Intra-metropolitan office price and trading volume dynamics: Evidence from Hong Kong[♣]

Charles Ka Yui Leung, Patrick Wai Yin Cheung
and Erica Jiajia Ding[♦]

This version: January 2008

Abstract

Previous studies on the office market tend to focus on either the rental market or the aggregate sale market. This paper focuses on the intra-metropolitan sale market and the office price and trading volume dynamics in Hong Kong. Buildings with higher prices are not necessarily being traded more. Office prices of different categories do not necessarily move together. On the other hand, the trading volumes of the higher class tend to Granger cause the lower class, and this conclusion is robust to alternative classifications. It is in contrast to several existing theories and directions for future research are discussed.

JEL Classification Number: G11,G120, R00
Key Words: Commercial Property, Correlation

[♣] Acknowledgement: The authors are very grateful to Paul Anglin, Yuming Fu, Francois Ortalo-Magne, S. E. Ong, and the seminar participants of Chinese University of Hong Kong, Tsinghua University MBA class, NUS-HKU Symposium on Real Estate Research, for comments and discussion, Nelson Lee for capable research assistance, and City University of Hong Kong (Project No. 7200076) for financial support. The usual disclaimer applies.
[♦] Correspondence: Leung, Department of Economics and Finance, City University of Hong Kong, Kowloon Tong, Hong Kong; (email): kycleung@cityu.edu.hk

1. Introduction

This paper studies the sale market of office within a metropolitan area. While the studies on intra-metropolitan residential property prices are voluminous, the office counterpart seems to be significantly smaller.[1] Many studies tend to use city/ national-level (among others, see Eppli, Shilling and Vandell, 1998; Sivitanidou and Sivitanides, 2000; Wheaton, 1987; Wheaton and Torto, 1988; Wheaton, Torto and Evans, 1997).[2] Moreover, previous studies on the office market disproportionally emphasizes on the rental market (among others, see Sivitanidou and Sivitanides, 1999, 2000; Sivitanidou 2002 and the reference therein). It may be partly due to the fact that the rental market dominates in the United States.

For other countries, parallel studies may be difficult. First, the rental market may not dominate. Second, the needed information for rental market studies may not be accessible. For instance, "side deals", such as rent-free period, inclusion of management fee, inclusion of utility, contract-completion rebate, conditional renewal agreement, etc., are very common in the Hong Kong office rental market.[3] These side deals also vary across firms and over time. Unfortunately, the information of "side deals" are not publicly available in Hong Kong. Moreover, some commercial property rental contracts are quite long, up to 3 to 5 years. Thus, the data set needs to cover a rather long period so that contract renewals can be observed in the data. While such time series are available for the United States market, it is a big challenge to many other countries.

[1] The literature on residential property price is too large to be reviewed here. Among others, see Chau et al. (2004), Englund, Quigley and Redfearn (1998), Hwang and Quigley (2004).

[2] Needless to say, there are also contract/loan level studies (among others, see Ambrose and Sanders, 2003; Fu, LaCour-Little and Vandell, 2003; Gunnelin and Soderberg, 2003; Patel and Sing, 2000). Again, such detailed dataset is not common, making related and follow-up studies very difficult.

[3] We confirm this statement with industry participants, who are unwilling to disclose their identities.

Given all these limitations, this paper instead focuses on the sale market of office. [4] In particular, this paper will study the intra-metropolitan office price and trading volume dynamics. It is an issue important because several existing theories of property market do carry implications on the dynamics of price and trading volume. As it will be clear, some refinements on the existing theories will be needed. The study on the sale market of office may indeed be a promising approach, especially for cross-country comparison, as sale information are usually recorded by the governments for tax and other purposes. While it is clear that a survey of the literature is beyond the scope of this paper, we nevertheless tabulate our literature review in the appendix I to facilitate the comparison. It suffices to say that this paper has substantial differentiation with the existing literature in terms of the dataset, the focus and the results.

In terms of the research strategy, this paper will construct indices for different "classes" of office, based on *all* the information we can access, which is more than 24,000 transactions, from 601 office buildings.[5] Notice that a direct study of all 601 office buildings is virtually impossible. First, we will need to find some metrics to compare more than one thousand time series (each building has a time series of price as well as trading volume). Second, some buildings are less frequently traded than the others and it is possible that some "outliner transactions" may contaminate the dataset. Aggregating the office buildings into classes will "average out the noises". Thus, aggregating

[4] In terms of research ideas, this paper is also related to the "spatial-temporal approach" in the residential property literature, such as Tu et al (2004), and the reference therein. We consider the spatial dimension to be less important for commercial property, especially for a small geographical area like Hong Kong and we simply take office buildings as a given unit to start with.

[5] Notice that in principle, all the sale market transaction of office during the sample period should be included in the EPRC, the dataset we employ. Thus, it is very possible that our dataset already includes *all* the sale transactions of the office market in Hong Kong during the sampling period.
Notice also that these indices are transaction-based, and thus this paper is not subject to the appraisal-smoothing debate. See Geltner (1991), Lai and Wang (1998), among others.

the 601 office buildings into a much smaller number of classes seems to be a much preferred strategy (more discussion on this will be followed). This paper will focus on the following questions: (1) whether different classes of office in fact move together in terms of the transaction price and of the trading volume, (2) whether some particular class of office is driving the rest.

Clearly, these questions carry important implications. For instance, if the movements of different classes of office prices are very different, then the construction of a city-level price index may be subject to serious aggregation bias. [6] It may also mask the important intra-metropolitan dynamics among different classes of office.

Perhaps more importantly, the casualty relationship among different classes of office will shed light on the transmission mechanism of shock within the property market. To clarify this point further, it may be instructive to compare with the case of residential property. Ortalo-Magne and Rady (2004, 2006) have established that the causality goes from lower-priced units to the higher-priced ones, which is consistent with the collateral-based theory of property market price and trading volume fluctuations. Thus, if the firms have some "consumption motives" for office space, and they are also subject to collateral constraint as the households, we would expect that the causality will go from the lower-priced units to the higher-priced units. This is the first possible relationship between the lower and higher-priced units and will be late referred as the Hypothesis I.

However, firms may be different from households. They may face less severe financial constraint, and hence the collateral-based mechanism should be significantly weakened. [7] Moreover, the

[6] Among others, see Hanushek et al (1996) and the reference therein.
[7] Among others, see Leung and Feng (2005) on more discussion of this point.

"consumption motive" may not exist in office. Thus, the price of lower-priced units may not Granger cause the higher-priced counterpart. In fact, firms may want to "move down the ladder" by selling a higher-priced unit and move to a lower one (which need not be small ones) and keep some of the cash for other purposes. In that case, we would expect the causality in price and trading volume is from higher-price units to lower-priced units. This is the second possible relationship between the lower- and higher-priced units and will be late referred as the Hypothesis II.

Needless to say, if the capital market is perfect and the large units and that the lower-priced and higher-priced ones are perfect substitutes, we may expect the price of small and large units move together. This is the third possible relationship between the lower- and higher-priced units and will be late referred as the Hypothesis III.

There is a fourth possibility. If the information is incomplete, less-traded properties may have a difficulty to price their units and may be inclined to use the information from more-traded ones to adjust their price expectation.[8] Therefore, the price causality should go from the office buildings which are being more frequently traded to the less. Thus, we should divide the office buildings according to their trading volume (or, a proxy of the *liquidity*) rather than price. And we should observe the causality from the group with higher trading volumes to the ones with lower. This will be late referred as the Hypothesis IV.

In sum, the price dynamics and trading volume dynamics in the office market can be very different from that in the residential market.

[8] We have private correspondence with several market practicing professionals, and they all point to this "theory".

More importantly, they provide an indirect test of alternative theories of property market dynamics.[9] Table 1a summarizes our discussion.

(Table 1a about here)

One may suggest that we should instead classify the office buildings according to their location. Unfortunately, the office buildings in Hong Kong are very concentrated, especially the higher end. According to a research by the Jones, Long and LaSalle, Tsang (2005) estimates that 29% of the Grade A office space is in the Central District. The Wanchai/Causeway Bay District, which is right next to the Central, holds another 21%. The Hong Kong East District, which is right next to the Wanchai/Casueway Bay District, holds another 12%. Crossing the harbor from the Wanchai/Casueway Bay, it will be the Tsimshatsui District, which holds another 14%. Together, these 4 districts possess more than three-fourths of the Grade A office space of the whole Hong Kong. And these districts are geographically very close! Therefore, a classification of office buildings based on the geographical areas will not yield very good results.[10] Furthermore, if the price is largely determined by the geographical locations, as in the case of Ricardo model, and if the price causality runs from better-located properties to less, we still should observe the price causality from the higher-priced class office to lower-priced office according to our classification.[11] Thus, our proposal to study the price and volume causality would still be a meaningful test of competing theories.

In terms of the data constraint, we are further constrained by the fact that the Hong Kong government never formally announces which

[9] Among others, see Kan et al (2004) for a dynamic general equilibrium model which exhibits a similar pattern.
[10] Leung, Wei and Wong (2006) provide some evidence that the geographical factor may not be important in determining the "substitutability" of office buildings in different districts.
[11] See Ricardo (1817; 1965).

office buildings belong to Grade A, which to B or C, and whether they adjust those classification over time. Thus, we are unable to use the government classification in the office buildings. Instead, we classify office buildings based on objective and quantitative criteria, and we are able to differentiate the office buildings into 10 classes, instead of 3 (the Hong Kong government classification). More detailed explanations will be provided in section 3.

The Hong Kong market is chosen for several reasons. Hong Kong is well known to have a simple tax system, a constant exchange rate (relative to the US dollars) over the whole sampling period, giving an equal treatment to the foreign investors. There is no capital control and there is no capital gains tax. The property market is relatively active.[12] The capital market is relatively developed.

The organization of this paper is as follows. The next section describes the dataset and the econometric tools. Section 3 presents the empirical findings and the interpretations. The last section concludes.

2. Data Description and Econometric Method

Data Source

The dataset we employed is collected by the Economic Property Research Center (EPRC), which in turn collects all the transactions recorded by the Land Registry Department of the Hong Kong Government.[13] The sample period for our analysis starts from January 1992 to December 2004. This research focused on the sale market of

[12] See Leung, Wong and Cheung (2007) for more evidence on this.

[13] The EPRC data set contains information about the building name, the address, the completion date, the transaction date, the transaction price, corresponding gross feet, net feet, gross feet price and net feet price.

Hong Kong office market, with more information and higher accuracy than the rental counterpart.

This research includes all buildings which have at least more than 4 transactions from January 1992 to December 2004 and have complete information of the transaction date, the transaction price, corresponding gross feet and net feet to construct quarterly data employed in this study. For our full sample, we totally have six hundred and one estates, more than 24,000 observations.

In order to examine the robustness of full sample, a restricted sample is selected, which is composed of the estates which have at least 52 transactions during the sampling period, i.e. on average, each selected estate is at least transacted once in each period, which is a quarter. We have totally one hundred and twenty estates in restricted sample. Ding (2006) find that the results from the full sample and the restricted sample are essentially the same. Thus, this paper will focus on the full sample. Table 1 and 2 provide more information about the dataset.

