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A COMPARISON BETWEEN OFFICE RENT DETERMINANTS OF ISTANBUL AND OTHER MAJOR METROPOLITAN AREAS

Oven V. A.¹ and Pekdemir D.²

Abstract

Office rent determinants are well established for various metropolitan areas in the US [2, 3, 25] and some other international centres in Europe, especially in the UK [12, 17, 28]. The site selection and investment decisions for new office construction will largely depend on the information how office rent determinants are ranked according to their importance. For this purpose, the ranking of 52 office rent determinants for the metropolitan area of Istanbul are presented using the technique of factor analysis, and later compared with the reported findings of available major metropolitan areas.

It has been found that, the only parameter commonly found significant is the vacancy rate. The results point out that regional differences and different economic conditions can significantly alter the perceived importance of rental determinants.

Keywords: office rent determinants, factor analysis.

1. Introduction

Istanbul's role as the gateway between east and west has begun to gain a great attention under rapidly changing global conditions. It is reported that the new conditions are largely governed by the outcomes of the end of Cold War and the spread of globalisation [30]. In this reference, it is claimed that Turkey's membership to NATO during the Cold War era has prevented Istanbul's natural potential to realise its hinterland into formerly hostile Black Sea and Central Asia neighbours. In addition, it is also stated that the absence of globalisation during this era has, somehow, undermined Istanbul's historic status as one of the major economic centres. Although encouraging changes are evident, the influence of these conditions should not be overestimated since both conditions are not particularly new. Perhaps, a real breakthrough, in terms of Istanbul's future prospect as one of the major world cities, lies ahead with Turkey's membership to the EU.

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Turkey has been officially recognised as a candidate for accession to the EU at the Helsinki European Council, in December 1999. Following this development the fulfilment of certain political criteria was demanded from Turkey at the Copenhagen European Council of 12-13 December 2002. The so called Copenhagen criteria demand the enforcement of three legislative packages to ease Turkey's alignment with the European Community. The first legislative package, referred to as being legal basis for the detention and sentencing of many intellectual for expressing their views, was adopted in February 2002. The second legislative package entered into force in April 2002 and extended further the scope of freedom and expression, the freedom of press, the freedom of the association and peaceful assembly. The third legislative package was fulfilled in August 2002, abolishing the death penalty, lifting legal restrictions on individual cultural rights, making retrial possible in the light of the decisions of the European Court of Human Rights, reinforcing legal guarantees on the freedoms of expressions and press, easing restrictions on the right to associations and peaceful assembly, ensuring the right to property of community foundation belonging into minorities in Turkey, providing the legal basis needed for the activities for the foreign foundations in Turkey and introducing new definitions and measures to deal with illegal immigration.

On realising reforms both in economic and political field, Turkey has been assured for the intensification of the pre-accession financial assistance within the accession partnership framework. If the next European Council in December 2004 decides that Turkey has fulfilled the Copenhagen Political Criteria, the EU will open negotiations without delay [21]. This development, if realised, is expected to cause an upturn in the industrial output, investment and service sector growth, since both the EU and Turkey promote strongly co-operation on innovation and information technology, development of the private sector, access to the single market and integration of customs union.

Turkey's service industry output by its share in GDP accounts for 59% and amounts to 117 billion US dollars by the year of 2000 (Figure 1.(a) and (b)), and its share continues to be steady throughout 2002 at a level of 61,6% and 111 billion US dollars.[29]. İstanbul is the major generator for the service industry in Turkey, since its stake in GDP by service sector amounts to 34,3 billion US dollars (Figure 2). İstanbul's ranking in terms of number of global service firms among major European centres appears to be rather respectable with continuing rise in the number of FDI firms in service sector

between 1984 and 1998 (Figure 3.(a) and (b)). The downturns in Figure 3.(b) usually correspond to the major economic crises in 1992 and 2000 period, nevertheless, the general trend during this period is always upwards. In conclusion, it is undeniable that İstanbul, even at prevalent conditions, poses a promising prospect for being a candidate for a major European finance and service generator in the verge between east and west.

