



THE NONLINEAR RELATIONSHIP BETWEEN RENTAL PRICE AND OFFICE SPACE IN HK



Hong Kong

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EXECUTIVE SUMMARY

Based on more than 25,000 transaction records of office units during the period 1993-2018, this study shows that the transaction prices of office property has a non-linear relationship with its size (saleable floor area or SFA), age and floor level. The non-linear size effect suggests that the market value of an office property does not increase proportionally with SFA, other things being equal. The prices per floor areas of smaller units, on average, are higher than those of the larger units. This can be explained by the intangible value of a location attributable its prestige or reputation which is not related to the size of the office units. The characteristics of the office markets in Central and Kwun Tong are used to illustrate the intangible value of locations. In addition, the data show that offices in these two markets are complements rather than substitutes of each other.

The price-age non-linear relationship as revealed from the estimated model suggests that the real value (after adjusted for price changes) of an office declines over time due to physical deterioration of the building structure. However, the rate of decline in value diminishes as the age of the office building increases. This is consistent with the non-depreciable nature of land. An obvious implication is that the constant rate of depreciation (fixed % decrease in value per annum) is unrealistic.

Finally, the empirical result show that floor level premium (change in office price due to an increase in floor level alone) is initially negative and then turns positive at higher floor levels. The floor level premium at higher levels is not constant but get larger at higher levels. This result is puzzling and not consistent with results from the residential market. We believe the view on higher floors has play an important role in shaping this non-linear relationship. More detailed study is needed to understand the observed price-floor non-linear relationship.

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1. Introduction and background of the study

The study examines the relationship between office prices and its attributes, namely size, floor level and age. Since price is capitalized future income, the result is also applicable to rent with the exception of age effect. These relationships are implicitly assumed to be linear in previous studies and practices (e.g. financial reporting and property valuation). This study uses empirical data to test the non-linearity hypothesis. The rationale for non-linear relationship is also discussed from a theoretical perspective. In particular the rationale for the non-linear size effect is demonstrated with a comparison of grade A office prices, supply and the profile of end-users in Central and Kwun Tong, which are the core areas of the primary and second CBDs in Hong Kong. This comparison is also of interest for policy makers and practitioners.

Hong Kong is the Asia financial center. The scarcity of office space is always a topical issue for both entrepreneurs and the government. The concern of shortage of office space and the ever-increasing office prices have driven Hong Kong government to establish a 2nd CBD in the Kowloon East, where Kwun Tong, Kowloon Bay and Kai Tak new development area are located. It has been formally made the target for the second CBD when the 2011-12 Policy Address announced the scheme "Energizing Kowloon East". In fact, we have already seen huge increase in new supply of office buildings the Kowloon East since 2005 and the increasing trend continues after the announcement. The results of this study should be of policy and practical relevance.

2. Research Design

2.1. General Framework

We have two main tasks. The first and main task is to estimate how office prices varies with size, age and floor level. The main tool for this task is regression analysis. The second task is to compare the office markets in Central and Kwun Tong to demonstrate the non-linear effect of size on office prices.

Data sources are presented in the next section. After that, general situation about office stock and completion over year are explored.

2.2. Data Sources

The sources of data are 1. EPRC (the original data source is from Land Registry), 2. Rating and valuation department and the 3. Census and Statistics Department.

The office transaction data are from EPRC. The data set covers the period 1993-2016 and contains information about the address of the transacted unit, its transaction date, transaction price, size of the office unit, building completion date. However, size as well the price in the EPRC could be misleading. We tried to verify the information by manually comparing those figures from EPRC with the information from Centaline Commercial online database. Since the volume of the transaction data is huge (>24000), we can only pick up those suspicious observations which have either very low or very high per square foot price for checking. Fortunately, numbers from EPRC are matched with those in Centaline among those suspicious observations we single out and the common mistakes, in EPRC, if occur, are mostly wrong decimal point for transaction price or incorrect floor area. We also drop those observations with incomplete information, like address,

size. To ensure that the price reveals the competitive market price, we drop out all first-hand transaction from our analysis.

We do several cleaning exercises for the EPRC dataset:

1. Delete all observation with dubious information on building completion date
2. Delete all observation with dubious information on floor level
3. We delete all possible first-time transaction for the office unit
4. We delete all observation without information on size or price or price is equal to zero
5. We delete all observation with age less than or equal to zero
6. We only look at transaction record after 1992 as the data quality before that seem doubtful and scattered; nevertheless, there are not many records deleted.

We mainly use the last two sources of data to implement our regression analysis to figure out the relative average office prices across districts after controlling for essential attributes of the office units. In order to control for the office grade differential, information that is not publicly available, we do two-step analysis to retrieve a proxy variable for office grade and then redo the analysis in the second stage with that variable to arrive estimates for district price differential estimates.

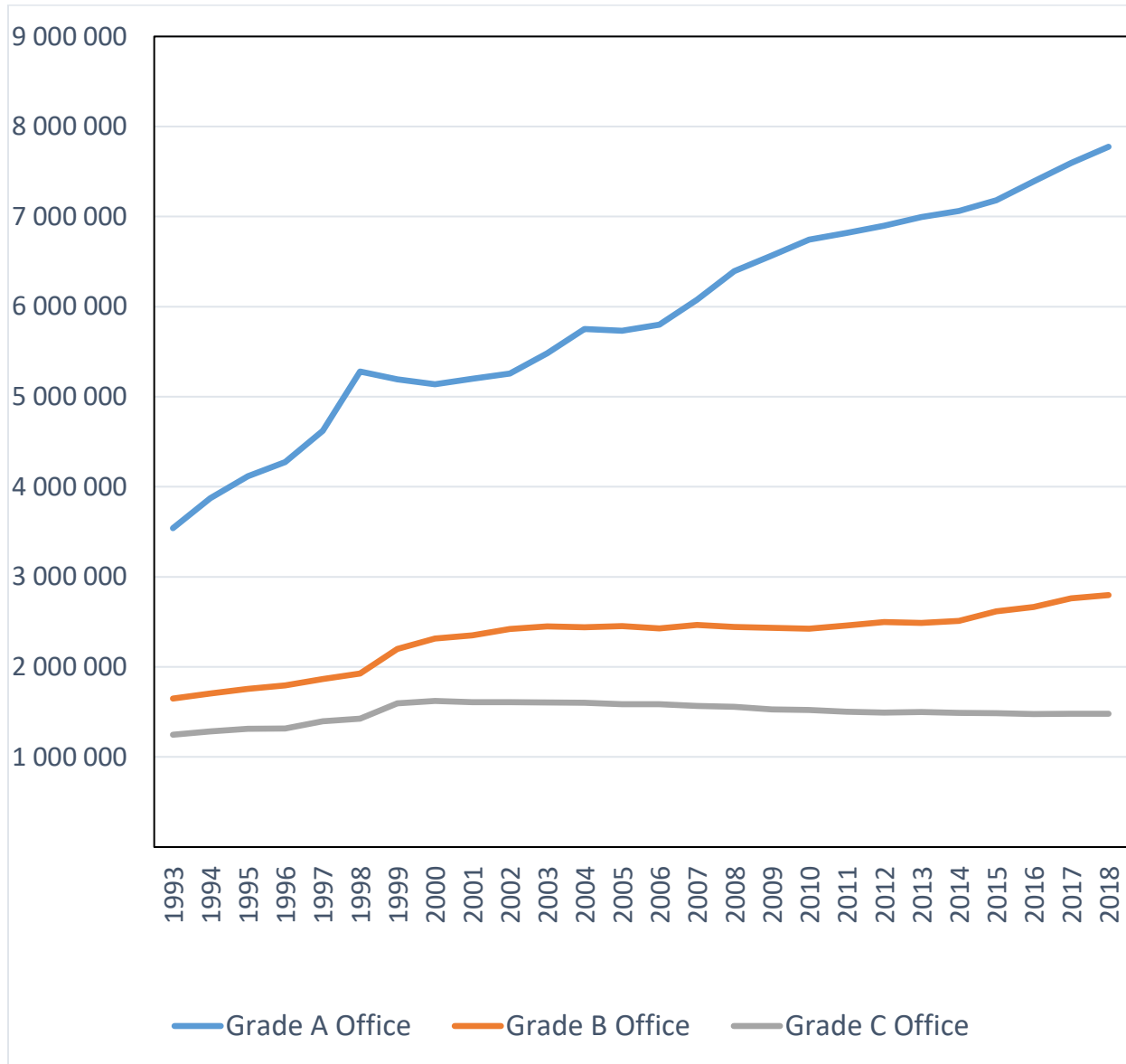
The data from the Census and Statistics Department are mainly from the Quarterly Report of Employment and Vacancies Statistics published by Hong Kong Census and Statistics Department(*Quarterly Report of Employment and Vacancies Statistics, various issues*). The major information we retrieve is the distribution of the number of engaged persons across various industry in major districts over time period of 2000-2018. We mainly use them to illustrate which industries are the dominant ones, like finance and insurance industry, in those major business districts and examine whether there is trend for the growth and decline of some industries in a district. By investigating districts' establishment and engaged persons' industry distribution and their changes over time, we can evaluate the idea that Kwun Tong will become a more dominant business district instead of remaining a secondary industry hub.

