant, suggesting that listed properties in areas of higher price dispersion are associated with shorter time on the market.

Also, due perhaps to variations in affordability, the market for small condominiums may behave differently from the market for larger properties. We distinguish those larger properties by flagging the upper three quantiles of the distribution

[25] It should be remembered that the fundamental assumption of our model is that the offer arrival rate is negatively related to the list price.

of units' size, or units in excess of 46.4 square meters, and interacting this large unit indicator with the logarithm of submarket transaction price dispersion. Results of model 2 show that the estimated interactive term is also positive and significant. Accordingly, submarket price dispersion has an even greater impact on larger properties.

The following tests show the robust relationship between price dispersion and properties' time on the market. From Model 3 to Model 6, we test the hypotheses as regards the roles of market thickness,[26] seller adjustment of the property list price, real estate agents affiliation, seasonal factors, and economy-wide conditions as captured in the de-listing year. Model 3 shows that a thick submarket, characterized by larger numbers of sellers and buyers, enhances property liquidity by increasing the offer arrival rate. As expected, market thickness is positively related to the likelihood of a sale. Model 4 controls for sellers who adjusted the list price of their properties. Those sellers who have adjusted the list price of the property are less likely to quickly sell their properties. In Model 5, real estate agents affiliated with mid-sized agencies exhibit the highest likelihood of sale, whereas properties listed with the largest agencies are associated with the longest time on the market. Model 6 provides controls for seasonality in condominium sales. Results here indicate that properties are more likely to be sold in March, June, and November, and are less likely to be sold in January.

Model 7 further includes the de-listing year indicator so as to control for macro trends in the condominium market from 1994 to 2002. As suggested above, the early years following the 1991 downward breakpoint in the Japanese economy have been characterized as a hard economic landing. Those years were followed by some improvement in macro and housing conditions in the mid-1990s, followed by further

[26] As described above, this control is specified as the submarkets with more than 1,000 listed properties.

easing in economic activity in the wake of the 1997 Asian financial crisis. We hypothesize that improved macroeconomic and housing market conditions are associated with an elevated potential buyers' arrival rate, λ, as described in equation (5).

Model 8 provides a more explicit specification of those macro and housing market effects. Instead of entering the de-listing year dummies, that model explicitly includes controls for time-varying macroeconomic and housing market indicators, including the Nikkei 225 index, average monthly household income, and the Tokyo condominium price index. The latter condo price index is also interacted with indicators of the two sub-periods of significant price declines. Results here conform to expectations. In that regard, upon inclusion of time-related fixed effects or the explicit macroeconomic variables, the transaction price dispersion in the corresponding submarket remains positively associated with property likelihood of sale.

Finally, Model 9 also includes interactions of the logarithm of transaction price dispersion with sub-periods of significant price decline. Upon inclusion of the two interactive terms, the estimated coefficients associated with the two sub-periods of price decline are negative, while the interactive term for the early period price decline indicator, prior to 1995, is positive. Results here suggest, as expected, that while the probability of sale was damped during the sub-periods of condominium price decline, even in the context of the larger slowing in activity, higher probabilities of sale were evidenced in sub-markets characterized by higher levels of price dispersion.

V. Conclusions

In the wake of the recent downturn in housing activity, substantial media and professional debate have focused on optimal seller pricing strategies. While sellers often observe a range of transaction prices in the marketplace, there exists little theoretical analysis or empirical test of the role of house price dispersion in the determination of optimal seller pricing strategies. Such insights could prove useful to seller profit maximization and to allocative efficiency.

Existing static models on price dispersion at the aggregate level fail to explain sellers behavior in markets with pronounced uncertainty. In the housing market, theoretical and empirical studies of the dynamic interaction between price dispersion and agents' selling strategy have become increasingly relevant, in the wake of the substantial cyclical fluctuations of recent years. This study provides a first step in this promising research agenda.

We adopt a multistage search model, in which the seller's reservation price is determined by opportunity costs, search costs, the seller's discount rate, and additional market parameters including the anticipated buyer offer arrival rate and buyer offer price distribution. The optimal asking price is chosen so as to maximize the return from search. Results of our derivations indicate that higher price dispersion leads to a higher reservation price and a higher optimal asking price, which in turn results in a higher expected transaction price. Under the assumption that offer prices are normally distributed, transaction price dispersion also accelerates the timing of sale of overpriced properties.

We apply a unique dataset from the Tokyo condominium market for the 1992-2002 period to test model hypotheses. Empirical results indicate that offer price dispersion is an important determinant of both pricing strategy and pricing outcomes. A one percentage point increase in the dispersion of offer prices, as proxied by the standard deviation of housing transaction prices in the relevant submarket, results in two-tenths of a percent increase in both the initial list price and the final transaction price. Although overpriced properties tend to stay on the market longer, an increase in the dispersion of offer prices enhances the probability of a successful transaction and/or an accelerated sale. Moreover, less well-informed sellers are more likely to list their properties at significantly higher prices and to later reduce their offer price. Those properties stay on the market longer and sell at about a three percent discount relative to the properties of better-informed sellers.

Appendix A:

Price dispersion and the optimal pricing strategy

We define price dispersion as the standard deviation of the offer price distribution (that is assumed to be distributed normally with mean μ and standard deviation σ), of which standard deviation in the properties' transaction prices in the corresponding real estate sub-market is used as being proxy, in the empirical analysis of Section III.

Let us first look at $\frac{\partial G(p)}{\partial \sigma}$:

$$\frac{\partial G(p)}{\partial \sigma} = \frac{\partial \left(\int_0^{P_a} p dF(p) + \int_{P_a}^{\infty} P_a dF(p) - \int_0^{P_r} (p - P_r) dF(p) \right)}{\partial \sigma} = \left(1\text{-}F(P_a)\right) \frac{\partial P_a}{\partial \sigma} + F(P_r) \frac{\partial P_r}{\partial \sigma} \quad \text{(A-1)}$$

According to formula (2), we have $\frac{\partial P_r}{\partial \sigma} = \frac{\partial e^{-\gamma/\lambda}}{\partial \sigma}\left(G(p) - C/\lambda\right) + e^{-\gamma/\lambda} \frac{\partial\left(G(p) - C/\lambda\right)}{\partial \sigma}$.

Then, we insert the calculated $\frac{\partial G(p)}{\partial \sigma}$ into $\frac{\partial P_r}{\partial \sigma}$ and rearrange to obtain

$$\frac{\partial P_r}{\partial \sigma} = \frac{e^{-\gamma/\lambda}\left(1 - F(P_a)\right)\frac{\partial P_a}{\partial \sigma} + e^{-\gamma/\lambda}\left[\frac{\gamma}{\lambda^2}\left(G(p) - C/\lambda\right) + C\right]\frac{\partial \lambda}{\partial \sigma}}{1 - e^{-\gamma/\lambda} F(P_r)} \quad \text{(A-2)}$$

According to formula (3), we get $-f(P_a^*)\frac{\partial P_a^*}{\partial \sigma} = -\frac{\partial \lambda}{\partial P_a^*}\left[\frac{\partial \frac{C}{\lambda^2}}{\partial \sigma} + \frac{\partial\left(\frac{C}{\lambda^2} + \frac{r}{\lambda^2}\left(G(p) - C/\lambda\right)\right)}{\partial \sigma}\right]$.