(Table 1b, 2a, 2b about here)

Measurement of Trading Volume and Office Price

In this study, as in many related studies, trading volume is simply measured by the numbers of times each estate has been transacted in a quarter.[14] As for measurement of office price, we employed the realized rate of return as the (de-trended) office price, and use the relative transaction value as weight to create an index.[15] The idea is that a higher value transaction (relative to other transactions in the same estate and same period) contains more information about the market. Formally, the

[14] Among others, see Leung, Lau, and Leong (2002), Leung and Feng (2005), and the reference therein.

[15] The transacted value was calculated as the product of price per feet and construction area. Since some estates only have gross area, some only have net area and some possess both, we choose net area as priority.

index is constructed as follows:

$W_i = P_{ij}Q_{ij} / \Sigma P_{ij}Q_{ij}$

$\Sigma W_i P_i = \tilde{P}$

where i is the index of estate, j is the number of transactions of the i estate per quarter, P is the nominal price per square feet, Q is the constructed area and $\tilde{P}$ **is** the weighted average price per quarter. To facilitate cross-period comparison, the weighted average price per quarter is deflated by the quarterly composite consumer price index (CPI) (1992=1). The real rate of return (ROR) is the change of percentage of the real price. That is,

$P^*_i = \tilde{P}_i / CPI$

$ROR_t = P_t^* - P^*_{t-1} / P^*_{t-1}$

where P* is real office price per quarter of a specified estate and ROR_t the realized rate of return, which can also be interpreted as the real de-trended office price, or, simple *real office price*. From this point on, we will use the term "real office price" and "ROR" interchangeably.[16]

3. Econometric Method

"Group" Analysis

As we discussed in the introduction, we split the sample into ten equal-sized groups twice:[17] first time by descending order in the total trading volume (as a proxy of *liquidity*) and the second by descending weighted average office prices (as a proxy of *quality*). Clearly, the uses

[16] This study focused on the effective sampling period which starts with the first actually transaction period for each estate. Ever since the effective sampling period, if there are other zero transaction period follows, in order to avoid uninformative zero ROR , for that zero transacted period, $ROR_t = ROR_{t-1}$.

[17] The last group always has 61 buildings, while all others have 60.

of alternative sorting methods highlight different dimensions of the market and also help to improve the robustness of the results. Notice that although the number "ten" is somehow arbitrary but the results do not seem to be very sensitive to this choice. And it is already much finer than the government classification, which has only 3 groups. Perhaps more importantly, the four hypotheses outlined *do not depend on the number of classes* in the data but should hold in general. Without any a priori knowledge, this choice seems to be acceptable. As we split the sample into ten groups, there would be enough trading for each class in each period. A simple test of correlation and Granger Causality tests of group volume and group price are conducted. Similar methods are applied to the restricted sample.[18] Table 3a, 3b provide some basic statistics of the 10 groups under different classifications. We also compute the correlation of the prices of groups under different classifications. Table 4 shows that the correlation is far from being unity confirms that the two classification methods indeed rank office buildings differently. In particular, the correlations of prices between group i (ranked by price) and group i (ranked by volume) , i = 1,2,3,... are in general very low. *In other words, office buildings with higher prices do not necessarily being traded more.* The price and the trading volume in the building level are not as correlated as in the aggregate. On the other hand, the correlations of volumes are all positively significant, reflecting some kind of consistency. (We will get back to this point later.)

(Table 3a, 3b, 4 about here)

Now, one may object to this classification of building offices for not taking the location factor into account explicitly. As we have explained before, while it may be important for other places, it may not be as

[18] See Ding (2006) for more details.

important in Hong Kong. First, Hong Kong is geographically small. Leung, Wei and Wong (2006) also find that the geographical factor may not be important in determining the "substitutability" of office buildings in different districts. Second, the locations of office buildings are endogenous. In particular, as Tsang (2005) has shown, most of the quality office buildings are concentrated in Central and Tsim-Sha-Tsui, making separate identification of different factors difficult. Third, the government classification is not transparent and is not as refined. They simply classify the office buildings in Hong Kong in three broad classes. Nevertheless, to address the potential concerns, we will also conduct a district-level analysis, which yields similar pattern. Due to the space limit, we present the "district analysis" in the appendix III and in the main text; we will focus on the classifications of office buildings based on price and trading volume.

4. Empirical Results

The empirical results will be presented in the following order. First, the matrix of correlation coefficients of volume and ROR of groups are illustrated for both full and restricted sample. Second, we calculate the correlation coefficients of volume and ROR ranked by volume and real price separately within each group. Third, in order to examine the lead-lag relationship of volume and real price separately, we check the granger causality for volume and ROR for each group for both full and restricted sample.

Correlation of Volume and ROR

Table 5a displays the matrix of correlation coefficients of volume when the buildings are ranked by real office price for the full sample. It is clearly that every group is highly correlated to other groups. And similar pattern emerges when the buildings are ranked by the trading volume (table 6b). It seems safe to conclude that the trading volumes among different groups are highly correlated. One may be tempted to interpret this in terms of substitution among different office buildings. However, the correlation coefficients among groups do not display any monotonic pattern, suggesting that the "substitution effect" may not be the driving force for this sample.

(Table 5a, 5b about here)

The results on the de-trended office price (or ROR) pose a further challenge to the hypotheses outlined before. Table 6a displays the matrix of correlation coefficients of ROR when the buildings are ranked by real office price for the full sample. We find that only five pairs of significant correlations are examined, which is in sharp contrast to the table 5a. The same conclusion holds when the buildings are ranked by the trading volume (table 6b). In the appendix III, it is shown that when the buildings are sorted by district, the correlation of ROR is even more absurd with only three significantly high correlations.

(Table 6a, 6b about here)

Granger Causality Tests

Interactions among office buildings need not be contemporary. To entertain the possibility of dynamic interactions, especially to test the different hypotheses concerning the lead-lag relationships among "higher groups" and "lower groups", we conduct the Granger causality tests of volume and ROR ranked by real office price, volume and district price separately. Table 7a displays the results of granger tests of volume when the buildings are ranked by real price in descending order. We can see that group one only significantly granger causes the volume trend of group two, group four and group six. Group two, group four, group five, group eight and group nine granger cause several other groups. However, the ordering is not uniform and the pattern is not clear.

On the contrary, when the groups are volume-ranked, table 7b shows that the group one Granger causes all other groups. Group two exhibit similar pattern except for group six. In general, higher-ranked groups tend to Granger cause the lower-ranked ones in trading volume. Thus, the results in the office market are in sharp contrast to the residential property market. It is consistent with the explanation that when the collateral constraints and up-trading incentives are less important, the causality from the lower-priced units to higher-priced ones will disappear. On the other hand, it is puzzling that the causality is from higher-ranked units to lower ones in trading volume when the office buildings are volume-ranked, but not when the office buildings are price-ranked. *These patterns are not completely consistent with the hypotheses outlined before* (see table 1a). Clearly, more refinements in the theoretical works are needed.

(Table 7a, 7b about here)

Table 9 summarizes the granger causality tests of volume for both full and restricted samples. The results are similar. Almost half of the granger causality results of volume exhibit significant lead-lag relationship among groups by the three grouping methods.

(Table 8 about here)

By the same token, we conduct the granger causality tests on price among different groups. The results are *very* different. For our full sample, no matter how the office buildings are categorized, almost none of a group shows significant causality effect on other groups. (The only exception is group three (price ranked) granger causes four other groups). In particular, while in general the higher-ranked office buildings Granger cause the lower-ranked in trading volume, they fail to carry the same causality in terms of office prices. *None* of the hypotheses discussed above can account for this phenomenon (again, see table 1a).

(Table 9a, 9b about here)

In table 10, which summarizes all the results, we can see that no more than 30% of the tests are significant, which is in sharp contrast to the case of volume. Perhaps more importantly, no group seems to be the "benchmark" of the others. Again, these results suggest that serious refinement of the office market theory is needed.

(Table 10 about here)

Estimation of Markov Chain Model Estimation

One possible explanation of the "negative results" identified in the previous sections is that the office buildings frequently move up and down across groups, making all the correlation and granger tests difficult to interpret. To entertain this concern, we also estimate a Markov chain model on our restricted sample to study the persistence of the return performance of estates. Since the first year of the whole period contains limited information, we start with the year 1993. The office buildings are categorized as follows: first we rank the buildings in each and every quarter according to their corresponding real price in descending order. There are 84 office buildings with transactions *throughout the sampling period* (12 years), and they are put into 6 groups. A Markov chain is then estimated.[19]

Given the space limit, we can only focus on the principal

[19] For further details, please refer to appendix VII.

diagonal elements (see Table 11a). They indicate the probability for an office building to stay in the original group for another period, which in some sense indicates the "stability" of the relative price/return performance of different office buildings.[20] For example, in 1993, there is a 76.19% chance that an office building that is ranked in the first group in the time period t will remain in the same group in next year. Clearly, the principal diagonal elements of each group are usually larger than the non-diagonal elements of the corresponding row, the return performance of each group can be considered as persistent. Moreover, the buildings in the polar groups (i.e. group 1 and group 6) have a very high probability to remain in their original groups, showing that mobility at the two ends of the (office buildings) distribution are relatively low, which is consistent with some previous research (for instance, see Lee & Ward, 2000).

On the other hand, figure 3 shows that the persistence of the in-between groups significantly (and only temporaily) dropped in 1998 (i.e. during the Asian Financial Crisis). It seems to suggest that a crisis does have an impact on the intra-metropolitan price dynamics of the office market. It seems to be a research topic to be further explored.

(Table 11a and Figure 2 about here)

As a comparison, we perform the same analysis on the real housing price of residential estates in Hong Kong[21]. Table 11b represents the elements of the principal diagonal from 1992 to 2004, which indicates the probability for a residential estate to stay in the original group for the

[20] See Young and Graff (1996, 1997).

[21] An "estate" in Hong Kong is similar to a "housing development" in the United States, i.e. a group of buildings built in the same neighborhood, at about the same time, usually by a single property developer. In Hong Kong, the population of some large estates is huge. Size of some of the estates can make them form a distinct community. For the details of the data used, see Leung and Cheung (2006).

proceeding month[22]. As in the case of office buildings, the principal diagonal elements of each group are always larger than the non-diagonal elements of the corresponding row, indicating a high degree of persistence. In addition, the estates in the polar groups remain having a very high probability to remain in their original groups (although there are some exceptional situations in the early sample period), showing that the property of relatively low mobility at the two ends of the (residential estates) distribution is applicable for both kinds of real estate asset.

On the other hand, both table 11b and figure 3 suggest a drop in the persistence in the (relative) ranking of price after the Asian Financial Crisis (i.e. 1998), especially the polar groups (1 and 6), which seems to be in sharp contrast with the office buildings.[23] Unlike office buildings, the drop in those two groups do not show any "rebound". The dramatic V-shaped drop of the persistence for most groups in office buildings in the year 1998 is not found in residential property market. Instead, the year 1998 is just the midway of decreasing within-group price persistence.