The district-wide price office price trends and stock are from the Hong Kong Property Review published by Rating and Valuation Department (Rating and Valuation Department, various issues). We focus on six major districts: Central, Sheung Wan, Tsim Sha Tsui, Wan Chai (+Causeway Bay), Hong Kong East, Mong Kok (+Yau MA Tei), Kwun Tong (+Kowloon Bay) and Hong Kong South whenever their data is available.

2.3. The Hong Kong Office Stock

From the Property review by Rating and Valuation Department, total office stock in Hong Kong has been ever increasing between 1993 and 2018. In 1993, the total stock was 6,436,100 square meters; by the end of 2018, the number has increased to 115,300,000 square meters. More noticeably, the increase has been largely driven by the increase in the stock of grade A office with modestly increase in grade B office stock.. On the contrary, the grade C office has been steadily low and it has never achieved any increment after 2000. The figure one below shows the trends of the stocks of the three grades of office stock.

Figure 1: Total Stock of Offices by Grade (m² of SFA) in Hong Kong (1985-2018)



It can be seen that stock of grade C office remains almost unchanged over while the stock of grade A office shows the steepest increase. This suggests that new supply of offices are mainly high specification grade A offices. Traditionally, this is explained by the high land prices. When land price is high, construction cost is only a fraction of the market value, which includes both land value and development cost (construction cost is major component.). A significant difference in

the construction cost only means a small different in the market value of the completed building. The construction cost of a high-end office in Central is less than 20% of its market value. High-end offices are approximately 50% more expensive to construct. However, the price per floor areas of a grade A offices is more than double that of a grade C office in a similar location. To develop a grade C office can save less than 5% in construction cost but value of the final product is more than halved. Sometime development of Grade A office is not possible due to shape or size of the sites, they are usually developed as Grade B office.

In Hong Kong's situation, many industrial buildings have been used as low-end offices (legally or illegally), competition from industrial building makes further suppresses the supply of new grade C offices. In addition, change in technology, higher demand for qualities from end-user also shifted the demand from grade C to grade A offices which widens gaps between their market values. Finally government policy can also influence the supply of grade A offices.

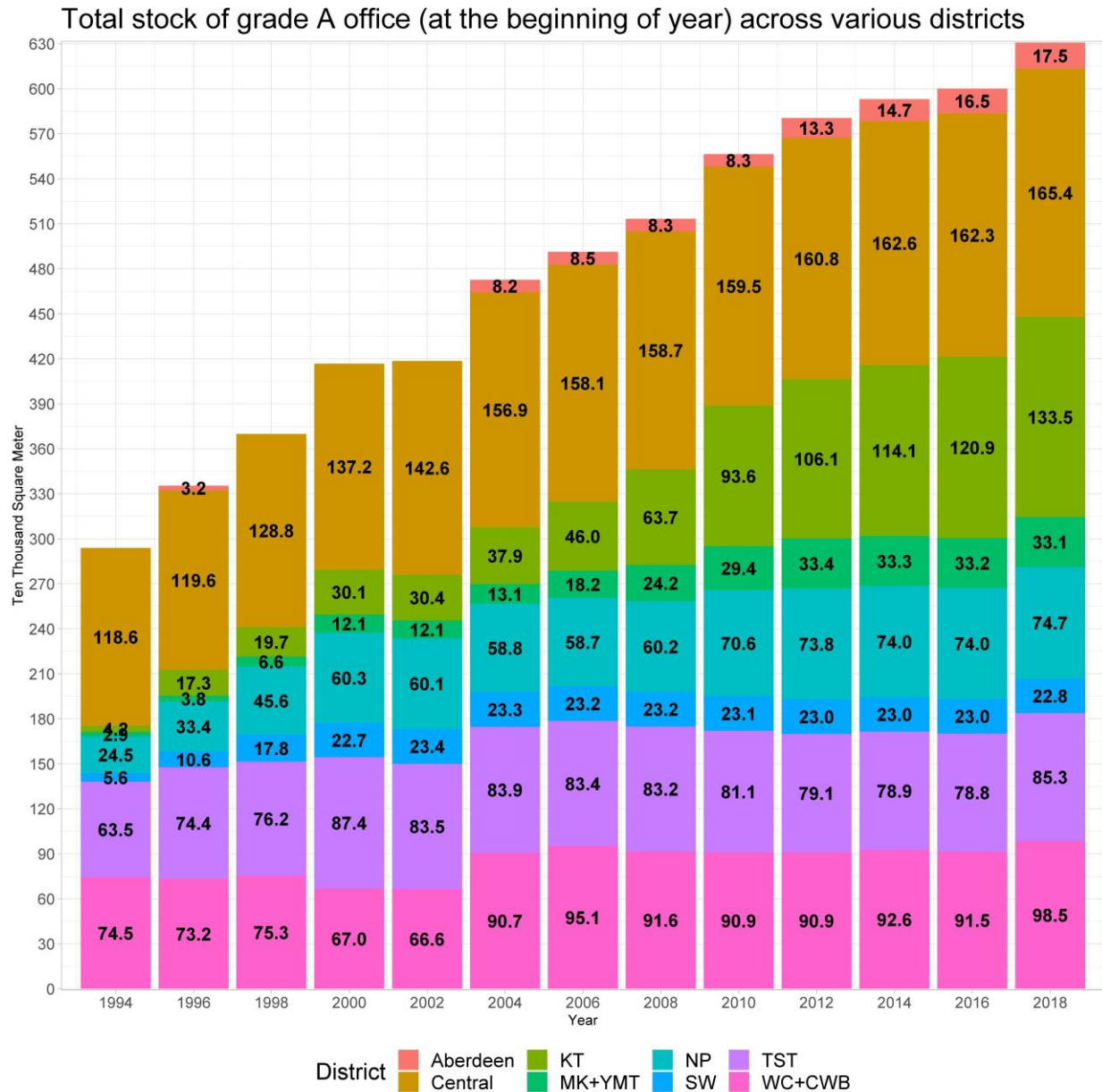
Without redevelopment constraints, we should see a decline on grade C office stocks as they will be redeveloped into the higher value grade A offices. However, many of these grade C offices are not single owned. Some occupy small sites that are not suitable for grade A office development. Therefore, new grade A office usually do not come from the traditional commercial areas.

To understand where these now grade A offices are located, we collect data on the distribution of the stock of different grades of offices across different commercial areas in Hong Kong over the period 1994-1998. The results are depicted in Figure 2. Here are some stylized facts:

1. Most grade A offices (brown) are located in Central, the traditional CBD of Hong Kong. However, the growth of total stock of grade A offices has been slow
2. Kwun Tong (KT, dark green), shows the higher growth in the total stock of grade A office since 2006.
3. Some new grade A offices merges in Aberdeen in recent years.
4. While there are some growth in the stock of grade A offices in other commercial areas, the growth rate is in slow or in line with that of the entire Hong Kong.