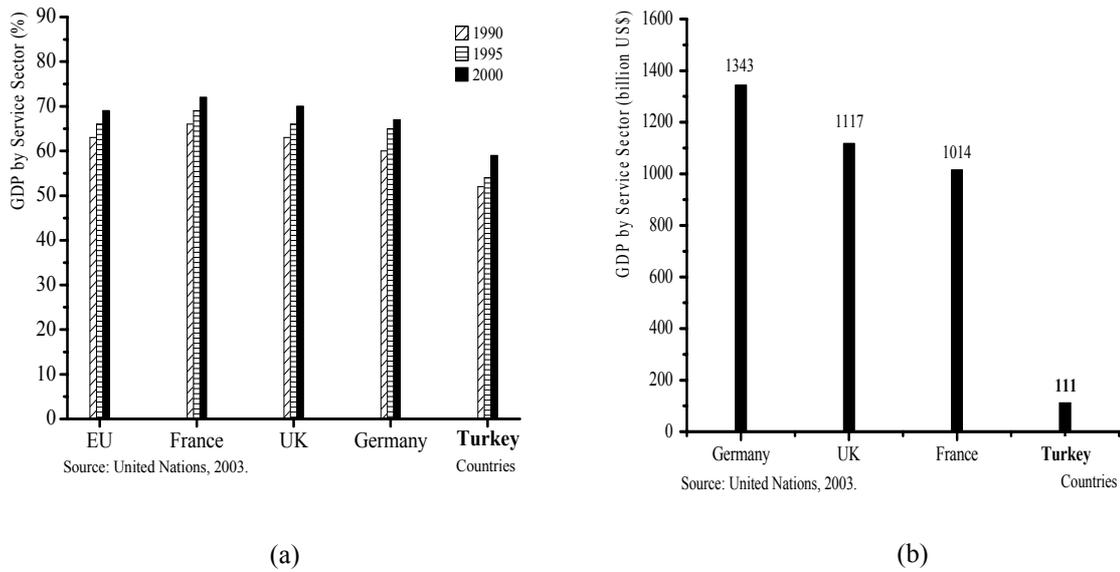


Figure 1. (a) GDP percentage by service sector, (b) GDP by service sector (2002).

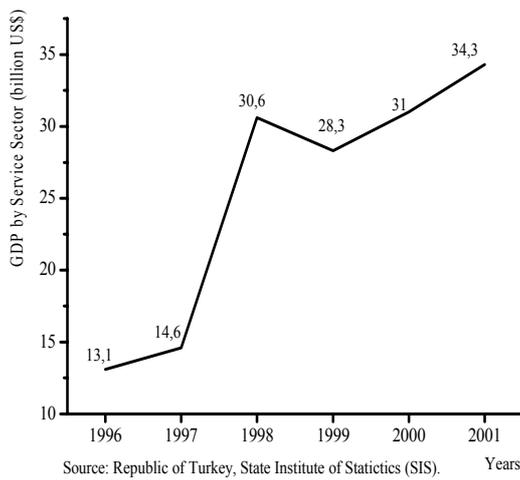
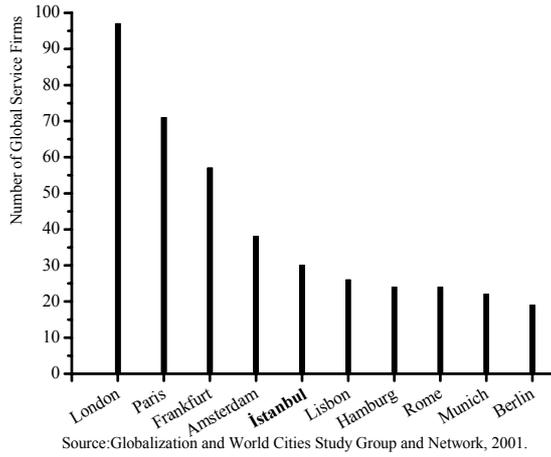
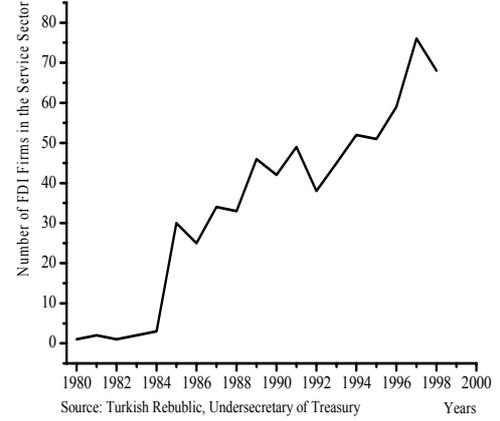


Figure 2. GDP by service sector in İstanbul.