In general, the six time paths for office buildings seem to fluctuate around some group-specific constant. However, the six time paths for residential market analysis exhibit a break (a level drop) in the persistence level at 1998. It seems to be another piece of evidence that even when we restrict to the sale market, the office property and the residential property do behave very differently.

(Table 11b and Figure 3 about here)

5. Robustness Checks

[22] Ding (2006) provides all transition matrices in each year.

[23] Limited by the sample size (13), we are unable to conduct a meaningful structural break test formally.

As an earlier draft of this paper is being presented around, serious doubts have been forwarded to the authors. To ease some of these doubts, we have performed some robustness tests. Due to the space limit, we will briefly explain them in this section and leave the details in the appendix IV. .

One of the serious objections is that it ignores the possibility of a structural change in 1997, the year when Hong Kong was handed over to China, and when the Asian financial crisis happened. We therefore split the sample into two sub-samples: 1992 Q1~1997 Q4, and 1998Q1~2004Q4. A clear consequence of sample-splitting is the reduction of the sample size which may have an impact on the significance of the test statistics, especially for the Granger Causality. The correlations and causality are in general weak, but the basic pattern sustains: There is no clear pattern in terms of the price across different group, while the causality in volume is in general from the "higher groups" (higher-priced or more frequently traded) to the "lower" ones.

Another objection that caught our attention is the potential bias due to the existence of seasonal factors. Theoretically, it is *not* clear why seasonal factor will lead to more significant causality in volume than in price. Nevertheless, to address this concern, we run a simple regression with constant term, autoregressive term and 3 seasonal dummies. None of the volume-regression displays any significance for seasonality. For price-regression, seasonal dummies are significant in only two groups when the buildings are sorted by Volume. It seems safe to conclude that the seasonal factors are not important in our sample (the details are in the appendix IV).

6. Concluding Remarks

Although the exercises conducted in this paper are technically simple, they contain important messages. One important finding of this research is that, the trading volume of commercial property displays clear lead-lag relationship and significant correlation (in general, from higher volume groups to lower ones), while the majority of office estates show neither significant correlation nor lead-lag relationship in price. Almost half of the granger causality results of volume exhibit lead-lag relationship among groups. The results are almost the same for both full and restricted sample. These findings are in sharp contrast to the case of residential property, where the price and volume of lower-quality properties typically drive the counterpart in the higher-quality counterparts (for instance, see Ortalo-Magne and S. Rady, 1999, 2005 and the reference therein). The results further indicate that the widely cited "benchmarking hypothesis", which is a form of "informational friction" story, may not be strong enough to be statistically detected. It then leads to the question of what determines the price and trading volume dynamics among different classes of office buildings. Existing search-theoretic models are silent on the dynamics between higher and lower quality office market. In other words, existing hypotheses of the office market dynamics are either silent to or apparently inconsistent to the stylized facts established in this paper. Clearly, more efforts on theoretical and empirical works are needed to solve this empirical puzzle.

This paper also carries implications to the construction of city-level index. Regardless the sorting method we use, the real office prices are not always significantly correlated. It leads to the concern that an "aggregate" city-level price index may not be a very informative device, although it is a widely used practice. On the other hand, the trading volumes among different classes are highly correlated. Thus, it may indeed be appropriate to construct a city-level trading volume index.

This observation also leads to one possible direction for future research. Macroeconomists have long been aware that the regional dynamics (in terms of output and other macroeconomic variables) may be significantly different from the aggregate counterpart (for instance, see Quah, 1996a). They go further and derive methods to test whether there is any trend of convergence among different "regions" to the "aggregate" (for instance, see Quah 1996b, c). Alternatively, they derive methods to characterize the "distributional dynamics" and how it is related to the "aggregate dynamics" (for instance, see Quah 1997). If the office prices of different classes do not move together, now is perhaps the time for real estate economists to examine the "convergence" issue and the "distributional dynamics" issue in the context of office market.

Needless to say, the econometric methods used here are relatively simple. It is possible that to revisit these conclusions with more non-linear models. Our current sample, however, has only 52 periods (quarters) and may not be an ideal sample for those techniques. A dataset with a longer time horizon and more transactions is needed.

Moreover, the comparison of the Markov Chains estimated from office and housing markets reveal further difference between the two types of property. In particular, the persistence in relative price ranking in the office market seems to be more robust than the residential market, especially when the market was impact by the Asian financial crisis. It may be somehow counter-intuitive because we expect that the "neighborhood" (including the geographical location, school district, crime rate, etc.) is relatively stable and should be more important to residential property price than office counterparts. Furthermore, the "polar groups" (the highest and lowest priced properties) in the office market seem to be more stable than the other groups in the office market. It seems to be the opposite for the residential market. Clearly, much more empirical as well as theoretical works are needed to understand the difference between the two markets.

References:

Ambrose, B. and Sanders, A. (2003), "Commercial Mortgage-backed Securities: Prepayment and Default", *Journal of Real Estate Finance and Economics*, 26(2-3), 179-196.

Bryson, J.R. (1997), "Obsolescence and the Process of Creative Reconstruction", *Urban Studies*, 34(9), 1439-1458.

Chau, K. W.; S. K. Wong; C. Y. Yiu; H. F. Leung (2004), "Real Estate price indices in Hong Kong", *Journal of Real Estate Literature*, forthcoming.

Ding, J. (2006), "Estimating the intra-metropolitan price and volume dynamics of Commercial Property: Empirical Study of Hong Kong," Unpublished Master Thesis, Chinese University of Hong Kong.

Du, J.; C. K. Y. Leung and D. Chu (2006), "Corporate real estate and corporate governance," Chinese University of Hong Kong, mimeo.

Englund, P., Gunnelin, A., Hoesli, M. and Soderberg, B. (2004), "Implicit Forward Rents as Predictors of Future Rents", *Real Estate Economics,* 32(2), 183-215.

Englund, P., Gunnelin, A.; Hoesli, M.; and Soderberg B (2005), "Adjustment in Property Space Markets: Estimates from the Stockholm Office Market", *NBER Working Paper No. 11345*

Englund, P.; J. M. Quigley, and C. Redfearn (1998), "Improved Price Indexes for Real Estate: Measuring the Course of Swedish Housing Prices", *Journal of Urban Economics,* 44, 171-196.

Eppli, M., J. Shilling and K. Vandell (1998), "What Moves Retail Property Returns at the Metropolitan Level?", *Journal of Real Estate Finance and Economics*, 16(3), 317-342.

Fu, Q., M. LaCour-Little and K. Vandell (2003), "Commercial Mortgage Prepayments under Heterogeneous Prepayment Penalty Structures", *Journal of Real Estate Research*, 25(3), 245-275.

Gabriel, S.A and Nothaft, F.E (1988), "Rental Housing Market and Natural Vacancy Rate", *AREUEA Journal,* 16(4), 419-429.

Geltner, D. M. (1991), "Smoothing in Appraisal-Based Returns", *Journal of Real*

Estate Finance and Economics, 4(3), 327-45.

Hanushek, E., S. Rivkin and L. Taylor (1996), "Aggregation and the Estimated Effects of School Resources", *Review of Economics and Statistics*, 78, 611-627.

Hendershott, P.H., Lizieri, C.M. and Matysiak G.A (1999), "The Working of the London Office Market", *Real Estate Economics,* 27 (2), 365-387.

Hwang, M. and J. M. Quigley (2004), "Selectivity, Quality Adjustment and Mean Reversion in the Measurement of House Values", *Journal of Real Estate Finance and Economics*, 28(2/3), 191-214.

Kan, K.; Kwong, S. K. S.; Leung, C. K. Y. (2004) "The dynamics and volatility of commercial and residential property prices: theory and evidence," *Journal of Regional Science,* 44(1), 95-123.

Kwong, S. K. S. and Leung, C. K. Y. (2000), "Price Volatility of Commercial and Residential Property", *Journal of Real Estate Finance and Economics*, 20(1), 25-36.

Lai, T.-Y.; Wang, K. (1998), "Appraisal Smoothing: The Other Side of the Story", *Real Estate Economics*, 26(3), 511-35.

Lee, S.L. and Ward, C.W.R. (2001), "Persistence of UK Real Estate Returns: A Markov Chain Analysis", *Journal of Asset Management,* 1(3), 279-291.

Leung, C. K. Y.; P. W. Y. Cheung (2006), "Estimating and Explaining Extreme Co-movements in Hong Kong Residential Property Market", *City University of Hong Kong*, mimeo.

Leung, C. K. Y. and D. Feng (2005), "What Drive the Price-Volume Correlation? Evidence from a Commercial Real Estate Market", *Journal of Real Estate Finance and Economics*, 31(2), 241-255.

Leung, C. K. Y., G. C. K. Lau and Y. C. F. Leong (2002) "Testing alternative theories of the property price-trading volume correlation", *Journal of Real Estate Research,* 23(3), 253-263.

Leung, C. K. Y.; P. Wei; S. K. Wong (2006) "Are the markets for factories and offices integrated? Evidence from Hong Kong," *International Real Estate Review*, 9, 62-94.

Leung, C. K. Y.; S. K. Wong and Patrick W. Y. Cheung (2007) "On the stability of the implicit prices of housing attributes: a dynamic theory and some evidence," forthcoming in *International Real Estate Review.*

Liu, H.L. and Chang, H.C. (2004), "Variation of Floor Rent Differentials of High-Rise Buildings", *Regional Science,* 83(2), 495-503.

Mcqueen, G. and Thorley, S. (1991), "Are Stock Returns Predictable? A Test Using Markov Chains", *Journal of Finance*, 46(1), 239-263.

Mills, T.C. and Jordanov, J.V. (2003), "The Size Effect and the Random Walk Hypothesis: Evidence from the London Stock Exchange Using Markov Chains", *Applied Financial Economics*, 13, 807-815.

Mun, S. and Hutchinson, B.G. (1995), "Empirical Analysis of Office Rent and Agglomeration Economies: A Case Study of Toronto", *Journal of Regional Science,* 35, 437-455.

Nagai, K., Kondo, Y. and Ohta, M. (2000), "A Hedonic Analysis of the Rental Office Market in the Tokyo Central Business District: 1985-1994 Fiscal Years", *Japanese Economic Review,* 51(1), 130-154.

Orr, A.M. and Jone, C. (2003), "The Analysis and Prediction of Urban Office Rents", *Urban Studies,* 40(11), 2255-2284.

Ortalo-Magne, F. and Rady, S. (1999), "Boom in, Bust out: Young Households and the Housing Price Cycle", *European Economic Review,* 43(4-6), 755-766.

Ortalo-Magne, F. and Rady, S. (2006) "Housing Market Dynamics: On the contribution of income shocks and credit constraints," *Review of Economic Studies*, 73, 459-485.

Patel, K. and T. F. Sing (2000), "Implied Volatility in the U.K. Commercial Property Market: Empirical Evidence Based on Transaction Data", *Journal of Real Estate Finance and Economics*, 20(1), 5-24.