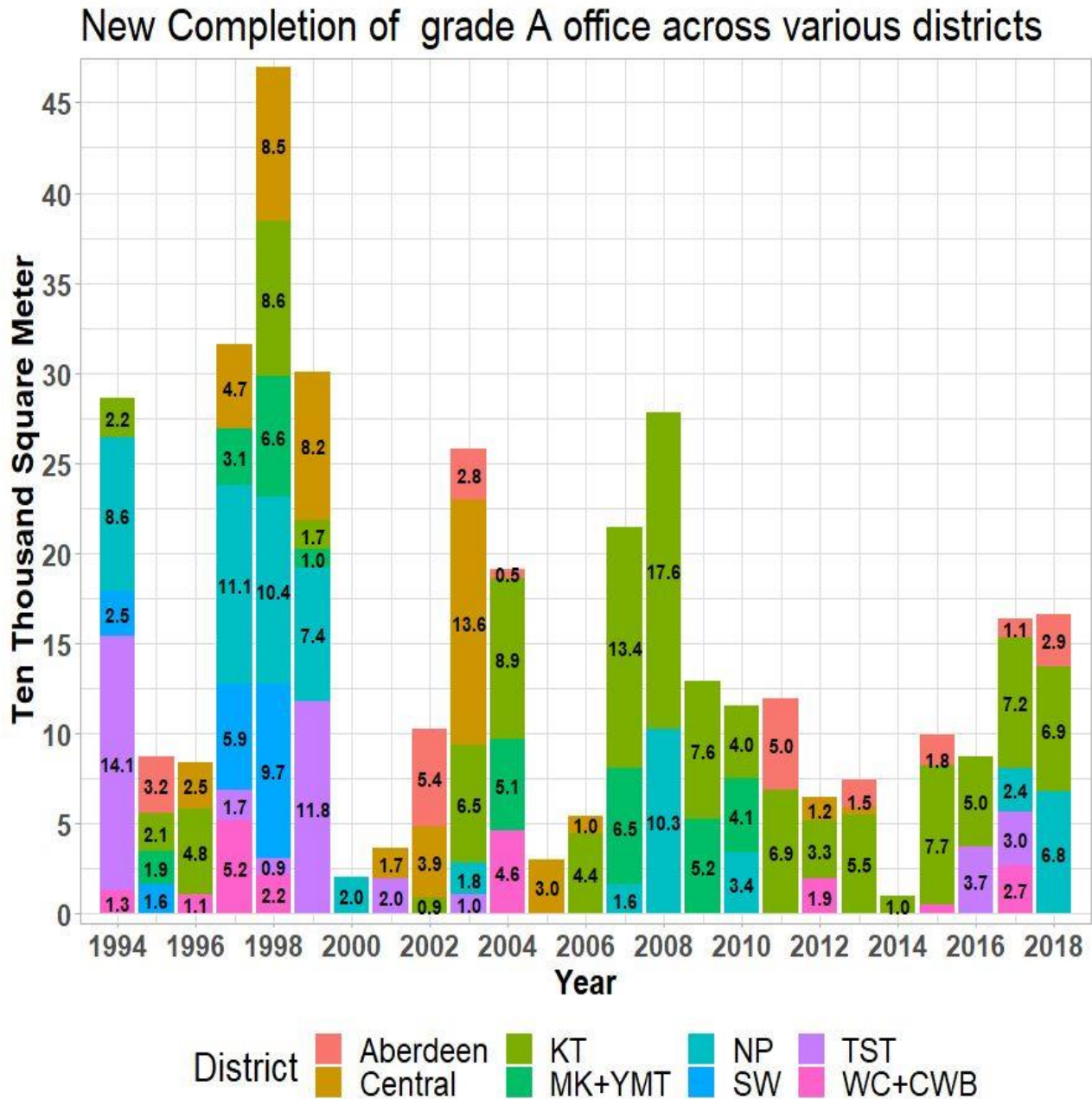
Since Kwun Tong is a major area of Kowloon East, the government’s policy of developing Kowloon East into a second CBD has played an important the significant role in propelling the supply of grade A offices in area.

Figure 2: Grade A office Stock across commercial areas



While figure 2 shows a stock view on the distribution of grade A office supply across districts over time, which is a result of new construction less demolition. Figure 3 shows the distribution of newly completed grade A offices across different commercial districts.

Figure 3: New Supply of grade A offices



The key message from figure 3 as follows:

1. Between 2006-2015, Central had less than 25000 square meters new completion of grade A office.
2. Around the same time period, Kwun Tong (KT) become the prime district for new completion of grade A office.
3. Tsim Sha Tusi (TST) had no more new supply of grade A office after 2003, except for 2016 [Note that ICC, which is completed in 2010, belongs to West Kowloon, not TST]
4. Hong Kong East (NP) also did not have new completion of grade A office after 2010 even it offered new supply of grade A office during 2007 and 2010.

From the above results, we can notice that Kwun Tong has become both a district of the second largest stock of grade A office space and a major source of its new supply. If ranking districts in terms of grade A office stock alone, Kwun Tong has already become second CBD. This begs the question of whether the new second CBD is a substitute (and therefore completing) or complement (therefore augmenting) the traditional CBD. To answer this, we examine the characteristics of the price, end-users and firms occupying in second and old CBD. We will examine the prices using a hedonic price model in the next section and the characteristics of end-users and firms in Section 3.

2.4. Hedonic Pricing Model

The above analysis examines the office market from quantity (supply) side. Now, let us look at it from the price side. The difficulty in comparing (average) prices across districts is that offices are heterogeneous in those transaction records in different districts.

To handle this kind of heterogeneity, regression analysis is applied and our focus here is on telling the average price differential among major business districts by examining voluminous transactions prices of office units there over time while controlling for essential quality of office units.

The model we use is a variant of hedonic pricing model. The hedonic price model captures an asset's value through its essential attributes. The exact specification of the model depends on the specific situation at hand. In Hong Kong, the location should be the most important feature, following by size and then the overall of condition of the office units, which can be proxy by age of the building as well as office building grade. We follow this idea by taking the location, the floor area, the floor level, age of the office unit into our regression analysis. To capture the market fluctuation over time, yearly dummies are incorporated into our statistical model.

We suffer several data limitations, which is needed to bear in mind when interpreting the results of our analysis (since our results could not distinguish among some differential features among office units). One is that we do not have information about the view of the office units, which could vary over time because of possible changing surrounding environment and are hard to verify without personal visit on each site, making it almost impossible to trace out the views of those office spaces scattered across various districts over more than 20 years of study period. The other missing information is traffic convenience. The ever-changing network of roads, bridges and subways as well as bus stops and even access to MTR station can't be easily identified and walking distance, hence convenience, can alter dramatically because of the construction of bridge or extension of a subway over years. Without every detailed information of those changes in each district of our interest over time, we cannot incorporate this factor into our analysis. Hence, what our regression analysis does is to estimate the relationship between office price and those included attributes as well as district differential factors by averaging out the difference in traffic convenience, view and other un-observables among observations.

Our major departure from traditional hedonic pricing model is to bring office grade factor into analysis. However, Rating and Valuation Department does not make available the office grade for each building to public use. Furthermore, the office grade can be time-varying, which makes its assignment more difficult for our analysis. Our approach to handling this missing data problem is

to do regression in two stages, trying to retrieve the office grade information from the pricing information. In the first-stage of regression, we try to include as many relevant variables as possible, including the supply stock, vacancy, and near-future supply forecast to make the residuals from the resultant regression model as clean as possible. The residuals should contain the office grade information since it is one of the most essential factors affecting the price for the office units at the time of transaction. We then make a classification that for those residuals with positive sign will be categorized as grade A office, and those with negative sign or zero will be regarded as non-grade A office. With this information, we then run a hedonic regression in the second stage by regressing the price on the office units' essential attributes as well as the imputed grade-A dummy variable with yearly and district fixed effects. Our goal is to examine and compare among district coefficients to tell the ranking of average office price during our study period after controlling those essential factors mentioned above.