(a)



(b)

Figure 3. (a) Number of global service firms in major European cities, (b) Number of foreign direct investment firms in service sector in İstanbul.

2. The Development of İstanbul, Its Relation to Service Sector and Demand for Office Space

A steady growth of İstanbul from early 1950s throughout 2000 has been experienced with a population increase from 983,041 to 10,018,735. Before 1970s the CBD as known to be the historical core of the city was restricted to the districts of Eminönü and Beyoğlu. Until the end of 1970s most of the business activities were attracted to this region. However, with the construction of the first Bosphorus Bridge and peripheral highways to the bridge, a new spatial structure has emerged causing the decentralisation of the old CBD and encouraging employment and commerce opportunities in the peripheral of the historical core of the city. The academics called this area as Zone 2 which encompasses the districts of Beşiktaş, Şişli, Kağıthane, Eyüp, Bayrampaşa, Güngören, Zeytinburnu, Fatih, Kadıköy and Üsküdar [1]. It is interesting to note that a new modern Class A office developments have been formed along the interconnects of the new Trans European Motorway (TEM) leading to the Bosphorus Bridge [1]. These areas are major office concentration regions known to be Zincirlikuyu-Levent-Maslak office developments in Şişli district and Kozyatağı-Bostancı office developments in the Kadıköy district. The development of this second zone was over by the middle of 1990s. However, the completion of the second bridge in 1988 and its infrastructure generated a third a peripheral attracting a new development for Class A office buildings

located along the major highways, namely in Kavacık in Beykoz district and around the International Atatürk Airport in Bakırköy district. Clearly, connection alternatives between east and west induced infrastructure which in turn satisfied the ever increasing demand for office space due to rapid rise of the service industry. This phenomenon can be held responsible for the rapid growth of the city in concentric circles as shown in Figure 4. This presumption can easily be proven by investigating Figure 5; the financial firms distribution in the aforementioned office concentration regions in the three concentric zones of İstanbul: Zone 1 (Core), Zone 2 and Zone 3 (see Figure 4). The statistics demonstrating the distribution of Class A office stock on major office development regions (Figure 6) strengthen the idea that there is a strong relation between the office development regions and the concentric growth of the city and that the former governs the latter.

In this context, it may be inferred that office rent determinants, dictating the office investment and its site selection, in a way, can control the growth of the city. In this sense, one need to know what office rent determinants there exist, and which of them are rated highly in comparison to the other for a particular city, in this case, for İstanbul.