Then, we insert the expression for $\frac{\partial G(p)}{\partial \sigma}$ and $\frac{\partial P_r}{\partial \sigma}$ and rearrange to obtain:

$$\frac{\partial P_a^*}{\partial \sigma} = \frac{\frac{\partial \lambda}{\partial P_a^*} \cdot \frac{\partial \lambda}{\partial \sigma} \cdot \frac{1}{\lambda^4}\left\{-2C\lambda - 2\gamma\lambda\left(G(P) - C/\lambda\right) + C\gamma + \frac{\gamma F(P_r)e^{-\gamma/\lambda}\left[\gamma\left(G(P) - C/\lambda\right) + C\right]}{1 - F(P_r)e^{-\gamma/\lambda}}\right\}}{\frac{f(P_a^*)\left(1 - e^{-\gamma/\lambda}F(P_r)\right) - \frac{\gamma}{\lambda^2}\left(1 - F(P_r)\right)\frac{\partial \lambda}{\partial P_a^*}}{1 - e^{-\gamma/\lambda}F(P_r)}}$$

(A-3)

The numerator is:

$$\frac{\partial\lambda}{\partial P_a^*}\cdot\frac{\partial\lambda}{\partial\sigma}\cdot\frac{1}{\lambda^4}\left\{-2C\lambda-2\gamma\lambda\left(G(P)-C/\lambda\right)+C\gamma+\frac{\gamma F(P_r)e^{-\gamma/\lambda}\left[\gamma\left(G(P)-C/\lambda\right)+C\right]}{1-F(P_r)e^{-\gamma/\lambda}}\right\},$$
$$=\frac{\partial\lambda}{\partial P_a^*}\cdot\frac{\partial\lambda}{\partial\sigma}\cdot\frac{1}{\lambda^4}\left\{\left[\gamma\left(G(P)-C/\lambda\right)+C\right]\left(\frac{\gamma}{1-B}-2\lambda\right)-\gamma^2\left(G(P)-C/\lambda\right)\right\}$$

(A-4)

where $B=e^{-\gamma/\lambda}F(P_r)$. Note $\frac{\partial\lambda}{\partial P_a^*}<0$, $\frac{\partial\lambda}{\partial\sigma}>0$, and $\left(G(P)-C/\lambda\right)>0$.

Further assume the discount rate between two expected offers is confined to $0.5\le e^{-\gamma/\lambda}\le 1$. Then, on one hand, it is straightforward to show that if $\frac{\gamma/\lambda}{1-B}\le 2$,[27] so that the numerator is positive (> 0). On the other hand, the denominator is $\frac{f(P_a^*)\left(1-e^{-\gamma/\lambda}F(P_r)\right)-\frac{\gamma}{\lambda^2}\left(1-F(P_r)\right)\frac{\partial\lambda}{\partial P_a^*}}{1-e^{-\gamma/\lambda}F(P_r)}>0$. Accordingly, we get $\frac{\partial P_a^*}{\partial\sigma}>0$. As to $\frac{\partial P_r}{\partial\sigma}$ expressed in equation (4), note that $\frac{\partial P_a}{\partial\sigma}>0$, $\left(G(P)-C/\lambda\right)>0$, and $\frac{\partial\lambda}{\partial\sigma}>0$, hence we obtain $\frac{\partial P_r}{\partial\sigma}>0$.

Thus, both reservation price and list price increase with price dispersion. Moreover, the expected return from searching, $G(P)$, will also be higher with greater price dispersion.

Expected transaction price and time on the market

Taking derivatives in terms of σ on both sides of equation (4) yields:

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[27] For function $f(x)=\frac{x}{1-e^{-x}F(p)}$, where $F(p)$ is a cdf function with $0\le F(p)\le 1$. $\frac{\partial f(x)}{\partial x}=\frac{1-e^{-x}F(p)\left(1-x\right)}{\left(1-e^{-x}F(p)\right)^2}>0$, if $e^{-x}F(p)\left(1-x\right)<1$, which includes the range $0<x<1$. When we define $x=\gamma/\lambda$, then e^{-x} is the discount rate. The range in the discount rate $0.5\le e^{-\gamma/\lambda}\le 1$ is equivalent to $0\le x\le 0.693$. Hence the maximum value of $f(x)$ is obtained with $x=0.693$ at 1.386.

$$\frac{\partial E(P_s)}{\partial \sigma} = \frac{f(P_r)}{\left[1-F(P_r)\right]^2}\left(\int_{P_r}^{P_a} p\,dF(p) + \int_{P_a}^{P_a} P_a\,dF(p) - \int_{P_r}^{\infty} P_r\,dF(p)\right)\frac{\partial P_r}{\partial \sigma} + \frac{1-F(P_a)}{1-F(P_r)}\frac{\partial P_a}{\partial \sigma} \qquad \text{(A-5)}$$

As previously shown, a higher price dispersion results in a higher list price and a higher reservation price, or $\frac{\partial P_r}{\partial \sigma} > 0$ and $\frac{\partial P_a}{\partial \sigma} > 0$. We can in turn state that a higher price dispersion will consequently lead to higher transaction price as well, or $\frac{\partial E(P_s)}{\partial \sigma} > 0$.

Equation (5) expresses the expected time on the market. The reservation price, P_r, determines the probability of match for each offer. The higher reservation price leads to a longer expected time on the market as the result of the lower probability of a match, as shown in $\frac{\partial E(N)}{\partial P_r} = f(P_r)/\left[\lambda\left(1-F(P_r)\right)^2\right] > 0$. On the other hand, when the offer arrival rate is a decreasing function in P_a, the higher list price results in longer time on the market due to the lower offer arrival rate as stated above, or $\frac{\partial E(N)}{\partial P_a} = -\left[1/\left(\lambda^2\left(1-F(P_r)\right)\right)\right]\frac{\partial \lambda}{\partial P_a} > 0$.

Assume that the offer price follows a normal distribution $N(\mu,\sigma)$, then higher variance (σ^2) indicates fatter tail, or $\partial F(p)/\partial\sigma = -\frac{p-\mu}{\sigma^2}\varphi(z) \quad \begin{cases} <0 & \text{if } P>\mu \\ >0 & \text{if } P<\mu \end{cases}$, where $z = \frac{p-\mu}{\sigma^2}$. So the impact of price dispersion on the time on the market is,

$$\begin{aligned} \frac{\partial E(N)}{\partial \sigma} &= \left\{1/\left[\lambda\left(1-F(P_r)\right)^2\right]\right\}\left[\partial F(P_r)/\partial\sigma\right] \\ &= -\frac{P_r-\mu}{\sigma^2}\varphi(z)\left\{1/\left[\lambda\left(1-F(P_r)\right)^2\right]\right\} \\ &= \begin{cases} <0 & \text{if } P_r>\mu \\ >0 & \text{if } P_r<\mu \end{cases} \end{aligned} \qquad \text{(A-6)}$$

Appendix B: Heckman Two-stage Estimation for market values of condominium

Step I: Probit estimates

Table B-1. Probit estimates
Dependent variable: dummy variable of sale

	Estimates and t statistics
Intercept	-0.41
	(12.17)
Average travel time to 40 most busiest stations	0.009
	(8.51)
Central Business District	-0.13
	(9.24)
Size	-0.0016
	(7.34)
No. of months after construction at de-list	0.0004
	(8.36)
- Log likelihood	57333

Step II: OLS regression of market values of condominium

Table B-2. OLS regression results

Dependent variable: Log(transaction price)