To be specific about our study period, our office transaction data is from EPRC,1993-2016, which contains various key attributes of the office units, and supply side information are from Property Review. The three key supply side information used in the first stage are:

They are not hedonic factors per se for the office price. However, they might be related to some other hedonic factors, like transportation convenience, surrounding environment, like bridges and road network.

We will lay out the regression models in a more detail in the regression section since it takes some time to set up those models. Let us now to look at the demand aspect of grade A office next section. In particular, the employment statistics across districts of interest.

3. Results of Hedonic Pricing Model Regression

3.1. Descriptive Statistics for the Data Used in the Hedonic Pricing Model

Before the formal regression analysis, we present the summary statistics to summarize the essential information. Table 1 shows the essential summary statistics of the key variables that are used in the later analysis.

Table 1: Summary Statistics for the sample used in the regression analysis

Statistic	N	Mean	St. Dev.	Min	Max
Floor (level)	26,171	12.13	6.67	1	66
CONSIDER	26,171	6.49	15.20	0.15	701.8
USIZEG	26,171	1,210.15	1,692.45	105	32,000
AGE	26,171	17.69	9.63	0.08	55.17

There are 26171 observations in our sample. The floor (level) statistics offered evidence that our data is quite balanced as it covers various floor levels with concentrated around 3-24 floor even though some office buildings have higher floor level and the highest floor in the sample is 66. The price varies a lot, from the lowest 0.15 million to the highest 702 million. The average size of office space in our sample is 1210 square feet. The standard derivation, 1692 square feet, is also large. This gives us further confidence that our sample has wide coverage of various size of office space. Age of the office building has average 17.7 years with 9.6 standard deviation. The transaction date for the observation is between 1993 and 2018. The age refers to the age of the building at the time of transaction.

To offer better idea how the observation in the sample is distributed across major districts over time, a two-way table is used to show the pattern. Table Two presents the distribution of sample across year and district.

Table 2 : Two-way Frequency Table for office transaction data

Year	Aberdeen	Central	KT	MK+YMT	NP	SW	TST	WC+CWB
1993	7	43	51	382	158	195	365	300
1994	5	40	49	343	176	225	452	410
1995	2	25	23	178	70	130	187	132
1996	6	83	49	213	102	163	309	228
1997	12	97	50	226	121	175	376	252
1998	2	78	11	98	35	76	178	92
1999	2	141	26	126	37	93	288	124
2000	5	67	34	147	63	75	258	112
2001	7	36	23	127	71	62	189	183
2002	9	23	8	139	43	71	161	86
2003	4	45	10	127	55	33	225	95
2004	10	112	62	193	87	133	418	305
2005	41	58	44	331	131	194	453	367
2006	35	29	50	224	80	151	278	251
2007	44	46	43	362	105	182	440	303
2008	45	30	33	273	72	150	337	198
2009	49	32	27	353	96	171	283	222
2010	92	52	39	468	104	181	438	286
2011	40	26	66	515	100	143	343	223
2012	38	23	99	529	115	142	281	151
2013	13	8	51	216	36	64	129	91
2014	13	9	16	103	32	41	66	58
2015	10	8	39	156	38	52	101	70
2016	14	24	38	106	39	55	120	80
2017	33	24	103	209	67	113	174	94
2018	58	13	57	165	49	71	129	79

Market transactions of offices are most frequent for Mong Kok and Yau Ma Tei district, followed by Tsim Sha Tsui, then by Wan Chai and Causeway Bay district. Central has relatively few transaction records since many high-end offices there are held by landlords for leasing purpose. Also, some offices are held by companies, the transactions of which are done by transfer of company shares and no transaction record can be found in the Land Registry. One might wonder why there are relatively few transaction observations from Kwun Tong, especially during recent years. This is due to our exclusion of first-hand transaction (which are usually presold based on listed prices which are affected by developer's financial arrangement).

3.2. Estimated Coefficients and Interpretations

We now perform the first-stage regression analysis to examine the relationship between office price and its characteristics. The following is our regression model for estimating the residual terms, ε_{it} .

$$\ln(np_{it}) = \alpha + size_i * \beta_{size} + size^2 * \beta_{size^2} + age_{it} * \beta_{age} + age^2 * \beta_{age^2} \\ + floor * \beta_{floor} + floor_i^2 * \beta_{floor^2} + \sum_j \phi_j D_{i,j} + \sum_{t'} \zeta_{t'} T_{t,t'} + \varepsilon_{it}$$

Notations	Explanation
np	Nominal Transaction Price
size (in square feet)	The gross floor area
age (in year)	The age of the office unit at the time of transaction
floor (level)	The floor level the office unit located
D	District dummies (letting Aberdeen as a reference point)
T	Year dummies (letting 1992 as a reference point)

Since our focus is on Grade A offices, we construct a proxy for grade A office, $gradeA$ as follows: $gradeA_{it} = 1(\hat{\varepsilon}_{it} > 0)$ and do a second-stage regression which limit the observation to Grade A offices. Table 3a and Table 3b show results of the first and second stage regressions respectively.

Table 3: Stage 1 Regression Result

Variable	Coefficient	Std. Error	P-value
C	-0.33363591	0.05846547	<1%
SIZE	0.01159508	0.00004405	<1%
SIZE²	-0.00000676	0.00000004	<1%
AGE	-0.02597335	0.00103023	<1%
AGE²	0.00049019	0.00002345	<1%
FLOOR	-0.00503621	0.00117848	<1%
FLOOR²	0.00021619	0.00003893	<1%
DCODE="HK-C"	1.05532577	0.02573053	<1%
DCODE="HK-CB"	0.57219677	0.02433281	<1%
DCODE="HK-NP"	0.22998447	0.02348093	<1%
DCODE="HK-SW"	0.38544041	0.02313960	<1%
DCODE="HK-WC"	0.50759216	0.02310003	<1%
DCODE="HK-WCH"	0.19699106	0.03301440	<1%
DCODE="KL-KB"	0.37567091	0.02600256	<1%
DCODE="KL-KT"	0.35072285	0.03643943	<1%
DCODE="KL-MK"	0.08473253	0.02254145	<1%
DCODE="KL-TST"	0.65869328	0.02274106	<1%
DCODE="KL-YMT"	0.10861329	0.02407494	<1%
Adjusted R-squared	0.875	N=25,542	

Table 4: Stage 2 Regression Result

Variable	Coefficient	Std. Error	P-value
C	-0.13461761	0.04624202	<1%
SIZE	0.01072928	0.00004458	<1%
SIZE²	-0.00000572	0.00000004	<1%
AGE	-0.01886067	0.00079386	<1%
AGE²	0.00034325	0.00001788	<1%
FLOOR	-0.00352792	0.00093068	<1%
FLOOR²	0.00022970	0.00003027	<1%
DCODE="HK-C"	1.22170168	0.02221801	<1%
DCODE="HK-CB"	0.62883622	0.02128733	<1%
DCODE="HK-NP"	0.26114822	0.02072397	<1%
DCODE="HK-SW"	0.43327636	0.02040440	<1%
DCODE="HK-WC"	0.56704035	0.02037143	<1%
DCODE="HK-WCH"	0.25194338	0.02779002	<1%
DCODE="KL-KB"	0.39600811	0.02219406	<1%
DCODE="KL-KT"	0.43338611	0.02946254	<1%
DCODE="KL-MK"	0.15460658	0.01999018	<1%
DCODE="KL-TST"	0.82269733	0.02029087	<1%
DCODE="KL-YMT"	0.16465125	0.02102686	<1%
Adjusted R-squared	0.936	N= 13,205	

As a caveat, the above results are from a trimmed sample by excluding potential outliers. The potential outliers are singled out by the criteria that those observations are outside the range of box and whisker plot for each district in each year. The sample is further trimmed by eliminating some extremely low transaction prices, which could be due to measurement error or possibly non-arms-length transaction.

We have also estimated equation with size-weighted (by SIZE), the results are similar, therefore we will stick to the normal regression one. All coefficients are with expected signs. We include squared terms for floor area, floor level, and age in the analysis and all of their coefficients are statistically significant, suggesting there exist non-linear relationship between these variables are office prices.