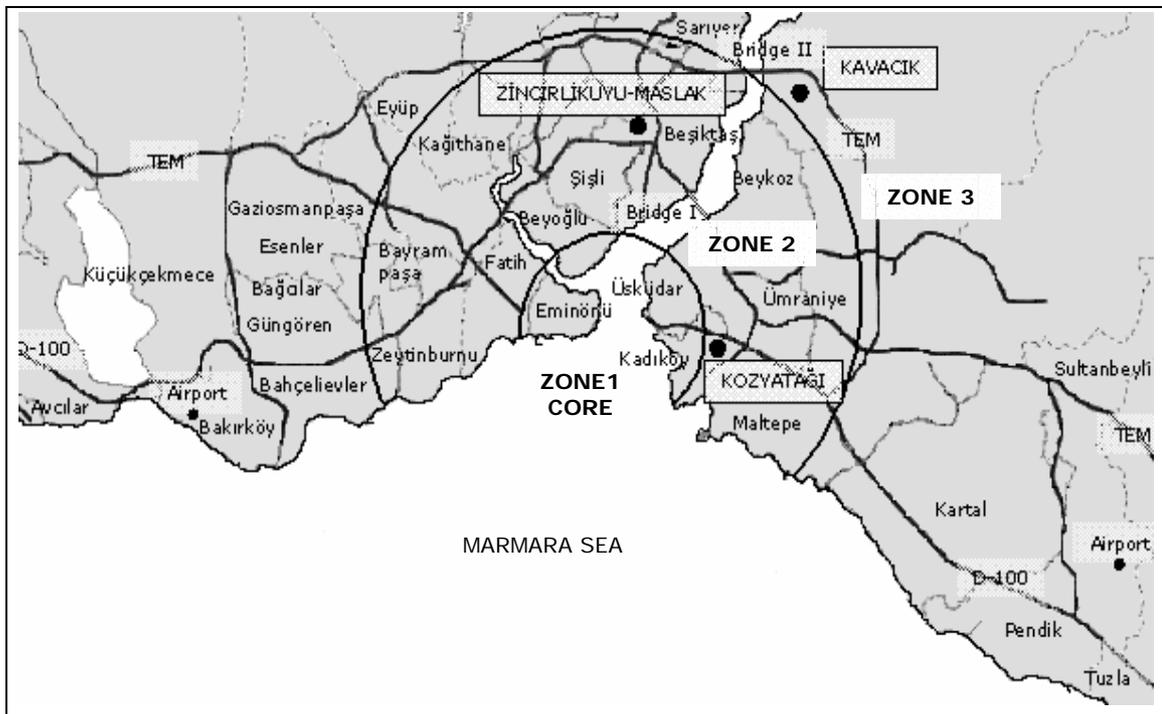


Figure 4. Office concentration regions and major concentric zones of İstanbul.

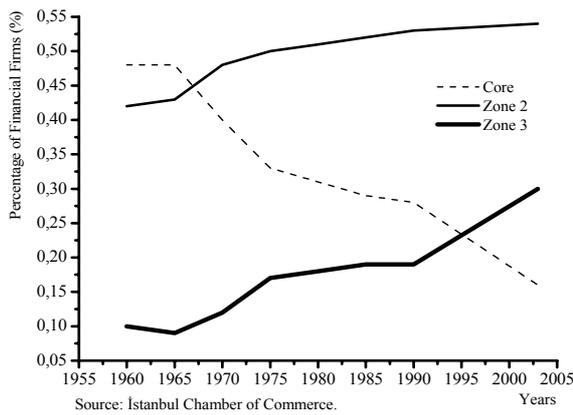
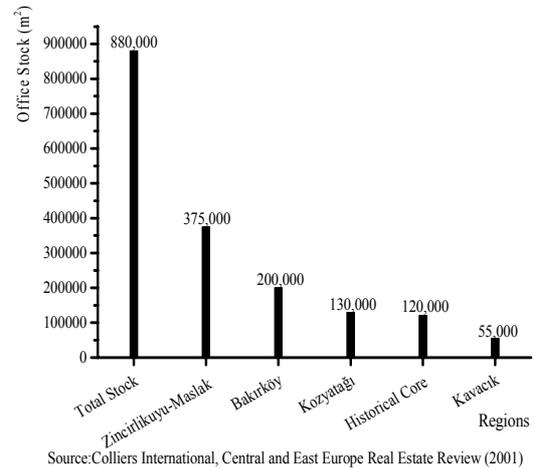
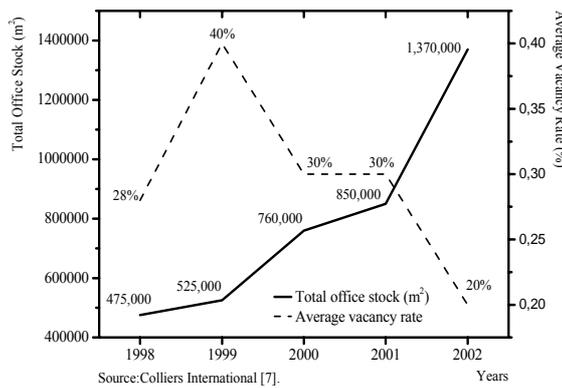


Figure 5. Change in the concentration of financial firms in concentric zones of İstanbul.



(a)

(b)

Figure 6. Distribution of office stock in major office concentration regions of İstanbul (2001).