Month	intercept	Access	CBD	Size	Age of building (months)	Inverse Mill's ratio	N	R^2
Jan-94	7.30	-0.01	0.09	0.02	-4.60E-04	8.63E-03	25	0.87
	(20.11)	(-0.88)	(0.66)	(6.85)	(-0.84)	(1.30)		
Feb-94	7.38	-0.01	0.18	0.02	-8.58E-04	4.20E-03	121	0.78
	(40.57)	(-1.65)	(3.02)	(14.57)	(-3.33)	(1.39)		
Mar-94	7.56	-0.02	0.15	0.02	-9.87E-04	3.07E-03	290	0.83
	(67.40)	(-5.44)	(4.15)	(24.74)	(-5.80)	(1.64)		
Apr-94	7.52	-0.01	0.15	0.02	-1.04E-03	5.55E-03	208	0.77
	(46.87)	(-2.61)	(3.13)	(17.60)	(-4.78)	(2.11)		
May-94	7.53	-0.02	0.09	0.02	-6.72E-04	5.49E-03	224	0.80
	(55.30)	(-4.47)	(2.13)	(21.20)	(-3.16)	(2.49)		
Jun-94	7.90	-0.02	0.08	0.02	-1.22E-03	9.74E-04	290	0.81
	(67.97)	(-6.96)	(2.47)	(25.60)	(-7.32)	(0.53)		
Jul-94	7.64	-0.02	0.13	0.02	-9.47E-04	2.24E-03	267	0.80
	(57.17)	(-5.37)	(3.39)	(23.90)	(-5.24)	(1.06)		
Aug-94	7.64	-0.02	0.05	0.02	-7.50E-04	8.46E-04	192	0.79
	(47.54)	(-4.44)	(0.93)	(19.56)	(-3.43)	(0.36)		
Sep-94	7.69	-0.02	0.09	0.02	-9.61E-04	2.24E-03	326	0.79
	(62.39)	(-5.95)	(2.55)	(24.70)	(-5.78)	(1.16)		
Oct-94	7.50	-0.02	0.14	0.02	-8.65E-04	3.98E-03	296	0.81
	(65.07)	(-4.71)	(3.64)	(25.73)	(-5.44)	(2.12)		
Nov-94	7.69	-0.02	0.17	0.02	-1.02E-03	1.73E-03	288	0.79
	(51.57)	(-5.57)	(3.79)	(22.14)	(-5.13)	(0.74)		
Dec-94	7.71	-0.02	0.09	0.02	-9.10E-04	3.17E-03	316	0.78
	(62.00)	(-6.94)	(2.00)	(26.10)	(-5.24)	(1.64)		
Jan-95	7.45	-0.01	0.08	0.02	-7.60E-04	1.74E-03	269	0.74
	(48.70)	(-3.30)	(1.90)	(21.11)	(-4.04)	(0.80)		
Feb-95	7.57	-0.02	0.07	0.02	-1.02E-03	4.13E-03	270	0.80
	(63.25)	(-6.45)	(2.00)	(23.67)	(-5.74)	(2.13)		
Mar-95	7.76	-0.03	0.11	0.02	-1.16E-03	-3.04E-03	376	0.79
	(68.79)	(-8.14)	(3.05)	(31.32)	(-7.81)	(-1.87)		
Apr-95	7.46	-0.01	0.14	0.02	-1.30E-03	2.52E-03	251	0.79
	(50.79)	(-3.62)	(3.23)	(23.15)	(-6.18)	(1.17)		
May-95	7.47	-0.02	0.07	0.02	-1.09E-03	4.26E-03	229	0.76
	(45.22)	(-4.33)	(1.49)	(19.97)	(-4.82)	(1.70)		
Jun-95	7.38	-0.01	0.09	0.02	-8.56E-04	2.02E-03	350	0.75
	(67.78)	(-5.48)	(2.61)	(25.67)	(-4.80)	(1.13)		
Jul-95	7.63	-0.02	0.07	0.02	-1.01E-03	1.64E-03	251	0.76
	(48.44)	(-5.73)	(1.49)	(21.86)	(-4.76)	(0.72)		
Aug-95	7.55	-0.02	0.08	0.02	-1.08E-03	2.50E-03	265	0.75
	(54.83)	(-5.64)	(1.88)	(22.67)	(-5.45)	(1.22)		
Sep-95	7.51	-0.02	0.13	0.02	-1.14E-03	1.42E-03	321	0.78
	(53.14)	(-5.43)	(3.24)	(26.42)	(-6.34)	(0.72)		
Oct-95	7.67	-0.02	0.06	0.02	-1.31E-03	2.17E-03	331	0.78
	(59.43)	(-7.05)	(1.46)	(26.48)	(-7.19)	(1.21)		
Nov-95	7.58	-0.02	0.07	0.02	-1.20E-03	1.79E-03	389	0.81
	(68.56)	(-7.96)	(2.21)	(34.48)	(-7.76)	(1.15)		
Dec-95	7.35	-0.01	0.17	0.02	-1.15E-03	2.13E-03	285	0.76
	(43.94)	(-3.45)	(3.87)	(24.08)	(-5.46)	(0.92)		
Jan-96	7.45	-0.02	0.11	0.02	-9.33E-04	-3.28E-04	210	0.78
	(45.49)	(-4.23)	(2.25)	(23.97)	(-3.89)	(-0.15)		

Table B-2. OLS regression results (Cont.)
Dependent variable: Log(transaction price)

Month	intercept	Access	CBD	Size	Age of building (months)	Inverse Mill's ratio	N	R^2
Feb-96	7.57	-0.02	0.10	0.02	-1.44E-03	-9.54E-04	476	0.79
	(68.57)	(-7.06)	(3.44)	(36.02)	(-10.34)	(-0.62)		
Mar-96	7.55	-0.02	0.14	0.02	-1.43E-03	-3.95E-03	359	0.80
	(64.87)	(-6.70)	(4.15)	(29.37)	(-9.65)	(-2.23)		
Apr-96	7.55	-0.02	0.13	0.02	-1.34E-03	7.10E-04	363	0.80
	(66.65)	(-7.21)	(3.83)	(31.47)	(-8.97)	(0.43)		
May-96	7.61	-0.02	0.14	0.02	-1.34E-03	-4.38E-04	321	0.79
	(59.40)	(-7.27)	(3.51)	(27.56)	(-8.05)	(-0.22)		
Jun-96	7.65	-0.03	0.08	0.02	-1.32E-03	-2.75E-03	324	0.79
	(56.72)	(-6.92)	(2.28)	(28.99)	(-7.69)	(-1.38)		
Jul-96	7.41	-0.02	0.10	0.02	-1.15E-03	3.25E-03	321	0.78
	(57.11)	(-5.14)	(2.53)	(26.77)	(-6.49)	(1.63)		
Aug-96	7.49	-0.02	0.05	0.02	-9.15E-04	-4.51E-04	326	0.81
	(59.45)	(-6.82)	(1.29)	(30.45)	(-5.15)	(-0.24)		
Sep-96	7.46	-0.02	0.08	0.02	-1.11E-03	2.11E-03	312	0.78
	(57.03)	(-5.52)	(2.06)	(28.17)	(-6.21)	(1.10)		
Oct-96	7.43	-0.02	0.11	0.02	-1.39E-03	4.58E-03	461	0.77
	(68.24)	(-5.95)	(3.44)	(33.14)	(-10.41)	(2.81)		
Nov-96	7.47	-0.02	0.11	0.02	-1.22E-03	2.62E-03	350	0.80
	(57.57)	(-5.90)	(3.06)	(31.65)	(-7.30)	(1.37)		
Dec-96	7.53	-0.02	0.02	0.02	-1.18E-03	5.88E-04	288	0.79
	(53.21)	(-6.13)	(0.59)	(28.18)	(-6.51)	(0.28)		
Jan-97	7.45	-0.02	0.06	0.02	-1.02E-03	2.92E-03	332	0.73
	(52.48)	(-4.75)	(1.61)	(25.28)	(-5.48)	(1.50)		
Feb-97	7.72	-0.02	0.11	0.02	-1.42E-03	-3.84E-04	383	0.77
	(64.09)	(-8.00)	(2.97)	(28.97)	(-8.93)	(-0.21)		
Mar-97	7.48	-0.02	0.08	0.02	-1.09E-03	-3.75E-05	392	0.79
	(59.21)	(-5.93)	(2.44)	(31.50)	(-7.07)	(-0.02)		
Apr-97	7.75	-0.02	0.03	0.02	-1.69E-03	-3.98E-04	354	0.79
	(61.79)	(-7.26)	(0.87)	(28.76)	(-11.38)	(-0.21)		
May-97	7.32	-0.02	0.12	0.02	-1.17E-03	2.59E-03	281	0.81
	(51.12)	(-4.63)	(3.23)	(27.68)	(-6.07)	(1.25)		
Jun-97	7.54	-0.02	0.13	0.02	-1.09E-03	-1.44E-03	301	0.80
	(53.19)	(-5.75)	(3.60)	(29.06)	(-6.57)	(-0.65)		
Jul-97	7.53	-0.02	0.11	0.02	-1.30E-03	-4.25E-05	381	0.78
	(59.08)	(-5.80)	(3.23)	(31.09)	(-8.40)	(-0.02)		
Aug-97	7.86	-0.03	0.04	0.02	-1.46E-03	-3.34E-03	197	0.77
	(45.49)	(-6.31)	(0.93)	(21.80)	(-7.16)	(-1.38)		
Sep-97	7.49	-0.02	0.08	0.02	-1.11E-03	3.08E-03	244	0.77
	(48.70)	(-5.60)	(1.78)	(21.36)	(-5.87)	(1.25)		
Oct-97	7.47	-0.02	0.12	0.02	-1.22E-03	8.52E-04	423	0.78
	(60.61)	(-5.66)	(3.61)	(32.76)	(-7.93)	(0.48)		
Nov-97	7.40	-0.02	0.09	0.02	-1.10E-03	1.99E-03	277	0.78
	(48.35)	(-4.94)	(2.37)	(26.66)	(-5.73)	(0.94)		
Dec-97	7.55	-0.02	0.09	0.02	-1.46E-03	-2.75E-03	248	0.75
	(51.62)	(-5.41)	(1.91)	(22.63)	(-7.58)	(-1.20)		
Jan-98	7.79	-0.03	0.09	0.02	-1.41E-03	-4.76E-03	248	0.78
	(49.82)	(-7.06)	(2.02)	(24.75)	(-7.17)	(-2.16)		
Feb-98	7.63	-0.02	0.11	0.02	-1.24E-03	1.24E-03	316	0.78
	(54.10)	(-6.86)	(3.06)	(26.29)	(-6.83)	(0.62)		