From the regression analysis, we have the following observations:

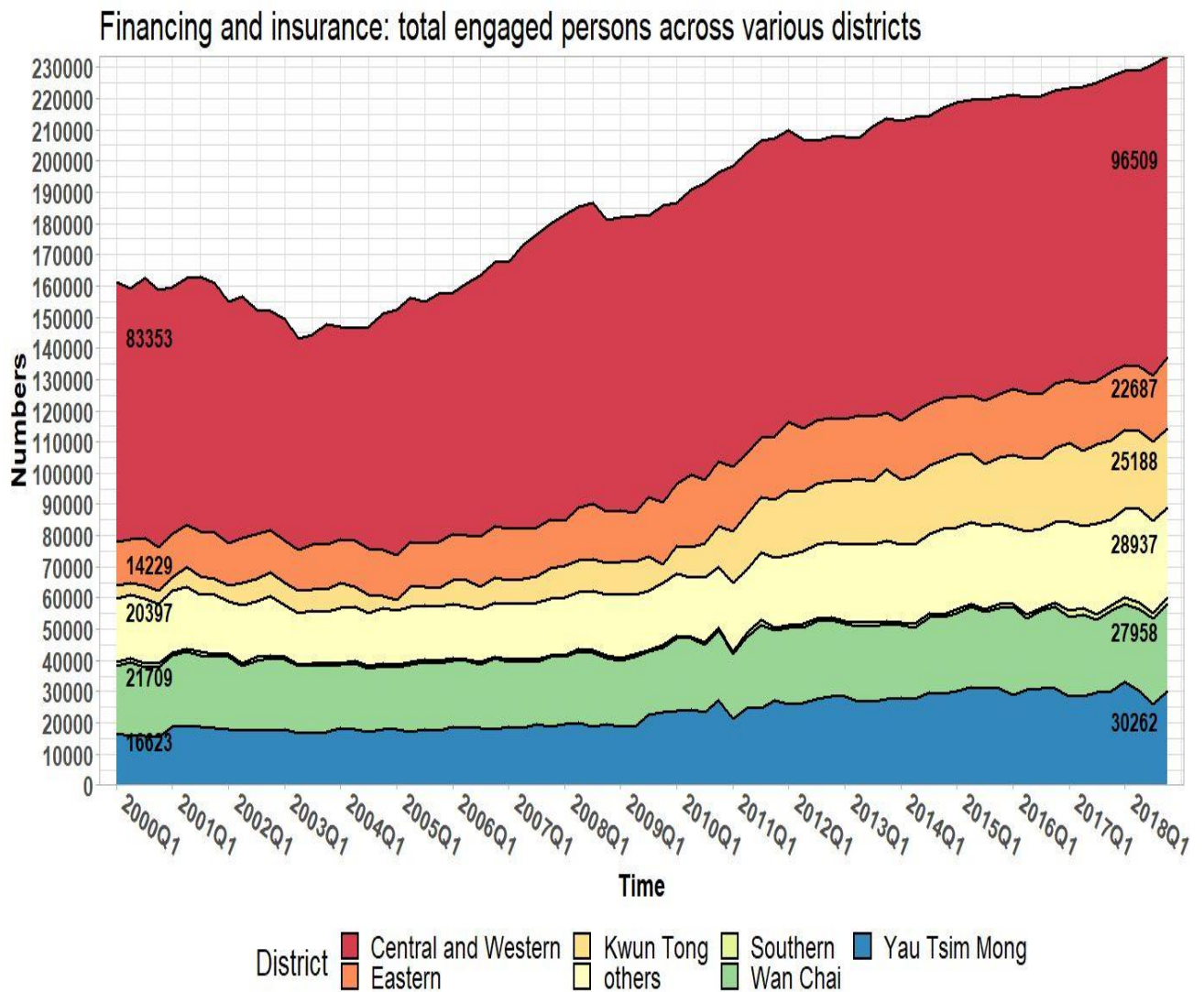
1. The coefficients of all squared terms are significant at the 1% level. The results confirm the non-linear effect of size, age and floor level on the office price.
2. Office price increases at a decreasing rate with the size of the office. On average, the smaller the office size, the higher is its unit price (or price per SFA).
3. Office prices decrease but at a decreasing rate with the age of the building. New offices command higher premium over the older ones due to physical deterioration economic obsolescences of the building structure, but such an age premium decreases as age increases. This is consistent with non-depreciable land value over time and the redevelopment real option value of old offices.
4. Office prices decrease initially as floor level increases but increase after the 8th floor (turning point at $-0.00352792/(-2*0.00022970) = 7.68$). Buyers are willing to pay a premium for units on higher levels after the 8th floor.
5. The floor level premium is not constant but gets larger at higher levels. This result is not consistent with that in the residential properties in Hong Kong, which exhibit an increasing at a decreasing rate relationship between price and floor level. The increase in floor level premium as at higher floor levels as is likely to be due better views at higher levels and that a good view is a prestigious factor and commands a higher premium.
6. Our regression model can explain 94% of the office price variation during the sampling period.
7. After controlling for size, floor level and the age factors, Central commands the highest prices for grade A and all offices amongst all districts.
8. Tsim Sha Tsui commands the second highest prices among all included districts for both grade A offices and all offices.
9. On average, grade A office prices in Kwun Tong (core part of the 2nd CBD is only about one third that of similar offices in Central, the old CBD).

4. Profiles of End-users

The following analysis investigates the number of office end-users in the financial sector - financing and insurance different commercial areas. These users are traditional grade A office users.

4.1. Distribution of office end-users in financial sector

Figure 4: Financial Sector - total engaged person across districts



The above graph shows that

1. Central has the lion share of end-users in the financial sector.
2. The number of financial sector end-users has been increasing in Kwun Tong in recent years.
3. Although the stock of grade A offices in Kwun Tong is approaching that of Central, the total number of end-users from the financial sector is only about one quarter of that of Central.

4.2. Distribution of office end-users in Professional and Business Services sector

Next to the financial sector, the total number persons engaged in professional and business services sector also major end-users of grade A offices. Example of these tenants include multi-national legal firms, medical doctors, management consultants and international surveying and real estate consultants etc. Figure 5 shows the distribution of end-users from the Professional and Business Services sector.

From figure 5, we have the following three observations:

1. Demand from the Professional and Businesses Service sector in Central has been increasing steadily while there is almost no growth in demand in Wan Chai and Yau Tsim Mong (also see Figure 7, Figure 8 and 9).
2. The growth in demand for office space from the Professional and Businesses Service sector in Kwan Tong is phenomenal. In 2000, occupants from this sector in Kwun Tong was approximately one quarter of that of Central. The ratio increased to more than 80%. Over the period 2000-2018 end-users from the Professional and Businesses Service sector increase by 350% in Kwun Tong while those in Central only increased by 47%. (also see Figure 6)
3. The growth rate of end-users in Professional and Businesses Service sector in "Others" areas is even higher indicating a decentralization trend for end-users in this sector.

In sum, the end-user profiles of Central and Kwun Tong suggest that the second CBD of Kowloon East complement rather than compete with the old CBD of Central. Grade A office building in Kwun Tong, despite being newer and cheaper, cannot attract much end-users from the Central. However, there is a decentralization trend in the Professional and Business Service sector. Offices in Kwun Tong has been able to attract many of these decentralized end-users.