Quah, D. (1996a) "Aggregate and Regional Disaggregate Fluctuations," *Empirical Economics*, 21(1), 137-59.

Quah, D. (1996b) "Regional Convergence Clusters across Europe," *European Economic Review*, 40(3-5), 951-58.

Quah, D. (1996c) "Empirics for Economic Growth and Convergence," *European*

Economic Review, 40(6), 1353-75.

Quah, D. (1997) "Empirics for Growth and Distribution: Stratification, Polarization, and Convergence Clubs," *Journal of Economic Growth*, 2(1), 27-59.

Ricardo, David' (1817; 1965), The Principles of Political Economy and Taxation, London: J. M. Dent and Son.

Rosen, K.T. and L.B. Smith (1983), "The Price-Adjustment Process for Rental Housing and the Natural Vacancy Rate", *The American Economic Review*, 73(4), 779-786.

Shilling, J. D., Sirmans, C. F. and J. B. Corgel (1987), "Price Adjustment for Rental Office Sapce", *Journal of Urban Economics,* 22(1), 90-100.

Sivitanidou, R. (1997), "Are Center Access Advantages Weakening? The Case of Office–Commercial Markets", *Journal of Urban Economics*, 42(1), 79-97.

Sivitanidou, R. and P. Sivitanides (1999), "Office capitalization rates: real estate and capital market influences," *Journal of Real Estate Finance and Economics*, 18(3), 297-322.

Sivitanidou, R. and P. Sivitanides (2000), "Does the theory of irreversible investments help explain movements in office-commerical construction?" *Real Estate Economics*, 28(4), 623-661.

Sivitanidou, R. (2002), "Office Rent Process: The Case of US Metropolitan Markets", *Real Estate Economics,* 30(2), 317-344.

Slade, Barrett A. (2000), "Office Rent Determinants during Market Decline and Recovery", *Journal of Real Estate Research,* 20(3), 357-381.

Smith, L.B. (1974), "A Note on the Price Adjustment Mechanism for Rental Housing", *American Economic Review*, 64(3), 478-481

Tsang, Kenneth (2005), "Hong Kong Grade A Office Market," Jones Lang LaSalle, mimeo.

Tu, Y., Shi-Ming Yu and Hua Sun (2004), "Transaction-Based Office Price Indexes: A Spatiotemporal Modeling Approach", *Real Estate Economics*, 32(2), 297-328.

Wheaton, W. C. (1987), "The Cyclic Behavior of the National Office Market", *Real Estate Economics,* 15(4), 281-299.

Wheaton, W. C. (1990), "Vacancy, Search and Price in A Housing Market Matching Model", *Journal of Political Economy*, 98(6), 1293-1306.

Wheaton, W. C., R. G. Torto and P. Evans (1997), "The Cyclic Behavior of Great London Office Market", *Journal of Real Estate Finance and Economics,* 15(1), 77-92.

Wheaton, W. C. (2005), "Does Location Matter? Property Fundamentals Vary Within Markets and Is This Reflected in Pricing?", *Journal of Portfolio Management,* Special Real Estate Issue, 100-107.

Young, M. S. and Graff, R. A. (1996), "Systematic Behavior in Real Estate Investment Risk: Performance Persistence in NCREIF Returns", *Journal of Real Estate Research,* 12(3), 369-381.

Young, M. S. and Graff, R. A. (1997), "Performance Persistence in Equity Real Estate Returns", *Real Estate Finance,* 14(1), 37-42.

Figures

Figure 1: VOL Correlation versus ROR Correlation for Each Group (Full Sample)

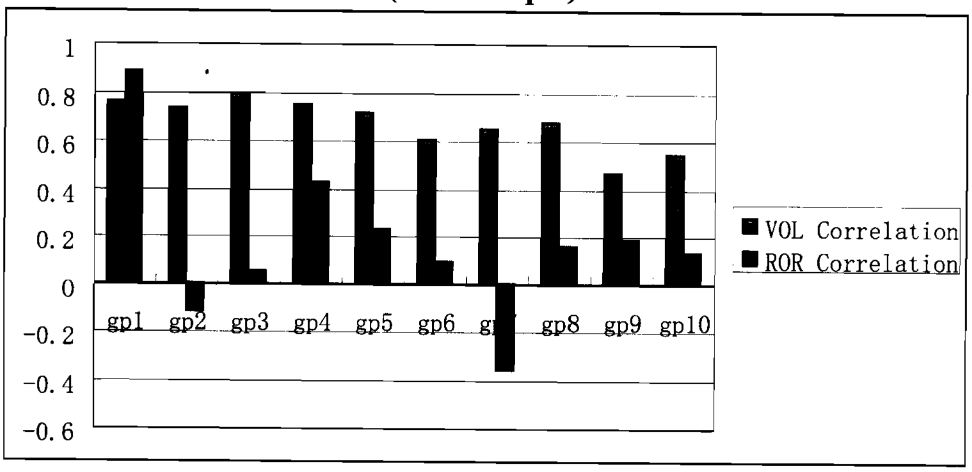


Figure 2 Within-Group Price Persistence of Office Buildings from 1993 to 2004

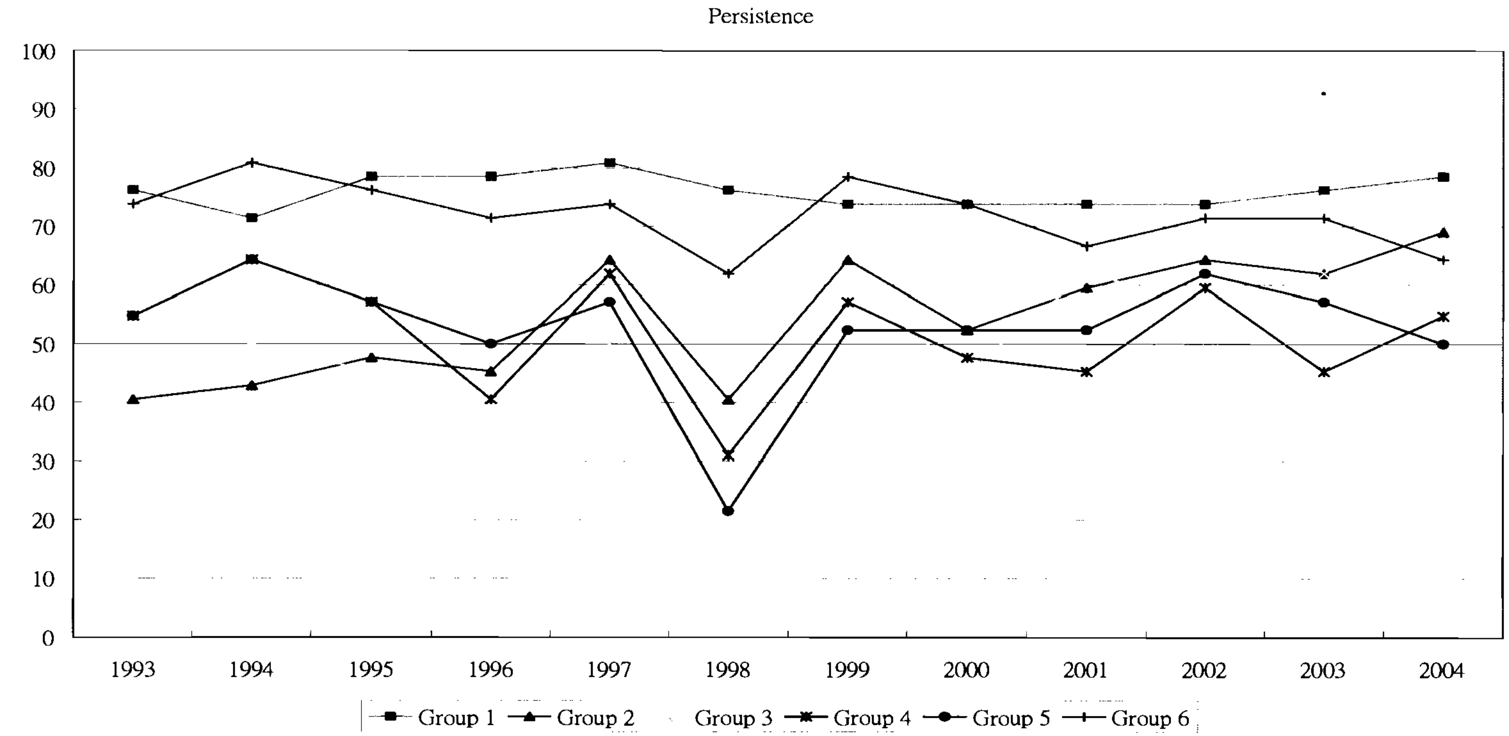
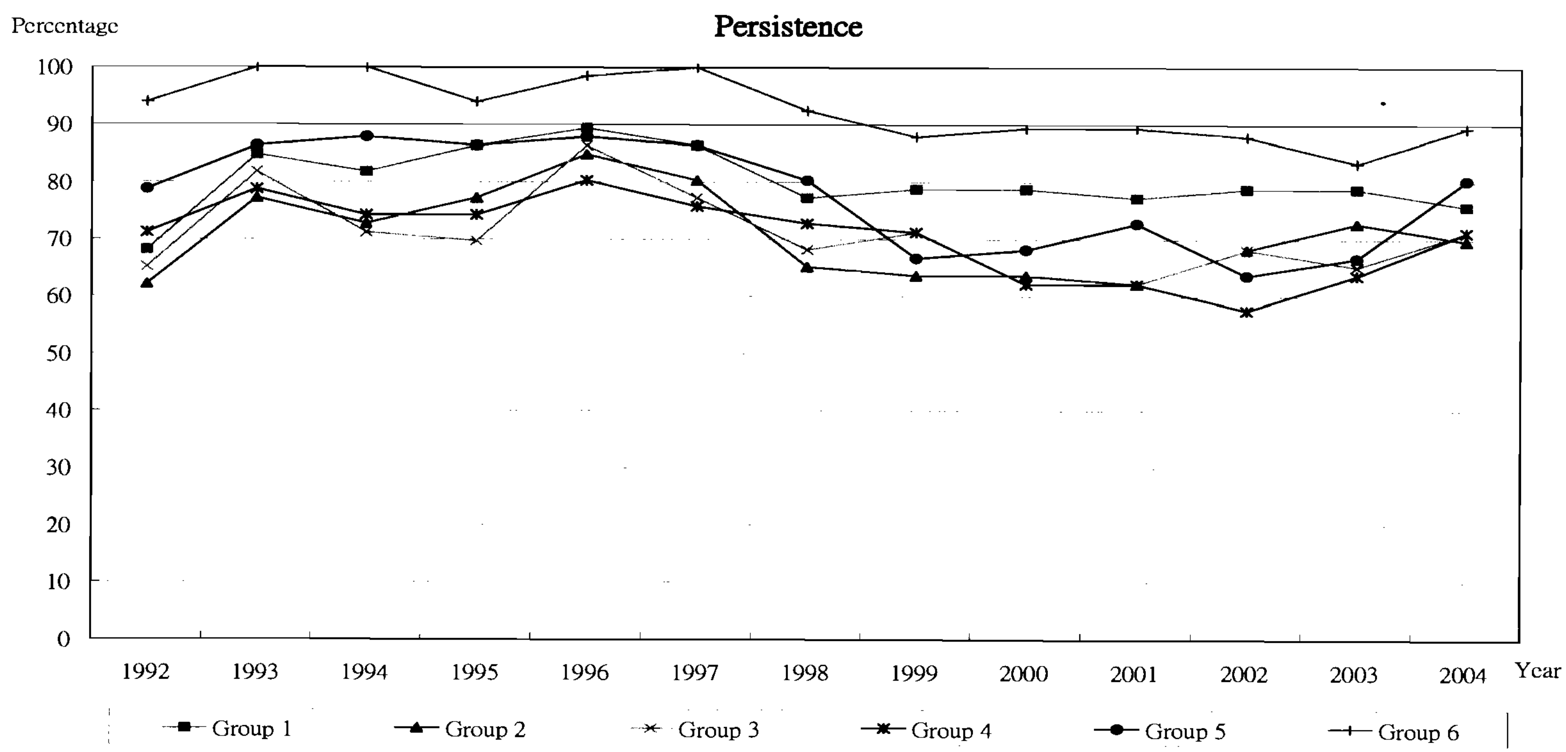