Table B-2. OLS regression results (Cont.)
Dependent variable: Log(transaction price)

Month	intercept	Access	CBD	Size	Age of building (months)	Inverse Mill's ratio	N	R^2
Mar-98	7.58	-0.02	0.06	0.02	-1.38E-03	-3.97E-04	315	0.79
	(56.36)	(-5.95)	(1.49)	(30.48)	(-8.30)	(-0.21)		
Apr-98	7.44	-0.02	0.10	0.02	-1.31E-03	-3.97E-04	343	0.77
	(56.83)	(-5.70)	(2.83)	(30.24)	(-7.75)	(-0.19)		
May-98	7.62	-0.02	0.02	0.02	-1.36E-03	3.02E-04	317	0.77
	(58.26)	(-6.06)	(0.55)	(27.83)	(-8.36)	(0.16)		
Jun-98	7.54	-0.02	0.08	0.02	-1.14E-03	-2.87E-04	276	0.77
	(50.32)	(-5.47)	(2.00)	(26.00)	(-6.40)	(-0.13)		
Jul-98	7.47	-0.02	0.09	0.02	-1.41E-03	-1.18E-03	335	0.80
	(52.18)	(-5.46)	(2.49)	(33.00)	(-7.87)	(-0.56)		
Aug-98	7.73	-0.02	0.07	0.02	-1.53E-03	-4.28E-03	209	0.74
	(46.30)	(-4.70)	(1.55)	(20.26)	(-7.88)	(-1.80)		
Sep-98	7.57	-0.02	0.06	0.02	-1.36E-03	5.92E-04	267	0.80
	(54.46)	(-6.49)	(1.38)	(25.43)	(-8.90)	(0.28)		
Oct-98	7.55	-0.02	0.10	0.02	-1.20E-03	-1.86E-04	358	0.79
	(65.21)	(-7.08)	(2.98)	(29.59)	(-8.68)	(-0.10)		
Nov-98	7.37	-0.02	0.06	0.02	-1.20E-03	6.52E-04	296	0.79
	(49.60)	(-4.31)	(1.55)	(28.15)	(-7.28)	(0.30)		
Dec-98	7.53	-0.02	0.11	0.02	-1.47E-03	1.87E-03	308	0.80
	(50.54)	(-6.29)	(3.06)	(29.06)	(-9.01)	(0.84)		
Jan-99	7.24	-0.01	0.07	0.02	-1.27E-03	2.00E-03	275	0.84
	(53.83)	(-4.29)	(1.90)	(33.54)	(-7.94)	(0.92)		
Feb-99	7.55	-0.02	0.17	0.02	-1.47E-03	-2.16E-03	415	0.74
	(61.63)	(-5.69)	(4.97)	(30.35)	(-10.24)	(-1.20)		
Mar-99	7.85	-0.03	0.13	0.02	-1.73E-03	-3.80E-03	336	0.79
	(64.04)	(-8.61)	(3.47)	(28.59)	(-12.59)	(-2.00)		
Apr-99	7.39	-0.01	0.09	0.02	-1.45E-03	2.13E-03	383	0.78
	(53.78)	(-4.11)	(2.51)	(31.98)	(-9.28)	(1.08)		
May-99	7.39	-0.02	0.08	0.02	-1.43E-03	3.04E-03	322	0.80
	(54.62)	(-4.48)	(2.14)	(29.29)	(-9.31)	(1.46)		
Jun-99	7.44	-0.02	0.12	0.02	-1.47E-03	2.64E-03	334	0.76
	(55.66)	(-4.83)	(3.05)	(26.06)	(-9.81)	(1.27)		
Jul-99	7.63	-0.03	0.08	0.02	-1.66E-03	5.33E-04	364	0.79
	(53.83)	(-7.13)	(2.34)	(30.79)	(-11.00)	(0.26)		
Aug-99	7.19	-0.01	0.10	0.02	-1.25E-03	6.75E-03	211	0.79
	(38.74)	(-2.34)	(1.88)	(22.10)	(-5.93)	(2.43)		
Sep-99	7.53	-0.01	0.13	0.02	-1.62E-03	-1.86E-03	384	0.79
	(59.26)	(-4.63)	(4.01)	(30.73)	(-12.60)	(-0.99)		
Oct-99	7.62	-0.02	0.09	0.02	-1.47E-03	-1.08E-03	274	0.77
	(49.63)	(-6.09)	(2.26)	(25.14)	(-8.86)	(-0.48)		
Nov-99	7.51	-0.02	0.09	0.02	-1.33E-03	1.78E-03	334	0.80
	(53.39)	(-6.19)	(2.46)	(28.71)	(-8.77)	(0.80)		
Dec-99	7.36	-0.02	0.12	0.02	-1.22E-03	4.29E-03	311	0.73
	(49.76)	(-4.26)	(2.79)	(24.63)	(-7.00)	(1.92)		
Jan-00	7.57	-0.02	0.06	0.02	-1.66E-03	1.35E-03	291	0.75
	(55.94)	(-4.83)	(1.37)	(23.36)	(-10.43)	(0.64)		
Feb-00	7.44	-0.02	0.11	0.02	-1.45E-03	2.96E-03	364	0.75
	(55.39)	(-5.32)	(3.12)	(26.88)	(-10.04)	(1.46)		
Mar-00	7.79	-0.02	0.14	0.02	-1.71E-03	-1.51E-03	508	0.72
	(59.48)	(-6.78)	(4.07)	(29.86)	(-12.70)	(-0.79)		
Apr-00	7.35	-0.02	0.10	0.02	-1.37E-03	3.18E-03	338	0.79
	(50.60)	(-4.79)	(2.59)	(27.47)	(-8.87)	(1.44)		

Table B-2. OLS regression results (Cont.)
Dependent variable: Log(transaction price)