Figure 5: Professional and Business Services - total engaged person across districts

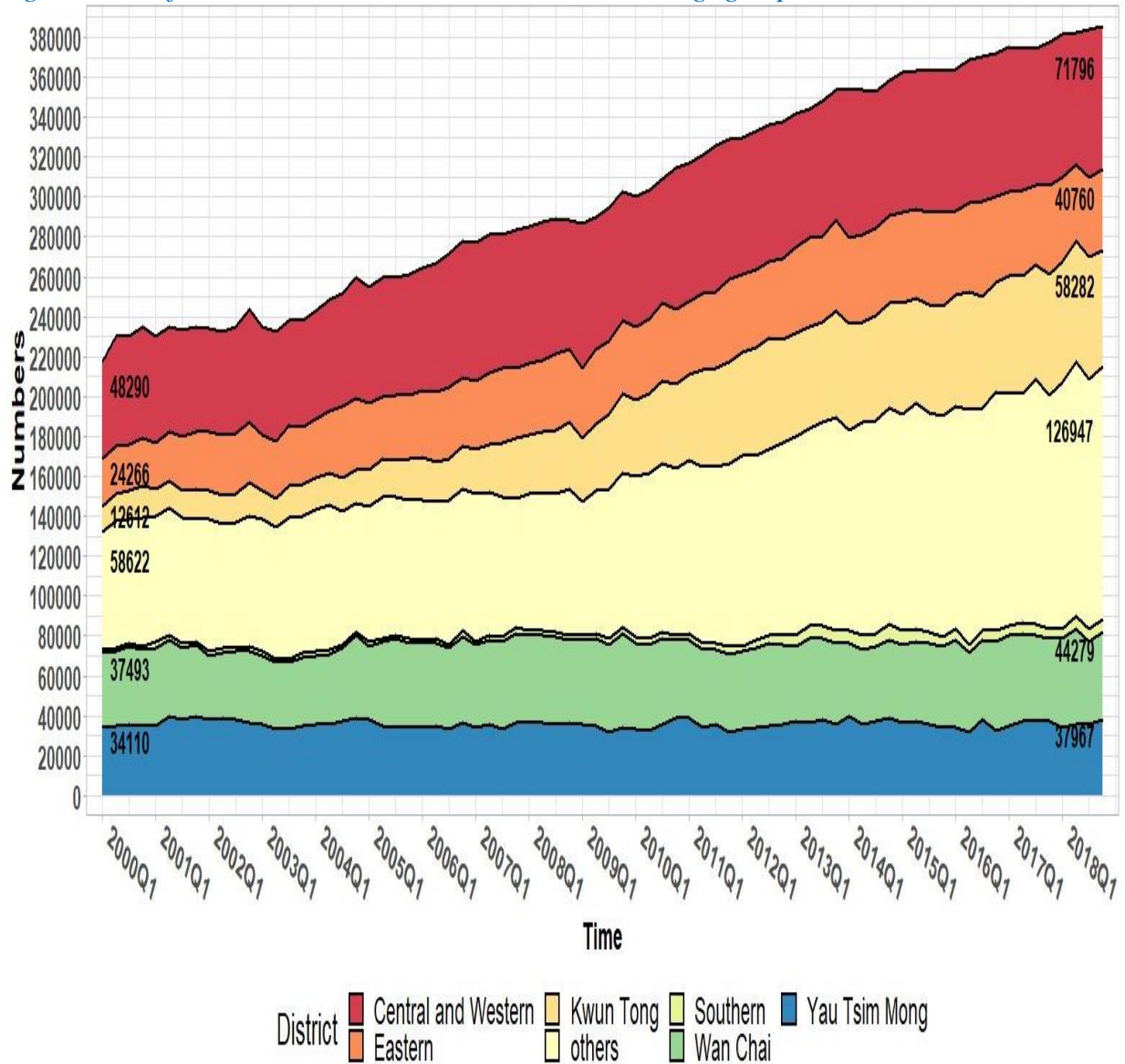
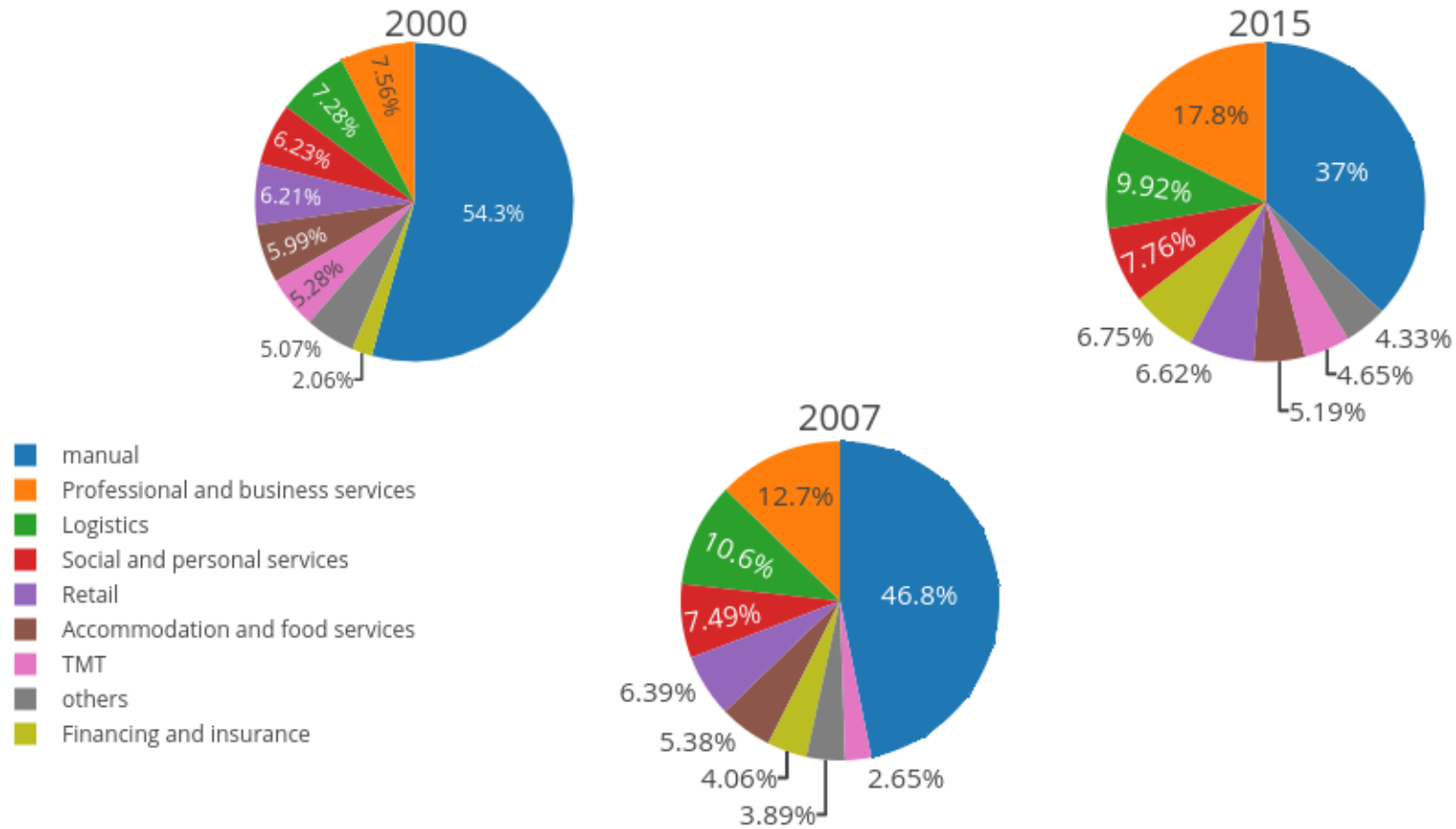


Figure 6: Number of Persons Engaged Across Industries in Kwun Tong in 2000, 2007, 2015