Figure 3 Within-Group Price Persistence of Residential Estates from 1992 to 2004



Tables

Table 1a Summary of Hypotheses

I	Lower-priced units causes Higher-priced units
II	Higher-priced units causes Lower-priced units
III	· Higher-priced units and Lower-priced units co-move
IV	Higher volume units causes lower volume units

Table 1b Number of Estates in Each Sampling Group

Sample Group	No. of Estates
Full Sample (total no. of transactions >4)	601
Restricted Sample (total no. of transactions >=52)	120

Table 2a Summary Statistics of Volume, office buildings sorted by ROR (Full Sample)

Group	Min	Max	Mean	Std. Dev.
Group 1	19	300	71.55769	58.36747
Group 2	4	267	42.63462	49.07299
Group 3	9	190	46	36.26482
Group 4	11	358	61.21154	62.61126
Group 5	14	345	64.96154	71.32911
Group 6	15	180	44.71154	34.15095
Group 7	12	115	49.80769	26.71787
Group 8	10	88	32.30769	18.99901
Group 9	13	81	29.53846	14.08443
Group 10	6	35	18.15385	7.437016

Table 2b Summary Statistics of Volume, office buildings sorted by Volume (Full Sample)

Group	Min	Max	Mean	Std. Dev.
Group 1	63	799	219.6538	175.6225
Group 2	22	283	75.98077	55.99842
Group 3	12	161	46.38462	32.79057
Group 4	3	139	32.61538	24.93612
Group 5	7	73	25.13462	15.07631
Group 6	5	75	19.48077	12.4782
Group 7	2	49	14.96154	8.659035
Group 8	2	36	11.67308	7.00342
Group 9	1	33	8.576923	5.248141
Group 10	0	17	6.423077	3.862064

Table 3a Summary Statistics of ROR, office buildings sorted by ROR (Full Sample)

Group	Min	Max	Mean	Std. Dev.
Group 1	-0.5876	1.95204	0.034406	0.329773
Group 2	-0.4059	0.764871	0.013924	0.190167
Group 3	-0.36961	0.83092	0.008961	0.215808
Group 4	-0.45428	0.403183	-0.00028	0.135383
Group 5	-0.2832	0.387924	-0.00169	0.138188
Group 6	-0.66969	1.30954	0.016486	0.251244
Group 7	-0.57738	1.475486	0.011802	0.255855
Group 8	-0.47721	1.192872	0.013125	0.23779
Group 9	-0.51321	0.566973	0.011208	0.204498
Group 10	-0.52022	0.960298	0.018369	0.269945

Table 3b Summary Statistics of ROR, office buildings sorted by Volume (Full Sample)

Group	Min	Max	Mean	Std. Dev.
Group 1	-0.60818	1.982352	0.034265	0.332764
Group 2	-0.68537	2.022708	0.050003	0.387081
Group 3	-0.62344	0.787426	0.057204	0.33792
Group 4	-0.61867	1.660154	0.058072	0.417386
Group 5	-0.38094	0.83926	0.024309	0.273031
Group 6	-0.60545	2.885353	0.07618	0.552682
Group 7	-0.47299	1.047905	0.046027	0.34612
Group 8	-0.57793	1.338889	0.066384	0.370358
Group 9	-0.5541	1.405929	0.067872	0.40459
Group 10	-0.71249	5.173311	0.165256	0.828395

Table 4 Correlation of Volume and Price, office buildings sorted by Volume and Price Separately (Full Sample)

Group	Correlation of Volume(Volume sorted, ROR sorted)	Correlation of Price(Volume sorted, ROR sorted)
Group1	0.7648*	0.8908*
Group 2	0.7391*	-0.1169
Group 3	0.7943*	0.053
Group 4	0.7495*	0.4325*
Group 5	0.7178*	0.2297
Group 6	0.6054*	0.0983
Group 7	0.6499*	-0.3586*
Group 8	0.6791*	0.1611
Group 9	0.4668*	0.1884
Group 10	0.5452*	0.1326

Note: * denotes that the correlation is significant at the 1% confidence level.

Table 5a Correlation of Volume, office buildings sorted by ROR (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1	1									
gp2	0.7110*	1								
gp3	0.8061*	0.8847*	1							
gp4	0.5675*	0.5978*	0.6390*	1						
gp5	0.5821*	0.7876*	0.7210*	0.7164*	1					
gp6	0.4629*	0.5204*	0.6013*	0.6827*	0.6211*	1				
gp7	0.5945*	0.7249*	0.7618*	0.6897*	0.7362*	0.6608*	1			
gp8	0.6219*	0.5415*	0.6686*	0.7879*	0.6171*	0.6966*	0.6673*	1		
gp9	0.5396*	0.4764*	0.5212*	0.8032*	0.5830*	0.6932*	0.6508*	0.8099*	1	
gp10	0.5426*	0.4188*	0.5163*	0.6088*	0.4743*	0.6074*	0.6061*	0.7106*	0.6684*	1

Note: * denote that it is significant at the 1% confidence level.

Table 5b Correlation of Volume, office buildings sorted by Volume (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1	1									
gp2	0.8155*	1								
gp3	0.8820*	0.8732*	1							
gp4	0.8535*	0.8062*	0.9278*	1						
gp5	0.7232*	0.7961*	0.7297*	0.6908*	1					
gp6	0.8229*	0.7950*	0.8175*	0.8285*	0.6684*	1				
gp7	0.7266*	0.7679*	0.8256*	0.8611*	0.5779*	0.7515*	1			
gp8	0.6454*	0.7292*	0.7424*	0.7507*	0.6584*	0.7497*	0.6694*	1		
gp9	0.7389*	0.6415*	0.7588*	0.8069*	0.4768*	0.8179*	0.7081*	0.6427*	1	
gp10	0.6312*	0.6320*	0.5773*	0.5763*	0.5523*	0.5836*	0.5241*	0.5431*	0.5440*	1

Note: * denote that it is significant at the 1% confidence level.

Table 6a Correlation of ROR, office buildings sorted by ROR (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1	1									
gp2	0.1352	1								
gp3	-0.1411	0.0363	1							
gp4	0.4999*	0.3627*	0.1262	1						
gp5	0.1547	0.4933*	0.1998	0.3385	1					
gp6	0.2126	0.0898	0.1223	0.325	0.296	1				
gp7	-0.0147	-0.0544	0.0182	-0.0573	-0.0613	-0.1236	1			
gp8	0.111	0.3205	0.1655	0.4657*	0.2092	0.003	-0.1181	1		
gp9	-0.1969	0.2154	0.4717*	0.2927	0.1884	0.0949	-0.0458	0.2324	1	
gp10	0.0566	0.1919	-0.1949	0.265	-0.033	0.1217	-0.1418	0.2098	0.1322	1

Note: * denote that it is significant at the 1% confidence level.

Table 6b Correlation of ROR, office buildings sorted by Volume (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1	1									
gp2	0.1441	1								
gp3	0.1529	0.2902	1							
gp4	0.2262	0.1599	0.096	1						
gp5	-0.2049	-0.1351	-0.2638	0.078	1					
gp6	0.0511	-0.0062	0.0169	0.102	0.1749	1				
gp7	-0.2024	-0.1393	-0.0162	0.2573	0.2435	0.1149	1			
gp8	0.2185	-0.184	0.0516	0.1172	0.1125	-0.0198	0.5345*	1		
gp9	0.0728	-0.0206	0.3538	-0.0048	0.1144	-0.1314	0.1873	0.4109*	1	
gp10	0.0032	-0.0451	0.1139	0.0743	0.0805	0.0913	0.4189*	0.4341*	0.3669*	1

Note: * denote that it is significant at the 1% confidence level.

Table 7a Granger Causality of Volume, office buildings sorted by ROR (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		Y	*N*	Y	*N*	Y	*N*	*N*	*N*	*N*
gp2	Y		Y	Y	Y	*N*	*N*	*N*	Y	Y
gp3	Y	*N*		*N*	Y	*N*	*N*	*N*	Y	*N*
gp4	Y	*N*	Y		Y	*N*	*N*	*N*	Y	*N*
gp5	Y	Y	Y	Y		*N*	Y	*N*	Y	Y
gp6	*N*	*N*	*N*	*N*	*N*		*N*	*N*	*N*	*N*
gp7	*N*	*N*	*N*	Y	*N*	*N*		*N*	Y	*N*
gp8	*N*	Y	Y	*N*	Y	Y	Y		Y	*N*
gp9	*N*	*N*	Y	Y	Y	Y	Y	Y		Y
gp10	*N*	*N*	*N*	*N*	*N*	Y	Y	Y	Y	

Table 7b Granger Causality of Volume, office buildings sorted by Volume (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		Y	Y	Y	Y	Y	Y	Y	Y	Y
gp2	Y		Y	Y	Y	*N*	Y	Y	Y	Y
gp3	*N*	*N*		Y	Y	Y	Y	Y	*N*	Y
gp4	*N*	Y	Y		*N*	Y	Y	Y	*N*	*N*
gp5	Y	Y	Y	Y		Y	Y	Y	Y	Y
gp6	Y	*N*	*N*	*N*	*N*		Y	*N*	*N*	*N*
gp7	*N*	Y	*N*	*N*	*N*	Y		*N*	*N*	*N*
gp8	*N*	*N*	*N*	*N*	*N*	*N*	*N*		*N*	*N*
gp9	Y	*N*	*N*	*N*	*N*	Y	*N*	*N*		*N*
gp10	*N*	*N*	*N*	*N*	Y	*N*	Y	*N*	*N*	