Month	intercept	Access	CBD	Size	Age of building (months)	Inverse Mill's ratio	N	R^2
May-00	7.90	-0.03	0.05	0.02	-1.66E-03	-4.22E-03	373	0.76
	(52.88)	(-7.96)	(1.14)	(28.99)	(-10.04)	(-1.94)		
Jun-00	7.46	-0.02	0.16	0.02	-1.55E-03	-1.61E-03	407	0.75
	(59.16)	(-5.50)	(4.40)	(29.02)	(-10.43)	(-0.78)		
Jul-00	7.57	-0.02	0.14	0.02	-1.68E-03	7.97E-05	244	0.81
	(46.51)	(-5.16)	(3.35)	(23.02)	(-10.63)	(0.03)		
Aug-00	7.92	-0.03	0.07	0.02	-1.54E-03	-1.80E-03	368	0.77
	(61.74)	(-10.14)	(2.05)	(29.43)	(-11.15)	(-0.88)		
Sep-00	7.66	-0.02	0.09	0.02	-1.58E-03	7.27E-06	280	0.74
	(47.54)	(-5.90)	(2.14)	(20.53)	(-9.61)	(0.00)		
Oct-00	7.51	-0.02	0.09	0.02	-1.09E-03	1.78E-03	372	0.75
	(51.47)	(-6.37)	(2.44)	(28.88)	(-6.77)	(0.83)		
Nov-00	7.67	-0.03	0.09	0.02	-1.52E-03	-2.47E-04	423	0.76
	(57.23)	(-7.13)	(2.30)	(29.85)	(-10.74)	(-0.12)		
Dec-00	7.73	-0.03	0.08	0.02	-1.61E-03	-2.09E-04	306	0.73
	(46.87)	(-6.59)	(1.77)	(23.14)	(-9.19)	(-0.08)		
Jan-01	7.45	-0.02	0.11	0.02	-1.25E-03	8.08E-04	454	0.72
	(54.24)	(-6.39)	(3.03)	(29.42)	(-8.57)	(0.39)		
Feb-01	7.50	-0.02	0.15	0.02	-1.33E-03	9.40E-04	469	0.71
	(56.82)	(-6.31)	(4.15)	(26.87)	(-9.86)	(0.48)		
Mar-01	7.73	-0.02	0.12	0.02	-1.72E-03	-1.62E-03	463	0.77
	(64.28)	(-8.10)	(3.68)	(31.93)	(-12.87)	(-0.88)		
Apr-01	7.52	-0.02	0.12	0.02	-1.30E-03	4.24E-04	451	0.73
	(60.40)	(-7.03)	(3.62)	(29.58)	(-9.29)	(0.22)		
May-01	7.48	-0.02	0.15	0.02	-1.18E-03	1.09E-03	485	0.74
	(60.97)	(-7.06)	(4.99)	(30.75)	(-8.92)	(0.54)		
Jun-01	7.74	-0.02	0.15	0.02	-1.58E-03	-4.26E-03	446	0.77
	(64.24)	(-8.30)	(4.49)	(31.74)	(-11.89)	(-2.22)		
Jul-01	7.61	-0.02	0.13	0.02	-1.62E-03	-5.08E-04	321	0.73
	(46.03)	(-4.98)	(3.19)	(23.52)	(-10.05)	(-0.20)		
Aug-01	7.77	-0.02	0.14	0.02	-1.66E-03	-3.98E-03	462	0.74
	(61.23)	(-7.38)	(4.19)	(28.75)	(-12.28)	(-2.01)		
Sep-01	7.66	-0.03	0.10	0.02	-1.28E-03	1.27E-04	446	0.75
	(55.03)	(-8.21)	(2.77)	(30.17)	(-9.01)	(0.06)		
Oct-01	7.55	-0.02	0.13	0.02	-1.38E-03	1.27E-03	524	0.78
	(62.36)	(-7.91)	(4.16)	(36.75)	(-11.09)	(0.68)		
Nov-01	7.68	-0.03	0.18	0.02	-1.36E-03	-1.01E-03	413	0.75
	(58.30)	(-7.77)	(5.39)	(26.71)	(-10.70)	(-0.48)		
Dec-01	7.91	-0.03	0.09	0.02	-1.70E-03	-3.14E-03	391	0.75
	(53.83)	(-8.20)	(2.27)	(26.29)	(-11.45)	(-1.37)		
Jan-02	7.92	-0.03	0.07	0.02	-1.68E-03	-4.77E-03	376	0.74
	(55.80)	(-8.01)	(1.91)	(26.71)	(-11.89)	(-2.07)		
Feb-02	7.51	-0.02	0.15	0.02	-1.24E-03	7.67E-04	508	0.76
	(61.27)	(-6.99)	(4.65)	(33.08)	(-10.07)	(0.41)		
Mar-02	7.78	-0.03	0.07	0.02	-1.48E-03	-2.47E-03	479	0.78
	(61.71)	(-9.60)	(2.10)	(32.87)	(-11.95)	(-1.22)		
Apr-02	7.97	-0.03	0.08	0.02	-1.55E-03	-5.70E-03	432	0.77
	(63.94)	(-10.02)	(2.36)	(32.34)	(-12.45)	(-2.82)		
May-02	7.73	-0.03	0.03	0.02	-1.30E-03	1.31E-03	435	0.77
	(58.58)	(-9.12)	(0.87)	(28.46)	(-10.03)	(0.61)		
Jun-02	7.84	-0.03	0.15	0.02	-1.50E-03	-3.67E-03	415	0.75
	(55.82)	(-8.03)	(4.47)	(29.59)	(-10.77)	(-1.60)		

Acknowledgements:

This research was supported in part by the John Randolph Haynes and Dora Haynes Foundation. Earlier versions were presented at the Tsinghua University, National University of Singapore, and University of Southern California Symposium on Real Estate Research, Beijing, China, March 2006, and at the Annual Meetings of the American Real Estate and Urban Economics Association, Chicago, January 2007. A substantial part of this study was completed before Nishimura joined the Policy Board of the Bank of Japan. The authors are grateful to Yuming Fu and Charles Ka Yui Leung for helpful comments and suggestions.

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Figure 1. Recruit residential (condominium) price index: Tokyo special district (2000=1.00) 1992-2002