Kwun Tong: Proportion of engaged persons in industries

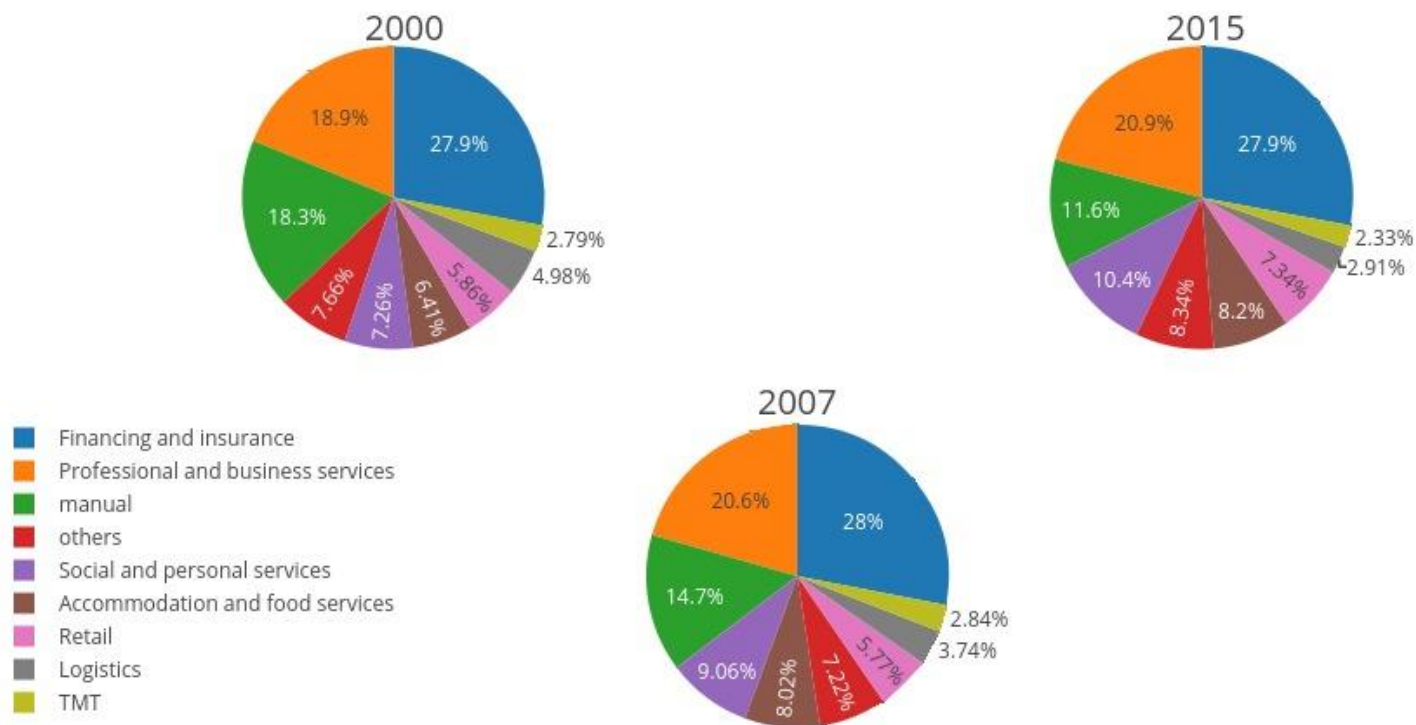


Kwun Tong demonstrates large changes over time. Manual sector, once taking the highest portion of engaged persons in 2000, dropped from 54.3% in 2000 to 37% in 2015. At the same time, professional and business services sector enjoyed large growth from 7.5% in 2000 to 17.8% in 2015. Financing and insurance sector has also seen rapid growth from 2.06% in 2000 to 6.75% in 2015. Both retail and, social and personal services sector have stable portion of engaged persons.

As a comparison to Kwun Tong, we plot the same distribution graph for Central and Western areas.

Figure 7: Number of Persons Engaged Across Industries in Central and Western District in 2000, 2007, 2015

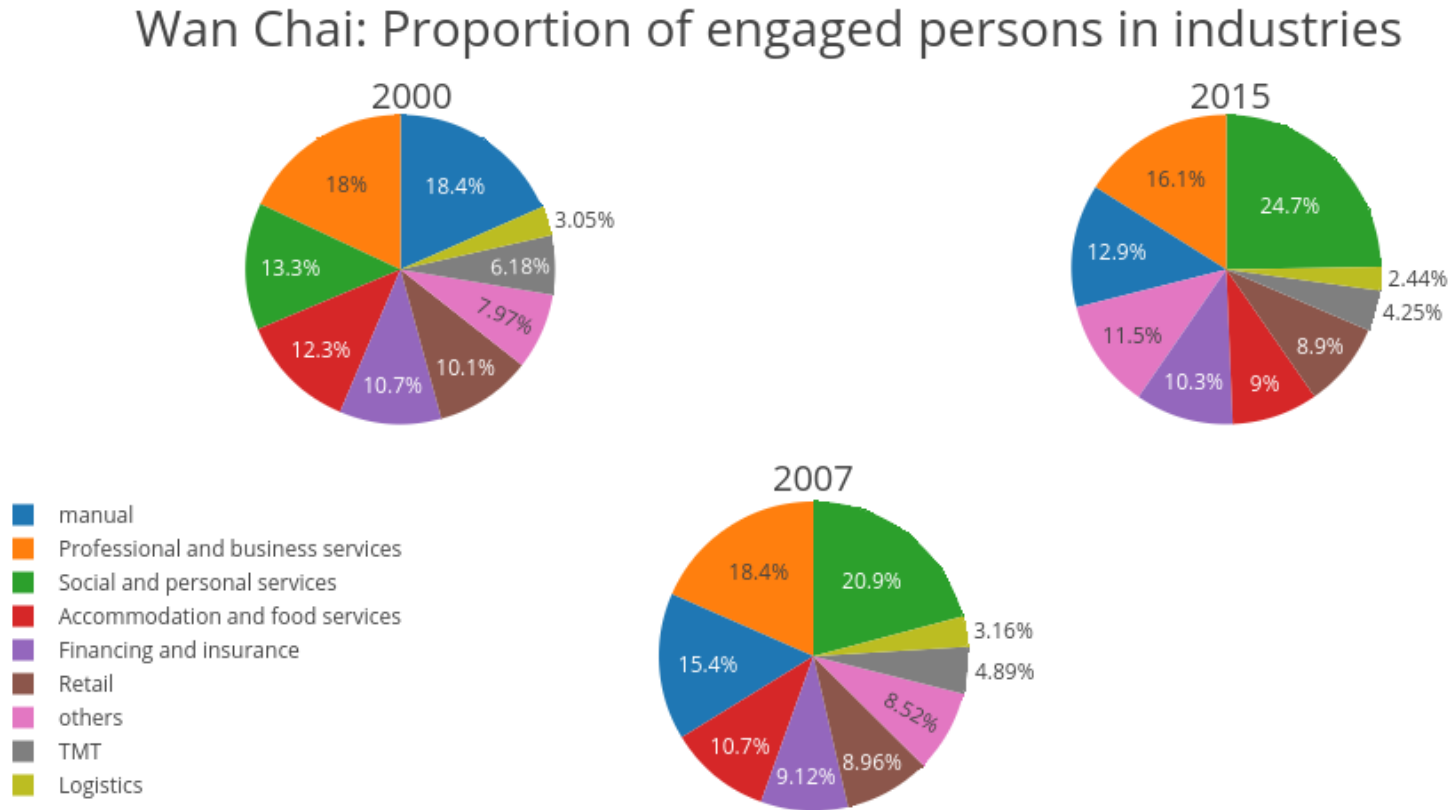
Central and Western: Proportion of engaged persons in industries



There is not much change in composition of engaged persons in industry between 2000 and 2015 in Central, with the financing and insurance taking the highest portion (~28%) and professional and business services taking the second lead (~20%). The third portion, manual, keeps decreasing from 18.3% in 2000 to 11.6% in 2015. The rest are social and personal services, accommodation and food services, and retail, each of which takes around 5-10% over the period of 2000-2015.

Since Central and Western might not be a good comparable as it is a well-established CBD, we select Wan Chai district and Yau Tsim Mong district for comparison.