3. Literature Review on Office Rent Determinants

Research on office rent determinants has been the subject of a wide range of specialist fields, ranging from econometrics to urban studies and from architecture to civil engineering. Investigating the published studies, a great number determinants has been claimed to influence the office rent, with a great degree of variation in the reported significance of these parameters. It is prudent to accept the highly variable nature of these determinants, since studies report findings from different geographical locations and socio-economic conditions. In response to this outcome, references [11, 12, 20, 25]

suggested the use of spatially disaggregated rent prediction models to allow for geographical variations. Researchers attempted either to develop different models applicable to only a particular region or introduce dummy parameters, representing the influence of certain regions, in a general form of the model. In addition, the examined office class is also reported to cause great fluctuations in the significance of these determinants [14]. As a conclusion, it may be inferred that office rent determinants are area specific and largely dependent on the type of office class.

The parameters used in various references can be classified into four categories:

1. Econometric
2. Building
3. Location
4. Contract

Econometric determinants are based on supply and demand variables: various demand side determinants have been used including the vacancy rate [10, 14-17, 20, 22-24, 33, 34], GDP [6-8, 11, 12, 15, 28], the service sector employment [2, 6, 26], the unemployment rate [6, 15], the interest rate [6, 7], the absorption rate [24, 34]. The only supply side determinant used in these studies was the office stock which reported to have either no or negligible influence on office rent [6, 28]. Furthermore, not all demand side determinants have been found influential. Indeed, only the vacancy rate [22, 23, 33], GDP [6, 8, 11] and the interest rate [6, 7] are reported to be significant influences. Hence it may be concluded that econometric parameters cannot be excluded from any realistic office rent model and that, although the relative value of these determinants may change, their influence on office rent is largely unaffected by any regional difference [6, 8, 11].

It has also been recognised that office property is a heterogeneous good which has strong attributes relating to physical characteristics of the building and locational influences [9]. In addition, the terms specified in the contract can influence the rental value and they also have to be considered as potential influential determinants. Clapp [5], Brennan, et. al. [3], Frew and Jud [10] and Wheaton [32] utilised building characteristics, such as building age, rentable floor area, number of storeys, area allocated to common use, number of amenities offered in the office building -bank, conference room, shop, restaurant, day-care, health club and parking area. The location

of the office building is also crucial from the investment point of view and its influence should be taken into account. Most references [2, 5, 10, 25, 26] specify determinants such as, distances to freeways, CBD, secondary centres, transit lines, prestigious areas, sea etc. Some environmental and safety related issues are also being considered among locational parameters, most notably, the air pollution rate and the crime rate in the vicinity of the office complex [5, 25, 26]. It goes without saying that the most extensive variety of locational parameters was undertaken by Sivitanidou [25, 26] who demonstrated that, of the presumed nineteen locational parameters, most had a significant influence on rental value. In that reference, as well as the distance of the office complex to focal points, densities of various sector employments, amenities and land constraints around the office site are examined, and rated highly significant.

The so called contract parameters include determinants extracted from the terms stated in the rent lease. Brennan, et. al., [3], Wheaton [32], Wheaton and Torto [34], Webb and Fisher [31] and Bollinger, et. al., [2] advocate the use of these parameters in office rent models. The most commonly used parameters in this category are the property tax rate, the elapsed time to recorded lease date, the CPI escalation, the escalation factor, the operating cost and expense stop clauses. Studies reveal that the escalation factor, the CPI escalation and the expense stop parameter are the strong influences [2, 3, 31], while all others are moderately significant [23, 32, 34].

Lately, Bollinger, et. al. [2] examined the variation in the influence of certain locational, building and contract determinants with spatial change. It is reported that, in particular, the influence of locational parameters can be highly variable [14, 20, 25]. This finding points to the fact that, except for econometric parameters, determinants in all other categories can be highly susceptible to spatial variations, and therefore insignificant determinants reported in a reference can be strong influences in the other. Hence, no determinant should be ruled out in studies tackling a different region.