Table 8 Summary of Granger Causality in Volume

	Full Sample		Restricted Sample	
sorted by Price	42	(Total) 90	14	(Total) 30
	46.67%	100%	46.67%	100%
sorted by Volume	45	(Total) 90	14	(Total) 30
	50%	100%	46.67%	100%
sorted by District	24	(Total) 42	16	(Total) 30
	57.14%	100%	53.33%	100%

Table 9a Granger Causality of ROR, office buildings sorted by ROR (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		*N*	*N*	*N*	*N*	*N*	Y	*N*	*N*	*N*
gp2	Y		*N*	Y	*N*	*N*	Y	*N*	*N*	*N*
gp3	*N*	*N*		Y	*N*	*N*	Y	Y	Y	N
gp4	*N*	*N*	*N*		*N*	*N*	*N*	Y	*N*	Y
gp5	Y	*N*	*N*	*N*		*N*	*N*	*N*	*N*	*N*
gp6	*N*	*N*	*N*	*N*	*N*		*N*	*N*	*N*	*N*
gp7	*N*	Y	*N*	*N*	*N*	Y		*N*	*N*	*N*
gp8	*N*	*N*	*N*	Y	*N*	*N*	Y		Y	Y
gp9	*N*	Y	*N*	*N*	*N*	Y	*N*	*N*		N
gp10	*N*	*N*	Y	*N*	*N*	*N*	*N*	*N*	Y	

Table 9b Granger Causality of ROR, office buildings sorted by Volume (Full Sample)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		*N*	*N*	*N*	Y	*N*	*N*	*N*	*N*	Y
gp2	*N*		*N*	*N*	*N*	*N*	Y	*N*	*N*	*N*
gp3	*N*	Y		Y	*N*	*N*	*N*	*N*	*N*	Y
gp4	*N*	*N*	*N*		N	*N*	*N*	*N*	*N*	*N*
gp5	Y	*N*	*N*	*N*		*N*	*N*	*N*	*N*	*N*
gp6	Y	*N*	*N*	*N*	Y		Y	*N*	*N*	*N*
gp7	Y	Y	*N*	*N*	*N*	*N*		Y	*N*	Y
gp8	*N*	Y	*N*	*N*	*N*	*N*	Y		*N*	*N*
gp9	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*		*N*
gp10	*N*	*N*	Y	*N*	*N*	*N*	*N*	*N*	Y	

Table 10 Summary of Granger Causality in ROR

	Full Sample		Restricted Sample	
sorted by Price	21	(Total) 90	7	(Total) 30
	23.33%	100%	23.33%	100%
sorted by Volume	18	(Total) 90	4	(Total) 30
	20%	100%	13.33%	100%
sorted by District	5	(Total) 42	8	(Total) 30
	11.90%	100%	26.67%	100%

Table 11a Within-Group ROR Persistence of Office Buildings from 1993 to 2004

Year	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
1993	76.19	40.48	54.76	54.76	54.76	73.81
1994	71.43	42.86	50	64.29	64.29	80.95
1995	78.57	47.62	45.24	57.14	57.14	76.19
1996	78.57	45.24	38.1	40.48	50	71.43
1997	80.95	64.29	50	61.9	57.14	73.81
1998	76.19	40.48	26.19	30.95	21.43	61.9
1999	73.81	64.29	59.52	57.14	52.38	78.57
2000	73.81	52.38	45.24	47.62	52.38	73.81
2001	73.81	59.52	61.9	45.24	52.38	66.67
2002	73.81	64.29	57.14	59.52	61.9	71.43
2003	76.19	61.9	61.9	45.24	57.14	71.43
2004	78.57	69.05	59.52	54.76	50	64.29
Whole Sample	76.29	54.71	51.06	52.28	53.5	72.04

Table 11b Within-Group ROR Persistence of Residential Estates from 1992 to 2004

Year	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
1992	68.18	62.12	65.15	71.21	78.79	93.94
1993	84.85	77.27	81.82	78.79	86.36	100
1994	81.82	72.73	71.21	74.24	87.88	100
1995	86.36	77.27	69.7	74.24	86.36	93.94
1996	89.39	84.85	86.36	80.3	87.88	98.48
1997	86.36	80.3	77.27	75.76	86.36	100
1998	77.27	65.15	68.18	72.73	80.3	92.42
1999	78.79	63.64	71.21	71.21	66.67	87.88
2000	78.79	63.64	62.12	62.12	68.18	89.39
2001	77.27	62.12	62.12	62.12	72.73	89.39
2002	78.79	68.18	68.18	57.58	63.64	87.88
2003	78.79	72.73	65.15	63.64	66.67	83.33
2004	75.76	69.7	71.21	71.21	80.3	89.39
Whole Sample	80.11	70.75	70.75	70.43	78.17	92.9

Appendix:

It is not intended for publication, just to illustrate the robustness of the results presented in the main text.

Appendix I: Comparison of Previous Literatures

Literature	Data	Key Features	Main Conclusions
Smith (1974)	five Canadian cities' rental housing market 1961 ~1971	Rental adjustment Mechanism	They found that the vacancy rate do significantly affect the change rate of rents.
Rosen and Smith (1983)	seventeen US cities' rental housing market	Cross-sectional data & Rental adjustment Mechanism	The variation of vacancy rate around the natural vacancy rate exerts a significant effect on the price level of rental housing services.
Gabriel and Nothaft (1988)	sixteen US cities' rental housing market 1981~1985	Price-adjustment mechanism	They further enabled the estimation of equilibrium vacancy rate.
Shilling et al. (1987)	seventeen US cities' rental office market 1960 ~ 1975	Rental-adjustment mechanism	Landlords of higher levels of vacant office would lower their rents

Appendix I: (continued) Comparison of Previous Literatures

Literature	Data	Key Features	Main Conclusions
Mun (1995)	25 districts in Toronto	Location & Office rent	Agglomeration economies are the significant variable in the office rents.
Mourouzi-Sivitanidou (2002)	18 U.S. metropolitan office markets 1986-1995	Time-series cross-section analysis	The implicit long-term rents are largely determined by the office employment factors.
M. Orr (2003)	Bi-annually Two UK cities 1979 to 2000	local take-up as a demand variable	The structure of the final rent equation for both cities is similar; moreover, the movement can be explained by the lagged one period.
H.Hendershott (1999)	London office market 1977~1996	Using both supply and demand in the rental equilibrium adjustment model	The cycle during 1985 to 1996 is related to the employment growth rate and real interest rate.
H.Hendershott (2002)	London and Sydney markets	Deriving an error correction framework	The coefficients of the vacancy and equilibrium rent variables are recognizably similar between the two markets.

Appendix I: (continued) Comparison of Previous Literatures

Literature	Data	Key Features	Main Conclusions
Sivitanidou (1995)	Greater Los Angeles 1990	Both competitive and constrained market	Firm amenities and worker amenities contributed to the spatial variation of office rents.
Nagai (2000)	Tokyo CBD 1985~994	Maximum likelihood estimation	The characteristics related to the office agglomeration and amenities are more significant, compared to the ones of transportation.
Slade (2000)	Phoenix metropolitan area 1991~1996	Distinct market cycles: decline, trough and recovery	The rental rates reacted positively to the floor area, story height and load factor with a decreasing rate, and the effect proved to be more pronounce during the period of recovery than the periods trough and decline.
Gunnelin (2003)	Stockholm office market 1977~1997	The term structure of office leases	Out of 15 years time period, 7 years of significant term structure effects are observed which seemingly predicted the future rent level well.
Englund (2004)	Stockholm, Gothenburg and Malmo office markets	Nonparametric term structure	The forward rates have little predictive power and with 100% change in rent, none reactions were found in both Gothenburg and Malmo, only 20%-30% of changes were detected in Stockholm.
Englund & Gunnelin (2005)	Stockholm office market 1977~2002	Distinguish between the long-run and short-run demand	The hidden vacancies were observably related to the differences between the long-run and short-run demands.

Appendix I: (continued) Comparison of Previous Literatures

Literature	Data	Key Features	Main Conclusions
Wheaton(1987)	aggregate data of the US national office market 1967~1986	structural econometric model	Office market is slow to clear and long run expectations are needed.
Wheaton et al. (1997)	aggregate data of London office market 1970~1995	structural econometric model	Their findings illustrate inelastic relationship between supply and demand.
Ortalo-Magne & Rady (1999)	disaggregated data of UK residential market mid-1980s ~mid-1990s	life-cycle model	Financial and income changes and age groups contribute to the boom-bust cycle.
Ortalo-Magne & Rady (2005)	disaggregate data of UK and US residential markets	life-cycle model	There exists a positive correlation between housing prices and transactions.
Wheaton (1990)	disaggregate data of household for the US residential market	matching model	Both the matching rate and the turnover rate have a negative relationship with the expected sales time, and the sales rate

Appendix I: (continued) Comparison of Previous Literatures

Literature	Data	Key Features	Main Conclusions
Yong Tu et al. (2004)	disaggregate data of Singapore office market 1992 ~ 2001	spatiotemporal autoregressive model	Their model outperforms the traditional hedonic model in capturing office price dynamics
Yong Tu (2004)	disaggregate data of Singapore residential market 1990 ~ 2002	the stock flow model	Their findings supported high responsiveness exists in the private housing market.
Kwong & Leung (2000)	aggregate data for several countries	Lucas-tree type of model	Higher volatility exists in commercial property market than in residential market.
Leung & Feng (2005)	transaction data of Hong Kong office market	Price-volume correlation	There is no significant correlation of price and trading volume in Hong Kong office market.
Sivitanidou (1997)	semi- aggregate data of LA office market 1989 ~1994	dispersed pattern of office location	Office-commercial value gradients radiating out of large business centers within polycentric Los Angeles are flattening.
Wheaton(2005)	semi- aggregate data of Atlanta office market		Location does seem matter.