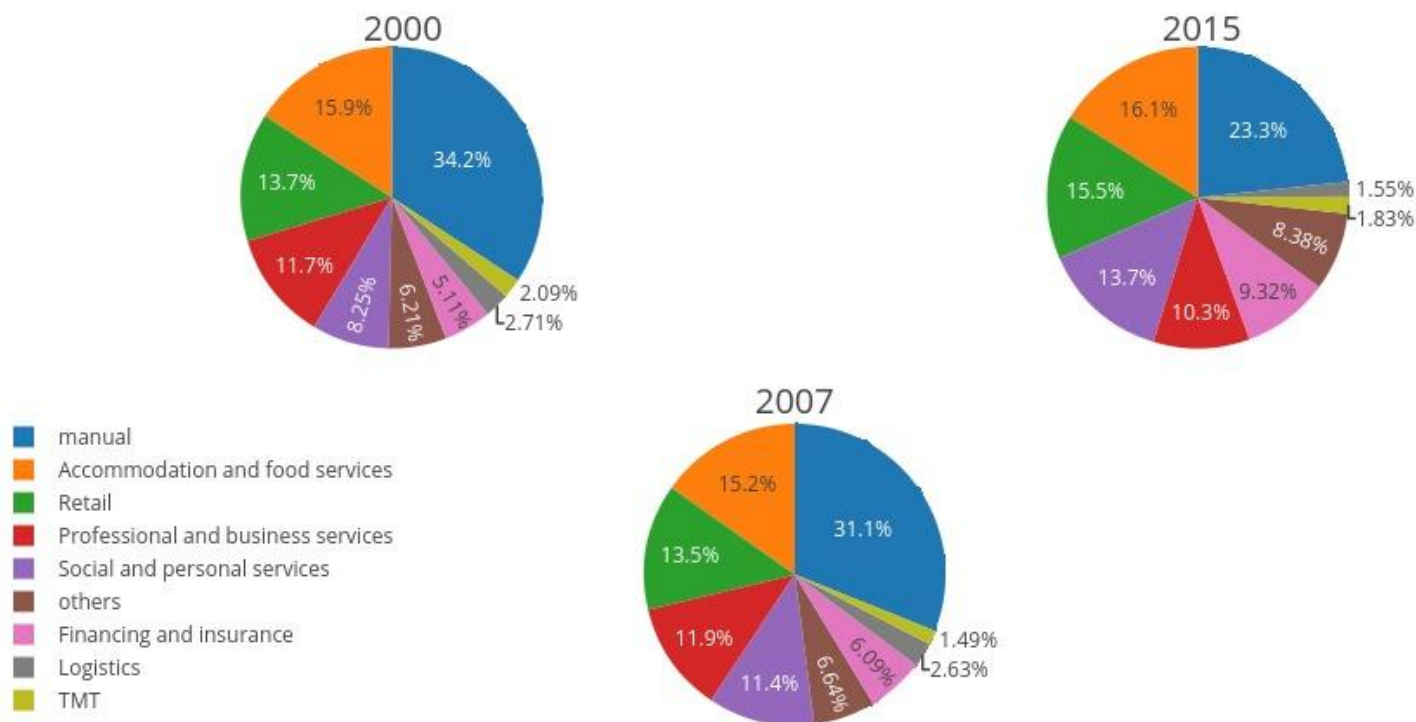
Figure 8: Number of Persons Engaged Across Industries in Wan Chai in 2000, 2007, 2015



There are some changes in the employment composition in Wan Chai. In 2000, Manual takes the highest portion (~18.4%) and it shrank to 12.9 in 2015. The second highest portion in 2000 is Professional and business services (18%), which remains stable at 16.1% in 2015. On the contrary, the social and personal services grew, from 13.3% in 2000 to 24.7% in 2015, which had the most engaged persons among industries in Wan Chai. The accommodation and food services sector show decreasing trend from 12.3% in 2000 to 9% in 2015. Financing and insurance industry show fluctuating pattern from 10.7% in 2000, to 9.12% in 2007, to 10.3% in 2015.

Figure 9: Number of Persons Engaged Across Industries in Yau Tsim Mong in 2000, 2007, 2015

Yau Tsim Mong: Proportion of engaged persons in industries



Yau Tsim Mong district shows rather stable employment pattern across industries with the largest two sectors being manual, and accommodation and food services. Retail industry commands the third place with 13.7%-15.5% of engaged people there. The importance of professional and business services remained rather stable from 11.7% in 2000 to 10.3% in 2015 while the importance of social and personal services (SP), and financing and insurance (FI) have growth over time: SP: increased from 8.25% to 13.7%; FI: increased from 5.11% to 9.34%.

The above analysis shows that Kwun Tong has a very different position from Central and tends to focus more on professional services, which is secondary to finance and insurance industry. And Kwun Tong also faces competition from other business districts, like Wan Chai, which has been more people engaged in service businesses over time. From this perspective, Kwun Tong might not be able to attain the 2nd CBD status from demand side.

5. Conclusion

In this study, we found that the transaction price of an office property has a non-linear relationship with its size, age, floor level. The non-linear size effect means that the market value of an office units is not proportional to its size (in SFA) after controlling for the effects of other price influencing factors. The model estimated from the office transaction records suggests that smaller office units tend to have a higher price per floor area. This trend is likely to continue after the COVID-19 pandemic as more people are used to work-from-home, which will be further facilitated by the technological progress and institutional innovations to facilitate remote working. The non-linear size effect is largely attributable to how users value office location. We conjecture that the location of an office has been and will continue to be valued more based on its intangible attributes such as prestige (which is not related to its size or number of users) than tangible attributes such as accessibility and convenience, the value of which is related to the number of users and size. We have also demonstrated the location factor using Central and Kwun Tong located in the old and new CBD respectively.

Ever since the rezoning of all industrial land in Kwun Tong to "Business" use in 2001, there has been a surge of supply of office, in particular grade A offices this area. By the end of 2014, the total stock of grade A offices in Kwun Tong already reached 1.15 million m² SFA, exceeded those in Tsim Sha Tsui, Mongkok and Yau Ma Tei combined. By the end of 2019, the total stock of grade A offices had grown to 1.54 million m² of SFA, which was very close to that in Central (1.63 million m² of SFA). The supply of grade A offices in Kwun Tong has provided the necessarily condition for it to function as a business hub. As the earlier and more developed part of the Kowloon East, which has been designated by HKSAR government as the second CBD, Kwun Tong is the core area of this second CBD, at least in the foreseeable future.

The empirical data in this study show that the number of end-users from the financial industry in Central was almost four times of that in Kwun Tong (2018Q4) despite the two areas having similar amount of grade A offices and that grade A offices in Kwun Tong are newer and cheaper (about one third the prices of the offices in Central). This suggests the location is a very important factor

for the choice offices in the financial sector. The location factor is not simply due to its accessibility or convenience but also the prestige image that has been built up over time, which can enhance the intangible value of a company. On the other hand, the number of end-users in the professional and business service sector in Kwun Tong was more than double that in the financial sector (2018Q4). This suggests that Kwun Tong has been able to attract end-users who are less concerned about prestige of a location but require high quality hardware (grade A offices) to support their business activities. Therefore, grade A offices in Kwun Tong and Central are complements rather than substitutes of each other. The supply of grade A offices in Kwun Tong (and probably the entire Kowloon East) is unlikely to have a major impact on the prices and rents of grade A offices in Central.

The hedonic price regression results show that old offices are cheaper due to physical deterioration and technological obsolescence. However, the impact of age on office prices diminished as age increase due to the non-depreciable nature of land value over time, which is the main cause of the non-linear age effect. As a building ages over time, its value-in-use will decline, however, its redevelopment value will not and may even go up depending on whether the building is single or multiple owned. Therefore, the rate of depreciation of an office building is declining rather than constant over time. This non-linear age effect casts doubt on the assuming of constant rate of depreciation of office property value (in real term) in accounting practices. Also, the non-depreciable nature of land implies that offices in prime locations have a lower depreciation rate due to the higher proportion of its value attributable to its location, i.e. the land value component of an office property.

Finally, the non-linear floor level effect suggests that the price of an office unit declines first at lower floors and then goes up after the 8th floor. That is, floor level premium (increase in price per increase in floor level alone) is negative from the first to the 8th floor and then turns positive after the 8th floor. The increase in the floor level premium after the 8th floor is not constant but increases at an increasing rate. This result is puzzling and different from those found in the residential sector. The initial negative floor premium may be due to saving on vertical transportation time on level floors. Since most offices have central air conditioning, the negative impact of noise and air quality on lower floors should be small. Therefore, the positive floor level premium at higher levels is likely to be attributable to the views. It is possible that the views on

lower floor levels are block by nearby buildings and thus moving up one floor at lower levels do not enjoy a better view compared with moving up one level at higher levels. Whether there are other intangible benefits of occupying higher floor levels due psychological or cultural reasons is an interesting topic for further studies.

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