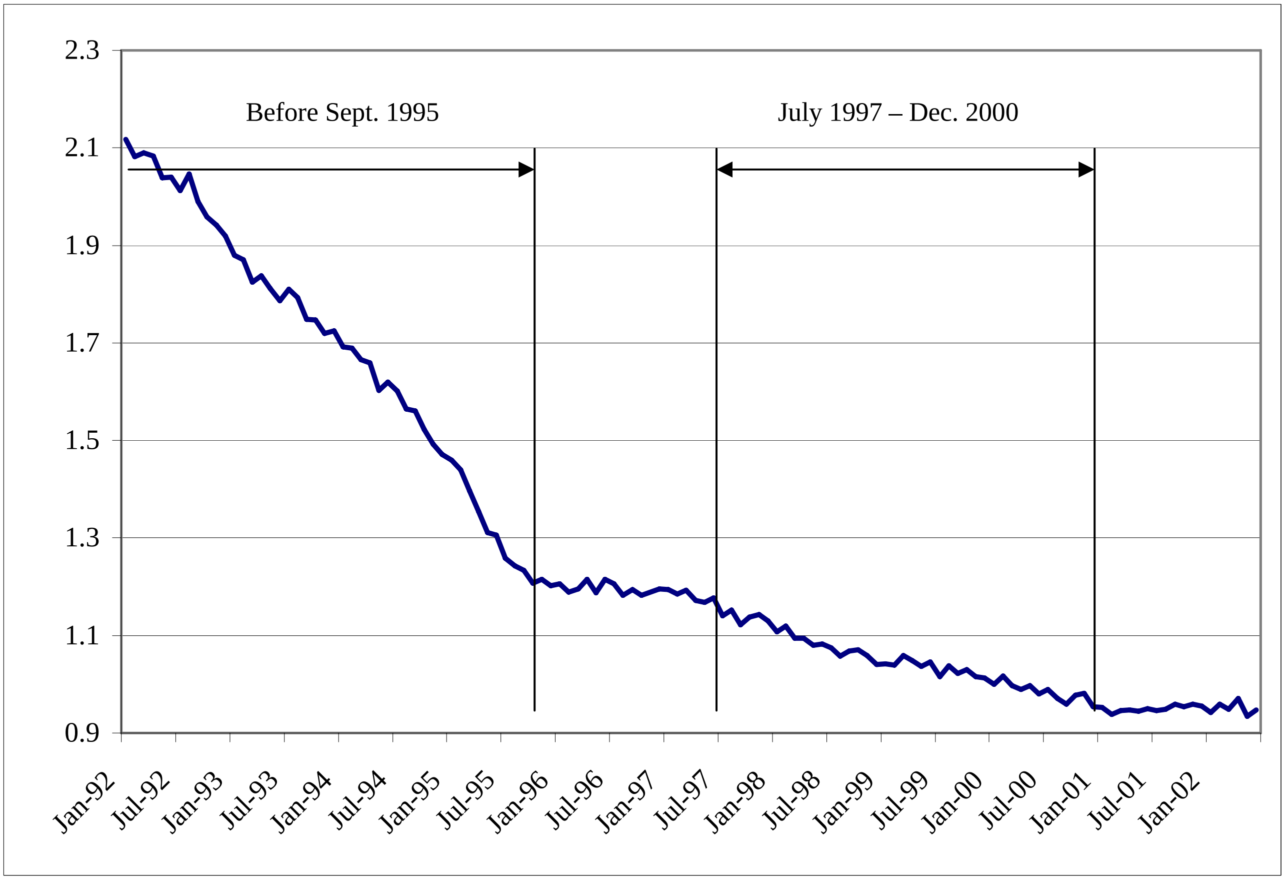
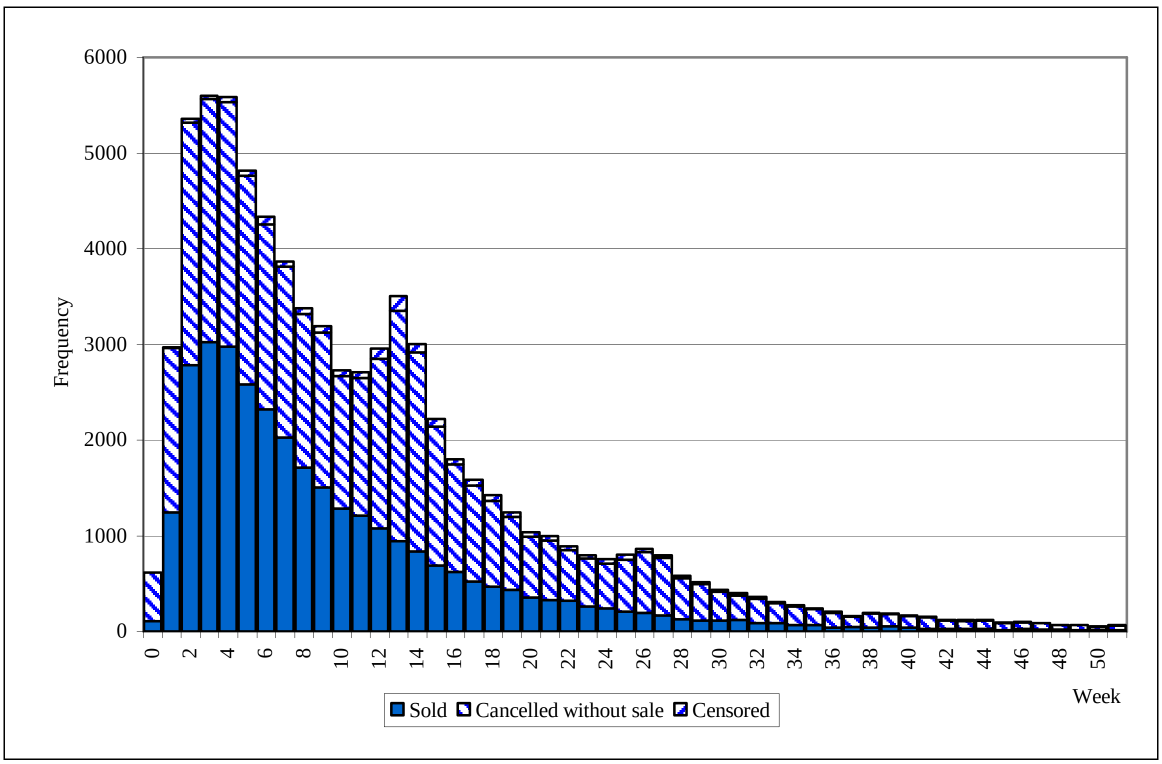


Table 1. Property Listing and delisting –annual counts

year	Units listed	Units de-listed	Units sold	Average initial list price (10 thousand yen, 2000)	Average time on the market (week)
1994	9,435	7,096	3,033	3,866	13.21
1995	8,513	8,909	3,848	3,343	12.75
1996	9,841	9,296	4,385	3,295	12.31
1997	10,634	10,347	4,128	3,234	13.05
1998	10,518	10,430	3,886	3,180	13.15
1999	11,004	11,081	4,325	3,081	12.57
2000	11,887	11,587	4,692	3,087	12.56
2001	12,916	13,572	5,836	3,091	11.79
2002	6,289	6,234	2,977	3,273	7.36

Note: Statistics for 2002 end on June.

Figure 2. Properties' time on the market, by status



Notes: This chart is limited to units remaining in the market up to 52 weeks.

Table 2. Mean and Std. deviation of selected continuous variables

	All	Sold	Cancelled without sale	Other
No. of weeks on market	12.8	10.7	14.5	9.3
	(10.7)	(8.8)	(11.7)	(9.6)
Initial list price (10 thousand yen)	3,258	3,094	3,368	3,458
	(1,631)	(1,504)	(1,693)	(1,907)
Delisting price (10 thousand yen)	3,171	3,012	3,286	
	(1,576)	(1,458)	(1,646)	
Transaction price dispersion in the submarket to which the condo belongs*	1,011	989	1,024	1,060
	(275)	(263)	(281)	(307)
No. of months after construction when listed	186	189	184	186
	(94)	(92)	(95)	(116)
Average travel time to 40 busiest stations	24.9	25.2	24.7	24.6
	(4.9)	(4.9)	(5.0)	(4.8)
Size (square meters)	59.2	58.6	59.3	65.3
	(19.9)	(18.9)	(20.5)	(22.0)
No. of observations	83,165	34,129	46,843	2,193

Note: Standard deviations are in parenthesis.

* "Transaction price dispersion of the submarket to which the condo belongs" is proxy of buyer offer price dispersion in the corresponding submarket, serving as one of the market's characteristics.

Table 3. Mean and Std. deviation of selected time varying covariates

(a) At initial listing

	All	Sold	Cancelled without sale	Other
Japanese Nikkei 225 index	16,651	16,736	16,846	11,160
	(3,240)	(3,251)	(3,078)	(484)
Average monthly household income (2000 yen)	481,202	481,382	481,939	462,654
	(9,653)	(9,465)	(9,129)	(1,802)
Recruit residential (condominium) price index: Tokyo special district (23 wards)	1.117	1.120	1.124	0.926
	(0.18)	(0.18)	(0.18)	(0.01)
No. of observations	83,165	34,129	46,843	2,193

(b) At delisting

	All	Sold	Cancelled without sale	Other
Japanese Nikkei 225 index	16,362	16,522	16,497	10,966
	(3,339)	(3,360)	(3,188)	
Average monthly household income (2000 yen)	480,520	480,854	481,134	462,207
	(10,074)	(9,918)	(9,610)	
Recruit residential (condominium) price index: Tokyo special district (23 wards)	1.114	1.120	1.118	0.947
	(0.18)	(0.18)	(0.18)	
No. of observations	83,165	34,129	46,843	2,193

Note: Standard deviations are in parenthesis.