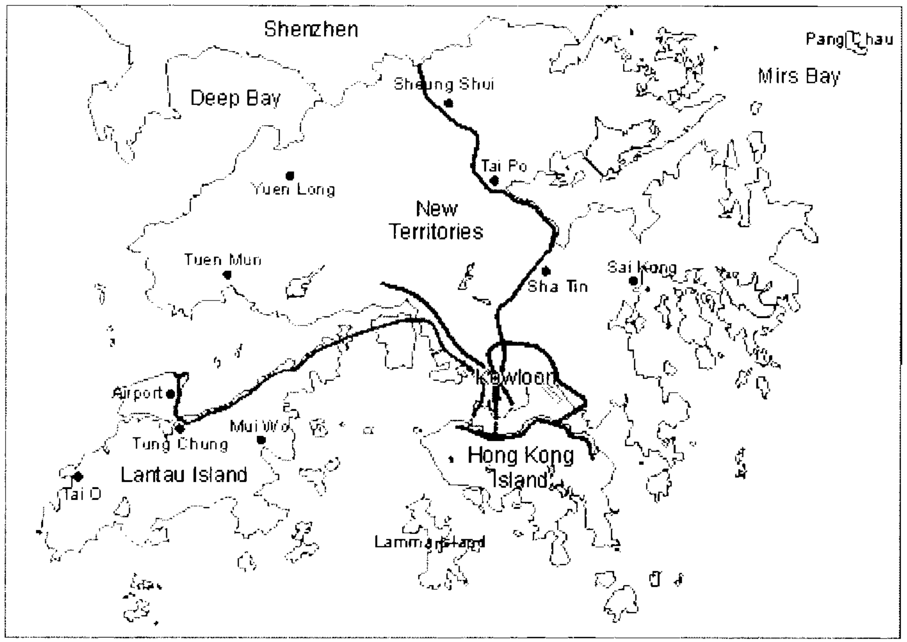
Appendix I: (continued) Comparison of Previous Literatures

Literature	Data	Key Features	Main Conclusions
Mcqueen & Thorley (1991)	NYSE stock data 1947 ~ 1987	Estimating random walk in Markov chain model	Annual stock returns exhibit nonrandom walk behavior. Low (high) return stocks tend to follow runs of high (low) return stocks.
Mills & Jordanov (2003)	London Stock Exchange 1985~1995	Testing size effect in Markov chain model	Large size stocks exhibit more predictability rather than the smallest size portfolios.
Duan & Simonato (2001)	A fixed set of American Options	Approximating Markov chain to GARCH pricing process	The Markov chain method is proved to be an effective numerical method in American option pricing.
Nagaev et al. (2005)	N/A	Theoretical proof of stock price evolution in Markov chains model	The promised profit of the investors arise when the stock price's volatilities are bounded
Lee & Ward (2000)	aggregate data of UK real estate 1981 ~1996	Estimating persistence of real estate returns in Markov chains model	There exists persistence in the performance of real estate from prior to subsequent period across sectors, regions and size.

Appendix II (a): Definition of District and Map

Markets				Estates				Transactions			
Entire Hong Kong	Hong Kong Island	Central & Western	Central & Western	170	170	345	601	5221	5221	11304	23966
		Wan Chai	Wan Chai	131	131			3831	3831		
		Rest of Hong Kong Island	Eastern	40	44			2095	2252		
			Southern	4				157			
	Kowloon	Yau Tsim Mong	Yau Tsim Mong	197	197	239		9375	9375	11286	
		Sham Shui Po	Sham Shui Po	24	24			354	354		
		Rest of Kowloon	Kowloon City	13	18			912	1557		
			Kwun Tong	4				635			
			Wong Tai Sin	1				10			
	New Territories	New Territories	Tsuen Wan	4	17	17		796	1376	1376	
			Tuen Mun	4				153			
			Yuen Long	6				98			
			Kwai Tsing	2				222			
			Shatin	1				107			
			Tai Po	0				0			
			Northern	0				0			
			Sai Kong	0				0			
			Islands	0				0			

Appendix II (b): Entire Hong Kong



Source: http://www.vectormap.com/eng/english.htm

Appendix III Supplementary Results on "District analysis"

One may argue that the office markets before and after the 1997 Handover and Asian Financial Crisis are very different and hence should be separated. We therefore re-do all the analysis with the before 1998 and after 1998 sub-samples and find that the results are strikingly similar. This appendix provides all the details.

Table 12a Summary Statistics of ROR, by District (Full Sample)

District	Mean	Std. Dev.	Min	Max
Central & Western	0.0261	0.228902	-0.39384	0.858859
Wan Chai	0.0189705	0.232495	-0.42175	0.571296
Yau Tsim Mong	0.0444642	0.406574	-0.67319	2.552099
Rest of HK Island	-0.0000677	0.175683	-0.62158	0.685647
New Territories	0.0049486	0.165768	-0.35269	0.43352
Rest of KLN	0.010902	0.181288	-0.37439	0.477085
Sham Shui Po	0.0404663	0.478082	-1	1.846711

Table 12b Summary Statistics of Volume, by District (Full Sample)

District	Min	Max	Mean	Std. Dev.
Central & Western	35	354	100.4038	63.5657
Wan Chai	17	311	73.67308	58.65777
Yau Tsim Mong	62	546	180.2885	120.0892
Rest of HK Island	13	205	43.30769	38.95676
New Territories	6	209	26.46154	35.40381
Rest of KLN	5	164	29.94231	33.3322
Sham Shui Po	0	29	6.807692	5.787202

Table 12c Correlation of Volume, by District (Full Sample)

District	Central & Western	New Territories	Rest of HK Island	Rest of KLN	Sham Shui Po	Wan Chai	Yau Tsim Mong
Central & Western	1						
New Territories	0.6060*	1					
Rest of HK Island	0.8416*	0.4921*	1				
Rest of KLN	0.7607*	0.2957	0.7281*	1			
Sham Shui Po	0.7744*	0.3868*	0.6213*	0.6471*	1		
Wan Chai	0.8735*	0.4093*	0.8242*	0.7809*	0.8165*	1	
Yau Tsim Mong	0.8740*	0.4828*	0.7904*	0.7035*	0.7730*	0.8862*	1

Note: * denote that it is significant at the 1% confidence level.

Table 12d Correlation of ROR, by District (Full Sample)

District	Central & Western	New Territories	Rest of HK Island	Rest of KLN	Sham Shui Po	Wan Chai	Yau Tsim Mong
Central & Western	1						
New Territories	0.1497	1					
Rest of HK Island	-0.0918	0.1855	1				
Rest of KLN	0.1024	0.186	0.2096	1			
Sham Shui Po	-0.0882	-0.2744	0.1299	-0.0132	1		
Wan Chai	0.3826*	0.4380*	0.2488	0.2667	-0.0199	1	
Yau Tsim Mong	0.2537	0.1747	-0.0166	0.1966	0.0038	0.3724*	1

Table 12e Granger Causality of Volume, by District (Full Sample)

District	Central & Western	Wan Chai	Yau Tsim Mong	Rest of HK Island	New Territories	Rest of KLN	Sham Shui Po
Central & Western		Y	N	Y	Y	Y	Y
Wan Chai	N		Y	N	Y	N	Y
Yau Tsim Mong	Y	Y		Y	Y	Y	Y
Rest of HK Island	N	Y	N		N	N	Y
New Territories	Y	Y	Y	N		Y	Y
Rest of KLN	N	N	N	N	N		Y
Sham Shui Po	N	N	N	N	Y	Y	

Table 12f Granger Causality of ROR, by District Price Descendingly (Full Sample)

District	Central & Western	Wan Chai	Yau Tsim Mong	Rest of HK Island	New Territories	Rest of KLN	Sham Shui Po
Central & Western		*N*	*N*	*N*	*N*	Y	*N*
Wan Chai	*N*		*N*	*N*	*N*	*N*	*N*
Yau Tsim Mong	*N*	*N*		*N*	*N*	*N*	*N*
Rest of HK Island	Y	*N*	Y		*N*	*N*	*N*
New Territories	*N*	*N*	*N*	*N*		Y	*N*
Rest of KLN	*N*	*N*	Y	*N*	*N*		*N*
Sham Shui Po	*N*	*N*	*N*	*N*	*N*	*N*	

Appendix IV: Supplementary Results on "1997 change"

One may argue that the office markets before and after the 1997 Handover and Asian Financial Crisis are very different and hence should be separated. We therefore re-do all the analysis with the before 1998 and after 1998 sub-samples and find that the results are strikingly similar. This appendix provides all the details.

Table 13a Test Granger Causality of ROR, office buildings sorted by ROR (1992 Q1 to 1997 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		Y	*N*	Y	Y	*N*	*N*	*N*	*N*	*N*
gp2	*N*		Y	Y	*N*	*N*	*N*	*N*	*N*	*N*
gp3	*N*	*N*		*N*	Y	*N*	*N*	*N*	*N*	Y
gp4	*N*	Y	Y		Y	*N*	Y	*N*	*N*	*N*
gp5	*N*	Y	*N*	*N*		Y	Y	Y	*N*	Y
gp6	*N*	Y	*N*	Y	Y		*N*	*N*	*N*	*N*
gp7	*N*	*N*	*N*	*N*	*N*	*N*		*N*	*N*	*N*
gp8	*N*	*N*	*N*	Y	*N*	*N*	*N*		*N*	*N*
gp9	*N*	Y	*N*	*N*	*N*	*N*	*N*	*N*		*N*
gp10	Y	*N*	*N*	*N*	*N*	*N*	*N*	Y	*N*	

Table 13b Granger Causality of ROR, office buildings sorted by Volume (1992 Q1 to 1997 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		Y	*N*	Y	*N*	Y	*N*	*N*	*N*	*N*
gp2	*N*		Y	*N*	Y	Y	*N*	*N*	Y	*N*
gp3	Y	Y	.	*N*	*N*	Y	Y	*N*	Y	*N*
gp4	*N*	*N*	*N*		*N*	*N*	*N*	*N*	*N*	Y
gp5	*N*	Y	Y	*N*		*N*	*N*	*N*	*N*	*N*
gp6	*N*	Y	*N*	*N*	*N*		*N*	*N*	*N*	*N*
gp7	*N*	*N*	*N*	*N*	*N*	*N*		*N*	*N*	*N*
gp8	*N*	*N*	*N*	Y	*N*	*N*	Y		*N*	Y
gp9	*N*	Y	*N*	*N*	*N*	Y	*N*	*N*		*N*
gp10	*N*	Y	*N*	*N*	*N*	Y	Y	Y	*N*	

Table 13c Granger Causality of ROR, by District (1992 Q1 to 1997 Q4)

District	Central & Western	Wan Chai	Yau Tsim Mong	Rest of HK Island	New Territories	Rest of KLN	Sham Shui Po
Central & Western		N	N	Y	N	N	Y
Wan Chai	N		N	N	Y	N	N
Yau Tsim Mong	Y	N		N	N	Y	N
Rest of HK Island	N	N	N		N	N	N
New Territories	N	N	N	N		N	N
Rest of KLN	N	N	N	N	Y		N
Sham Shui Po	Y	N	Y	N	N	N	

Table 13d Granger Causality of ROR, office buildings sorted by ROR (1998 Q1 to 2004 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		N	N	N	N	N	Y	N	N	N
gp2	Y		N	N	N	N	Y	N	N	N
gp3	Y	Y		Y	N	N	N	Y	Y	N
gp4	N	N	N		N	N	N	Y	N	N
gp5	Y	N	N	Y		N	N	N	N	N
gp6	N	N	N	N	N		N	N	N	N
gp7	N	Y	N	N	N	N		N	N	N
gp8	N	N	Y	Y	N	N	Y		Y	Y
gp9	N	N	N	N	N	Y	N	N		N
gp10	Y	N	Y	N	N	N	N	Y	Y	