Perhaps the most crucial use of the contract data is to obtain the rent value itself, since the rent model and the significance of the determinants are dependant upon. Webb and Fisher [31] argue that the asking rent, as they are used by many research papers, can reveal misleading results since they remain fairly constant over time, even when market conditions weaken. In reality, the weakening of the market is usually reflected through providing concessions which, in turn, vary the effectively paid rent [31, 34]. Thus, from more to less desirable, three options for the measurement of the dependent variable -

rental value- there exist: asking rent (the value as stated by the brokerage firms, or advertisements), contract rent (the value stated in the contract) and effective rent (adjusted contract rent taking into account the concessions and terms enforcing liability for certain expenses either to landlord or the tenant). However, the use of contract data brings about the difficulty in obtaining sufficient undisclosed contract data from real estate firms.

Clearly a large number of variables is involved in predicting the office rent behaviour and none of the references discussed herein attempted to take into account the full range of these determinants. This was mainly due to the limitation of the multiple regression technique adopted in interpreting the results.

The challenge in this paper is to demonstrate that perhaps, an office rent model using the whole number of determinants can be developed, with previously reported parameters, regardless of their reported significance or rating in the original reference. In this regard 'Factor Analysis' provides a useful tool. The numerical technique is useful in regressing a large number of parameters, by grouping them into factors and establishing the hedonic model with a few factor values, without compromising the influence of a whole range of parameters. The presented work places, however, more emphasis on the rating of the office rent determinants for the office market in İstanbul, using a technique combining 'Factor Analysis' and multiple regression analysis. Data from previously executed studies are also studied and the reported significance of the determinants is aligned to smooth down any modelling differences to obtain a general scaling of the office determinants so that it can be compared with the data obtained from İstanbul as a result of factor analysis.

Method

Research methodology handles the implementation of two objectives:

1. Scaling office rent determinants for İstanbul according to Factor Analysis findings,
2. Scaling office rent determinants for global centres according to literature review findings.

Factor Analysis provides the necessary means for condensing a large number of variables into a smaller number, called factors, without excluding less influential variables [19]. General expressions of the method can be expressed by Eqs. (1-3).

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \dots + \beta_n x_n + \varepsilon \quad (1)$$

$$Y = \alpha + A_1 F_1 + A_2 F_2 + A_3 F_3 + \dots + A_k F_k + u \quad (2)$$

$$F_k = W_{k1} x_1 + W_{k2} x_2 + W_{k3} x_3 + \dots + W_{kn} x_n \quad (3)$$

where ‘ x_n ’ represents the n th variable and ‘ n ’ the number of independent variables interrelated to the dependant variable ‘ Y ’. ‘ F_k ’ and ‘ A_k ’ denote the ‘ k ’th factor value and its coefficient respectively, and ‘ k ’ denotes the number of calculated factors as a result of ‘principal component analyses’. ‘ W_{kn} ’ are the calculated factor score coefficients converting the standardised values of independent variables into factor values. The viability of the method is plausible if only the number of factors is considerably less than the number of variables ($k < n$).

Factor extraction is implemented using the principal component analysis. The technique ranks the variance of independent variables (*eigenvalues*) from high to low. The number of variables providing the greatest portion of the total variance (>70%) determines the number of factors. Each variable is expressed in terms of ‘ k ’ number of factors, the coefficients of which are known to be the *factor loadings* ‘ $\overline{\beta_{ik}}$ ’ (Eq. (4)).

$$x_i = \overline{\beta_{i1}} F_1 + \overline{\beta_{i2}} F_2 + \overline{\beta_{i3}} F_3 + \dots + \overline{\beta_{ik}} F_k \quad (4)$$

In Eq. (4), ‘ $\overline{\beta_{ik}}$ ’ coefficients are the correlation coefficients between each variable and the factors. The matrix of correlation coefficients, ‘ $\overline{\beta_{ik}}$ ’, derived from Eq. (4) is called the *factor structure matrix*. In the factor structure matrix, each variable must have a high correlation coefficient with only a single factor. In case this cannot be clearly defined, a rotation technique must be employed to transform the initial factor structure matrix, named the *rotated correlation matrix*. After rotation, small factor loadings or rotated correlation coefficients ($< |0,5|$) can be omitted to reveal clusters of variables belonging to each factor group. This also helps assigning a meaning to the factors generated. As a result of factor analysis the factor score coefficients are calculated, and then substituted into Eq. (3) to determine factor values. The relatively small number of factors representing the total number of parameters can now be used to establish the regression model given in Eq. (5).