Table 4. Frequency of selected discrete variables

	All	Sold	Cancelled without sale	Other
Area				
Area I - Central Business	22,814	8,241	13,888	685
	(27.4)	(36.1)	(60.9)	(3.0)
Area II - Southwest	36,710	14,987	20,765	958
	(44.1)	(40.8)	(56.6)	(2.6)
Area III - Northeast	23,641	10,901	12,190	550
	(28.4)	(46.1)	(51.6)	(2.3)
Train station within walking distance	82,040	33,595	46,286	2,159
	(98.6)	(40.9)	(56.4)	(2.6)
Ever adjust list price	28,173	11,270	14,710	2,193
	(33.9)	(40.0)	(52.2)	(7.8)
Ever adjust list price - increase	581	273	308	0
	(0.7)	(47.0)	(53.0)	(0.0)
Ever adjust list price - decrease	27,592	10,997	14,402	2,193
	(33.2)	(39.9)	(52.2)	(7.9)
Thick market	76,990	31,723	43,293	1,974
	(92.6)	(41.2)	(56.2)	(2.6)
Real estate agent category				
Big	51,864	19,076	31,383	1,405
	(62.4)	(36.8)	(60.5)	(2.7)
Middle	15,247	7,283	7,623	341
	(18.3)	(47.8)	(50.0)	(2.2)
Small	16,054	7,770	7,837	447
	(19.3)	(48.4)	(48.8)	(2.8)
Delisting season				
Spring	22,043	9,320	12,634	89
	(26.5)	(42.3)	(57.3)	(0.4)
Summer	21,572	9,253	12,281	38
	(25.9)	(42.9)	(56.9)	(0.2)
Fall	19,705	7,294	10,793	1,618
	(23.7)	(37.0)	(54.8)	(8.2)
Winter	19,845	8,262	11,135	448
	(23.9)	(41.6)	(56.1)	(2.3)
Size (square meter)				
Less than 25sq.m.	2,469	856	1,573	40
	(3.0)	(34.7)	(63.7)	(1.6)
25-85sq.m.	73,318	30,661	40,834	1,823
	(88.2)	(41.8)	(55.7)	(2.5)
More than 85sq.m.	7,378	2,612	4,436	330
	(8.9)	(35.4)	(60.1)	(4.5)
Structure age				
1-4 years	8,081	2,728	5,013	340
	(9.7)	(33.8)	(62.0)	(4.2)
4-10 years	13,495	5,436	7,593	466
	(16.2)	(40.3)	(56.3)	(3.5)
10-22 years	44,454	18,881	24,799	774
	(53.5)	(42.5)	(55.8)	(1.7)
More than 22 years	17,135	7,084	9,438	613
	(20.6)	(41.3)	(55.1)	(3.6)
No. of observations	83,165	34,129	46,843	2,193

Note: Column percentages are in parenthesis for "all" in column 1; row percentages by "sold", "cancelled without sale", and "other "are in parenthesis in column 2-4.

Table 5. OLS regressions on price for the full sample

(a) Dependent variable – logarithm of list price, at initial listing

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
intercept	0.10	-0.77	-0.82	-0.81	-0.78	-0.75	-0.75
	(7.16)	(-44.44)	(-47.24)	(-46.51)	(-44.63)	(-42.22)	(-41.04)
Logarithm of estimated market value at listing	0.99	0.90	0.92	0.92	0.91	0.91	0.91
	(541.79)	(444.82)	(425.98)	(424.57)	(421.83)	(402.52)	(402.06)
Logarithm of transaction price dispersion of the submarket to which the condo belongs		0.23	0.21	0.21	0.21	0.22	0.22
		(85.71)	(74.94)	(75.18)	(75.33)	(75.38)	(75.24)
Thick market			0.06	0.06	0.06	0.06	0.06
			(21.14)	(20.88)	(20.49)	(19.41)	(19.41)
Ever adjust list price				0.03	0.03	0.03	0.03
				(20.97)	(20.02)	(20.65)	(20.67)
Middle size agent					-0.01	-0.02	-0.02
					(-7.69)	(-7.87)	(-7.88)
Small size agent					-0.03	-0.03	-0.03
					(-14.31)	(-14.23)	(-14.22)
De-list year							
1995						-0.03	-0.03
						(-7.70)	(-7.57)
1996						-0.01	-0.01
						(-2.71)	(-2.22)
1997						-0.01	-0.01
						(-3.61)	(-2.02)
1998						-0.02	-0.02
						(-7.21)	(-2.90)
1999						-0.03	-0.03
						(-9.94)	(-4.12)
2000						-0.03	-0.02
						(-7.92)	(-3.19)
2001						-0.03	-0.03
						(-7.73)	(-4.94)
2002						-0.03	-0.03
						(-8.04)	(-5.38)
Logarithm of transaction price dispersion × Period: Jan. 1994 - Sept. 1995							-0.0006
							(-0.82)
Logarithm of transaction price dispersion × Period: July 1997 – Dec. 2000							-0.0010
							(-1.68)
R square	0.779	0.797	0.798	0.799	0.800	0.800	0.800
Number of observations	83,165	83,165	83,165	83,165	83,165	83,165	83,165

Note: t-statistics are in parenthesis.

(b) Dependent variable – logarithm of list price, at delisting (transaction price for sold as well as delisting price for withdrawn)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
intercept	0.13	-0.75	-0.81	-0.82	-0.80	-0.77	-0.77
	(8.59)	(-42.70)	(-45.40)	(-46.54)	(-44.79)	(-42.61)	(-41.23)
Logarithm of Logarithm of estimated market value at delisting	0.99	0.90	0.91	0.92	0.92	0.91	0.91
	(528.07)	(434.47)	(416.09)	(418.61)	(415.85)	(396.67)	(396.36)
Logarithm of transaction price dispersion of the submarket to which the condo belongs		0.23	0.21	0.21	0.21	0.21	0.22
		(84.73)	(74.10)	(74.24)	(74.38)	(73.81)	(73.68)
Thick market			0.06	0.06	0.06	0.06	0.06
			(20.56)	(21.14)	(20.78)	(20.00)	(20.01)
Ever adjust list price				-0.04	-0.04	-0.04	-0.04
				(-25.98)	(-26.86)	(-26.31)	(-26.26)
Middle size agent					-0.01	-0.01	-0.01
					(-6.82)	(-6.99)	(-6.99)
Small size agent					-0.03	-0.03	-0.03
					(-13.25)	(-13.18)	(-13.17)
De-list year							
1995						-0.03	-0.03
						(-8.74)	(-8.66)
1996						-0.01	-0.01
						(-2.24)	(-2.34)
1997						-0.01	-0.01
						(-2.70)	(-1.93)
1998						-0.02	-0.02
						(-6.46)	(-2.89)
1999						-0.03	-0.03
						(-8.97)	(-3.99)
2000						-0.02	-0.02
						(-6.91)	(-3.06)
2001						-0.02	-0.03
						(-6.61)	(-4.64)
2002						-0.02	-0.03
						(-5.38)	(-4.27)
Logarithm of transaction price dispersion × Period: Jan. 1994 - Sept. 1995							-0.0010
							(-1.33)
Logarithm of transaction price dispersion × Period: July 1997 – Dec. 2000							-0.0010
							(-1.69)
R square	0.775	0.793	0.794	0.796	0.797	0.797	0.797
Number of observations	80,972	80,972	80,972	80,972	80,972	80,972	80,972

Note: t-statistics are in parenthesis.

Table 6. OLS regressions on price for the sold units

(a) Dependent variable – logarithm of list price, at initial listing

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
intercept	0.09	-0.85	-0.92	-0.90	-0.90	-0.86	-0.86
	(3.84)	(-31.24)	(-33.52)	(-32.75)	(-32.55)	(-30.39)	(-29.46)
Logarithm of Logarithm of estimated market value at listing	0.99	0.90	0.92	0.92	0.92	0.91	0.91
	(343.62)	(288.57)	(277.66)	(276.09)	(273.80)	(258.97)	(258.87)
Logarithm of transaction price dispersion of the submarket to which the condo belongs		0.24	0.22	0.22	0.22	0.22	0.22
		(57.57)	(50.84)	(51.25)	(51.33)	(51.23)	(51.25)
Thick market			0.07	0.07	0.07	0.07	0.07
			(15.44)	(15.04)	(14.96)	(14.30)	(14.32)
Ever adjust list price				0.04	0.04	0.04	0.04
				(16.86)	(16.81)	(17.14)	(17.21)
Middle size agent					0.01	0.01	0.01
					(2.74)	(2.48)	(2.49)
Small size agent					0.00	0.00	0.00
					(-0.79)	(-1.02)	(-1.01)
De-list year							
1995						-0.04	-0.04
						(-7.04)	(-7.20)
1996						-0.02	-0.03
						(-3.40)	(-3.40)
1997						-0.02	-0.03
						(-3.48)	(-2.64)
1998						-0.03	-0.03
						(-5.13)	(-2.40)
1999						-0.03	-0.03
						(-5.96)	(-2.75)
2000						-0.03	-0.03
						(-6.13)	(-2.81)
2001						-0.03	-0.04
						(-6.23)	(-4.93)
2002						-0.02	-0.03
						(-3.63)	(-3.63)
Logarithm of transaction price dispersion × Period: Jan. 1994 - Sept. 1995							-0.002
							(-1.81)
Logarithm of transaction price dispersion × Period: July 1997 – Dec. 2000							-0.002
							(-2.03)
R square	0.776	0.796	0.797	0.799	0.799	0.799	0.799
Number of observations	34,129	34,129	34,129	34,129	34,129	34,129	34,129

Note: t-statistics are in parenthesis.