Table 13e Granger Causality of ROR, office buildings sorted by Volume (1998 Q1 to 2004 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		*N*	*N*	*N*	Y	*N*	*N*	Y	*N*	Y
gp2	*N*		*N*	*N*	*N*	*N*	Y	*N*	*N*	*N*
gp3	*N*	*N*	·	*N*	*N*	*N*	*N*	*N*	Y	Y
gp4	*N*	*N*	*N*		*N*	*N*	*N*	*N*	*N*	*N*
gp5	Y	*N*	Y	*N*		*N*	*N*	*N*	*N*	Y
gp6	Y	*N*	*N*	*N*	Y		Y	*N*	*N*	*N*
gp7	Y	Y	*N*	*N*	Y	*N*		Y	*N*	*N*
gp8	*N*	Y	*N*	*N*	Y	*N*	Y		*N*	*N*
gp9	*N*	Y	*N*	*N*	*N*	*N*	*N*	*N*		*N*
gp10	*N*	*N*	*N*	*N*	Y	*N*	*N*	*N*	Y	

Table 13f Granger Causality of ROR, office buildings sorted by District (1998 Q1 to 2004 Q4)

District	Central & Western	Wan Chai	Yau Tsim Mong	Rest of HK Island	New Territories	Rest of KLN	Sham Shui Po
Central & Western		*N*	Y	*N*	Y	Y	*N*
Wan Chai	*N*		*N*	Y	*N*	Y	*N*
Yau Tsim Mong	*N*	*N*		*N*	*N*	*N*	*N*
Rest of HK Island	*N*	*N*	Y		*N*	*N*	*N*
New Territories	*N*	*N*	*N*	*N*		Y	*N*
Rest of KLN	Y	*N*	Y	*N*	*N*		*N*
Sham Shui Po	*N*	*N*	*N*	*N*	*N*	*N*	

Table 13g Summary of Granger Causality in ROR (Sub-Samples)

	1992 Q1 to 1997 Q4		1998 Q1 to 2004 Q4	
sorting by Price	·23	Total 90	22	Total 90
	25.56%	100%	24.44%	100%
sorting by Volume	25	Total 90	22	Total 90
	27.78%	100%	24.44%	100%
sorting by District	8	Total 42	9	Total 42
	19.05%	100%	21.43%	100%

Table 14a Granger Causality of Volume, office buildings sorted by ROR (1992 Q1 to 1997 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		Y	Y	Y	*N*	Y	Y	Y	Y	*N*
gp2	Y		*N*	Y	Y	*N*	*N*	*N*	Y	Y
gp3	Y	*N*		*N*	Y	*N*	*N*	*N*	Y	*N*
gp4	Y	Y	*N*		Y	Y	*N*	Y	Y	Y
gp5	Y	Y	Y	Y		*N*	Y	Y	Y	*N*
gp6	Y	*N*	*N*	Y	*N*		*N*	Y	Y	*N*
gp7	Y	*N*	*N*	Y	*N*	*N*		Y	*N*	*N*
gp8	Y	*N*	*N*	Y	*N*	Y	*N*		Y	*N*
gp9	*N*	*N*	*N*	Y	Y	Y	*N*	Y		*N*
gp10	*N*	*N*	*N*	Y	*N*	Y	*N*	*N*	*N*	

Table 14b Granger Causality of Volume, office buildings sorted by Volume (1992 Q1 to 1997 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		Y	Y	Y	*N*	Y	Y	Y	Y	Y
gp2	Y		Y	Y	*N*	Y	Y	*N*	Y	Y
gp3	Y	Y		*N*	*N*	Y	*N*	Y	Y	*N*
gp4	Y	Y	*N*		*N*	Y	Y	Y	*N*	*N*
gp5	Y	Y	Y	Y		Y	*N*	Y	Y	Y
gp6	Y	Y	Y	Y	*N*		*N*	*N*	*N*	Y
gp7	Y	Y	*N*	Y	Y	Y		*N*	Y	*N*
gp8	Y	Y	Y	*N*	Y	*N*	*N*		*N*	*N*
gp9	Y	Y	Y	*N*	Y	*N*	Y	*N*		*N*
gp10	*N*	Y	*N*	Y	Y	*N*	Y	*N*	*N*	

Table 14c Granger Causality of Volume, office buildings sorted by District (1992 Q1 to 1997 Q4)

District	Central & Western	Wan Chai	Yau Tsim Mong	Rest of HK Island	New Territories	Rest of KLN	Sham Shui Po
Central & Western		Y	Y	Y	Y	Y	Y
Wan Chai	*N*		*N*	Y	Y	Y	*N*
Yau Tsim Mong	Y	Y		Y	Y	Y	Y
Rest of HK Island	Y	Y	*N*		Y	Y	Y
New Territories	Y	Y	Y	Y		Y	Y
Rest of KLN	Y	*N*	Y	*N*	*N*		Y
Sham Shui Po	*N*	*N*	*N*	*N*	*N*	*N*	

Table 14d Granger Causality of Volume, office buildings sorted by ROR (1998 Q1 to 2004 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		*N*	*N*	*N*	Y	*N*	*N*	*N*	Y	*N*
gp2	*N*		Y	*N*	Y	*N*	*N*	*N*	*N*	*N*
gp3	*N*	Y		Y	*N*	Y	Y	*N*	Y	*N*
gp4	Y	Y	Y		Y	Y	Y	Y	Y	*N*
gp5	*N*	*N*	Y	*N*		*N*	*N*	*N*	Y	*N*
gp6	*N*	Y	*N*	*N*	Y		*N*	*N*	Y	*N*
gp7	*N*	*N*	*N*	*N*	*N*	*N*		*N*	*N*	*N*
gp8	*N*	Y	*N*	Y	Y	*N*	Y		Y	*N*
gp9	*N*	Y	Y	Y	Y	*N*	*N*	*N*		Y
gp10	Y	Y	Y	Y	Y	Y	*N*	Y	Y	

Table 14e Granger Causality of Volume, office buildings sorted by Volume (1998 Q1 to 2004 Q4)

Group	gp1	gp2	gp3	gp4	gp5	gp6	gp7	gp8	gp9	gp10
gp1		*N*	*N*	*N*	Y	Y	*N*	Y	*N*	*N*
gp2	Y		*N*	*N*	Y	Y	Y	Y	*N*	*N*
gp3	Y	Y		*N*	Y	Y	Y	Y	*N*	*N*
gp4	Y	Y	Y		*N*	Y	Y	Y	Y	*N*
gp5	Y	*N*	*N*	*N*		Y	Y	Y	Y	*N*
gp6	Y	*N*	*N*	Y	*N*		*N*	Y	*N*	Y
gp7	*N*	*N*	*N*	*N*	*N*	Y		*N*	*N*	*N*
gp8	*N*	Y	*N*	*N*	Y	Y	*N*		*N*	Y
gp9	*N*	*N*	Y	Y	*N*	*N*	*N*	*N*		*N*
gp10	*N*	*N*	*N*	Y	*N*	*N*	*N*	*N*	*N*	

Table 14f Granger Causality of Volume, office buildings sorted by District (1998 Q1 to 2004 Q4)

District	Central & Western	Wan Chai	Yau Tsim Mong	Rest of HK Island	New Territories	Rest of KLN	Sham Shui Po
Central & Western		Y	*N*	Y	*N*	*N*	*N*
Wan Chai	*N*		*N*	Y	*N*	*N*	*N*
Yau Tsim Mong	Y	Y		Y	Y	Y	Y
Rest of HK Island	Y	Y	*N*		*N*	*N*	*N*
New Territories	*N*	Y	*N*	Y		*N*	*N*
Rest of KLN	Y	Y	*N*	Y	Y		*N*
Sham Shui Po	*N*	*N*	*N*	*N*	*N*	*N*	

Table 14g Summary of Granger Causality in Volume (Sub-Samples)

	1992 Q1 to 1997 Q4		1998 Q1 to 2004 Q4	
sorting by Price	45	Total 90	40	Total 90
	50.00%	100%	44.44%	100%
sorting by Volume	57	Total 90	38	Total 90
	63.33%	100%	42.22%	100%
sorting by District	29	Total 42	16	Total 42
	69.05%	100%	38.10%	100%

Table 15a T-value of coefficients of Seasonal Dummies in a Regression of Volume with buildings sorted by Volume

	Q1	Q2	Q3
gp1	-1	-0.22	-1.51
gp2	0.89	0.61	-0.4
gp3	0.26	0.35	-1.08
gp4	0.63	0.63	-0.58
gp5	0.26	0.35	-0.21
gp6	0.16	-0.11	-1.28
gp7	0.78	1.01	0.15
gp8	-0.04	0.64	0.07
gp9	-0.02	-0.09	-1.22
gp10	-0.45	-0.73	-0.41

Table 15b T-value of coefficients of Seasonal Dummies in a Regression of Volume with buildings sorted by Price

	Q1	Q2	Q3
gp1	-0.8	-0.1	-1.31
gp2	0.84	-1.44	-0.23
gp3	0.05	-0.05	-0.75
gp4	0.42	1.17	-0.83
gp5	-1.32	-1.06	-1.72
gp6	0.44	1.47	0.15
gp7	-0.29	0.62	0.31
gp8	0.13	0.94	-0.26
gp9	-0.01	1.43	-1.36
gp10	0.09	0.92	0.37

Table 15c T-value of coefficients of Seasonal Dummies in a Regression of Volume with buildings sorted by District

	Q1	Q2	Q3
Central & Western	-0.62	-0.13	-1.23
Wan Chai	1.3	0.81	-0.11
Yau Tsim Mong	-0.12	-0.5	-0.51
Rest of HK Island	0.03	1.82	-1.11
New Territories	-1.01	0.12	-1.12
Rest of KLN	-0.13	-0.38	-1.25
Sham Shui Po	0.92	-0.07	0.74

Table 15d T-value of coefficients of Seasonal Dummies in a Regression of Price with buildings sorted by Price

	Q1	Q2	Q3
gp1	1.3	0.45	0.06
gp2	-1.03	-1.02	-1.31
gp3	0.59	0.32	1.02
gp4	0.73	0.85	1.07
gp5	-0.76	-0.73	-1.57
gp6	-0.12	0.1	0.93
gp7	-0.41	-0.31	1.06
gp8	0.28	0.46	0.77
gp9	1.22	-0.3	-0.17
gp10	0.27	-0.17	-0.27

Table 15e T-value of coefficients of Seasonal Dummies in a Regression of Price with buildings sorted by Volume

	Q1	Q2	Q3
gp1	0.57	-0.43	-0.86
gp2	0.1	-0.26	1.07
gp3	-0.07	0	2.44*
gp4	1.27	0.99	-0.04
gp5	-0.37	0.91	-0.77
gp6	0.74	0.68	1.33
gp7	0.12	0.86	0.09
gp8	-1.21	-0.29	-0.57
gp9	-1.53	0.35	-0.45
gp10	-2.06*	-3.16*	-2.27*

Table 15f T-value of coefficients of Seasonal Dummies in a Regression of Price with buildings sorted by District

	Q1	Q2	Q3
Central & Western	-0.02	0.83	-0.4
Wan Chai	0.31	-0.94	-1.12
Yau Tsim Mong	1.08	-0.35	0.52
Rest of HK Island	1.03	1.64	-0.59
New Territories	0.47	0.35	-0.82
Rest of KLN	-0.74	0.65	0.07
Sham Shui Po	0.1	0.36	1.06

Note: * indicates 5% level statistical significance.