(b) Dependent variable – logarithm of list price, at delisting (transaction price)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
intercept	0.12	-0.83	-0.90	-0.92	-0.92	-0.89	-0.88
	(5.36)	(-30.20)	(-32.31)	(-33.14)	(-33.02)	(-31.00)	(-29.96)
Logarithm of Logarithm of estimated market value at delisting	0.98	0.90	0.91	0.92	0.92	0.91	0.91
	(339.11)	(284.48)	(273.35)	(274.57)	(272.35)	(257.90)	(257.82)
Logarithm of transaction price dispersion of the submarket to which the condo belongs		0.24	0.22	0.22	0.22	0.22	0.23
		(57.97)	(51.49)	(51.51)	(51.58)	(51.18)	(51.20)
Thick market			0.07	0.07	0.07	0.07	0.07
			(14.44)	(14.88)	(14.83)	(14.34)	(14.37)
Ever adjust list price				-0.04	-0.04	-0.04	-0.03
				(-15.31)	(-15.26)	(-14.87)	(-14.78)
Middle size agent					0.01	0.01	0.01
					(3.07)	(2.82)	(2.84)
Small size agent					-5.27E-04	-1.07E-03	-1.03E-03
					(-0.19)	(-0.38)	(-0.37)
De-list year							
1995						-0.04	-0.05
						(-7.96)	(-8.23)
1996						-0.02	-0.03
						(-3.18)	(-3.65)
1997						-0.02	-0.03
						(-2.94)	(-2.73)
1998						-0.03	-0.03
						(-4.89)	(-2.65)
1999						-0.03	-0.03
						(-5.42)	(-2.87)
2000						-0.03	-0.03
						(-5.69)	(-2.97)
2001						-0.03	-0.04
						(-5.73)	(-5.04)
2002						-0.02	-0.03
						(-2.75)	(-3.46)
Logarithm of transaction price dispersion × Period: Jan. 1994 - Sept. 1995							-0.0025
							(-2.26)
Logarithm of transaction price dispersion × Period: July 1997 – Dec. 2000							-0.0018
							(-1.93)
R square	0.771	0.792	0.793	0.794	0.794	0.795	0.795
Number of observations	34,129	34,129	34,129	34,129	34,129	34,129	34,129

Note: t-statistics are in parenthesis.

Table 7. Time on the market: proportional hazard models

Dependent variable: number of weeks in the market

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Logarithm of list price	-0.30	-0.50	-0.46	-0.42	-0.41	-0.41
	(-20.08)	(-26.74)	(-23.39)	(-20.99)	(-20.70)	(-20.80)
List price/hedonic price	-0.52	-0.42	-0.46	-0.44	-0.43	-0.43
	(-19.46)	(-15.21)	(-15.92)	(-15.42)	(-15.11)	(-15.09)
Logarithm of transaction price dispersion of the submarket to which the condo belongs	0.05	0.08	0.05	0.03	0.04	0.04
	(2.47)	(4.23)	(2.45)	(1.66)	(1.87)	(2.04)
Units above 46.4 sq.m. × Logarithm of transaction price dispersion - submarket		0.04	0.04	0.05	0.05	0.05
		(18.27)	(17.26)	(19.87)	(19.91)	(19.98)
Thick market			0.11	0.14	0.13	0.13
			(4.76)	(5.85)	(5.71)	(5.63)
Ever adjust list price				-0.70	-0.69	-0.68
				(-58.57)	(-57.45)	(-56.77)
Middle size agent					0.18	0.18
					(13.07)	(12.93)
Small size agent					0.08	0.09
					(6.13)	(6.28)
De-list month						
February						0.28
						(10.61)
March						0.38
						(14.40)
April						0.31
						(11.53)
May						0.30
						(10.93)
June						0.36
						(13.33)
July						0.23
						(8.20)
August						0.17
						(5.88)
September						0.18
						(6.52)
October						0.27
						(10.13)
November						0.33
						(11.97)
December						0.25
						(8.64)
-Log (likelihood)	359,322	359,152	359,141	357,327	357,240	357,078
SBC	359,325	359,156	359,146	357,333	357,248	357,097

Table 7. Time on the market: proportional hazard models (Cont.)
Dependent variable: number of weeks in the market

	Model 7	Model 8	Model 9
Logarithm of list price	-0.56	-0.43	-0.43
	(-25.77)	(-19.76)	(-19.48)
List price/hedonic price	-0.34	-0.40	-0.41
	(-11.57)	(-13.81)	(-13.90)
Logarithm of transaction price dispersion of the submarket to which the condo belongs	0.15	0.06	0.02
	(6.74)	(2.76)	(0.58)
Units above 46.4 sq.m. × Logarithm of transaction price dispersion - submarket	0.06	0.05	0.05
	(23.93)	(18.83)	(18.48)
Thick market	0.08	0.13	0.11
	(3.51)	(5.45)	(4.87)
Ever adjust list price	-0.68	-0.68	-0.68
	(-56.69)	(-56.68)	(-56.69)
Size of real estate agent			
Middle size agent	0.18	0.18	0.18
	(12.69)	(13.04)	(12.98)
Small size agent	0.08	0.08	0.08
	(5.61)	(5.50)	(5.57)
De-list month			
February	0.29	0.31	0.31
	(10.74)	(11.54)	(11.56)
March	0.38	0.40	0.40
	(14.34)	(15.03)	(15.04)
April	0.31	0.32	0.32
	(11.38)	(11.99)	(11.99)
May	0.29	0.29	0.29
	(10.54)	(10.70)	(10.72)
June	0.33	0.34	0.34
	(12.26)	(12.60)	(12.58)
July	0.22	0.26	0.26
	(7.55)	(9.06)	(9.10)
August	0.15	0.16	0.16
	(5.00)	(5.47)	(5.46)
September	0.15	0.18	0.18
	(5.35)	(6.21)	(6.22)
October	0.25	0.34	0.34
	(9.04)	(12.54)	(12.55)
November	0.30	0.39	0.39
	(10.76)	(14.13)	(14.16)

	Model 7	Model 8	Model 9
December	0.22	0.31	0.31
	(7.63)	(10.68)	(10.66)
De-list year			
1995	-0.28		
	(-11.04)		
1996	-0.15		
	(-5.80)		
1997	-0.40		
	(-15.48)		
1998	-0.54		
	(-20.65)		
1999	-0.49		
	(-18.99)		
2000	-0.44		
	(-16.96)		
2001	-0.38		
	(-15.08)		
2002	-0.31		
	(-10.30)		
Macro and housing market indicators			
Logarithm of Nikkei 225 Index		0.26	0.26
		(6.10)	(6.12)
Logarithm of average monthly household income (2000 yen)		1.77	1.71
		(3.81)	(3.68)
Recruit residential condominium price index: Tokyo special district (23 wards)		-1.32	-1.32
		(-13.76)	(-13.76)
Sub-periods			
Period: Jan. 1994 - Sept. 1995		0.56	-1.47
		(15.61)	(-4.42)
Period: July 1997 – Dec. 2000		-0.25	-0.13
		(-18.48)	(-0.52)
Interaction with *Logarithm of transaction price dispersion*			
Period Jan. 1994 - Sept. 1995			0.30
			(6.15)
Period: July 1997 – Dec. 2000			-0.02
			(-0.49)
-Log (likelihood)	356,730	356,752	356,729
SBC	356,757	356,776	356,755

Note: t-statistics are in parenthesis.