$$Y_{rent} = \alpha + \beta_1 F_1 + \beta_2 F_2 + \beta_3 F_3 + \dots + \beta_k F_k + u \quad (5)$$

The level of significance of each parameter is determined from the calculated factor score coefficients “ W_{nk} ” (Table 1) and beta coefficients of the regression model in Eq. (5). The contribution of each parameter to a factor is determined from the ratio of $W_{ij}/\sum W_{ij}$ where, ‘ i ’ and ‘ j ’ indices denote the ‘ i ’th parameter and ‘ j ’th factor respectively. The parameter significance, “ $\chi_{n\text{sgnf}}$ ”, is then evaluated as the sum of the ratio of $W_{ij}/\sum W_{ij}$ multiplied by the beta coefficients of the factors obtained from Eq. (5) (Table 2).

Table 1. Factor score coefficient matrix.

	F₁	F₂	F₃	..	F_k
x_1	W_{11}	W_{12}	W_{13}	...	W_{1k}
x_2	W_{21}	W_{22}	W_{23}	...	W_{2k}
x_3	W_{31}	W_{32}	W_{33}	...	W_{3k}
..
..
x_n	W_{n1}	W_{n2}	W_{n3}	...	W_{nk}
	$\sum W_{n1}$	$\sum W_{n2}$	$\sum W_{n3}$	..	$\sum W_{nk}$

Table 2. Significance for parameters.

	F₁	F₂	F₃	..	$\Sigma(\beta_k W_{ik}/\sum W_{nk})$
x_1	$\beta_1 W_{11}/\sum W_{n1}$	$\beta_2 W_{11}/\sum W_{n2}$	$\beta_3 W_{11}/\sum W_{n3}$	...	$\chi_{1\text{sgnf}}$
x_2	$\beta_1 W_{21}/\sum W_{n1}$	$\beta_2 W_{21}/\sum W_{n2}$	$\beta_3 W_{21}/\sum W_{n3}$	...	$\chi_{2\text{sgnf}}$
x_3	$\beta_1 W_{31}/\sum W_{n1}$	$\beta_2 W_{31}/\sum W_{n2}$	$\beta_3 W_{31}/\sum W_{n3}$	...	$\chi_{3\text{sgnf}}$
..
..
x_n	$\beta_1 W_{n1}/\sum W_{n1}$	$\beta_2 W_{n1}/\sum W_{n2}$	$\beta_3 W_{n1}/\sum W_{n3}$	...	$\chi_{n\text{sgnf}}$

‘Student’s t Test’ for a confidence level of 95% is applied on the significance values obtained, and the upper and lower bounds of the test are assumed to define the thresholds of very influential-influential and influential-not influential respectively.

The influence scale of the determinants, according to literature findings, is determined using the following procedure: Published academic work on office rent prediction models has been thoroughly investigated and the determinants used in the models have been derived. Only the determinants reported to satisfy t statistics are considered, by assessing their reported beta coefficients. However, the scaling of the determinants could not be entirely relied on beta coefficients, considering they came from different

models having different explanatory powers. Therefore, an adjustment had to be made to take into account the variation in explanatory powers so that the significance of determinants from different studies could be comparable. The adjustment procedure for each parameter was conducted according to Eq. (6) where β_i is the reported beta coefficient of the parameter, $\sum \beta$ is the sum of beta coefficients and R^2 the explanatory power of the model.

$$\chi_i = (\beta_i / \sum \beta) R^2 \quad (6)$$

If a determinant satisfying t-statistics is used in more than one model, then the mean relative significance is considered to be the significance of this determinant. Once the adjusted significance of determinants is obtained, they are ranked in accordance with their value. The influence scale is then constructed applying student's t test at confidence level 95% and specifying the thresholds between "very influential-influential" and "influential-not influential" as the upper and lower bounds of the confidence interval, respectively.

Results and Discussion

The total of 64 office rent determinants derived from literature review has been listed in Appendix A. The source of the literature review and the category of parameters used in the prediction models are summarised in Appendix B. Of these parameters 12 were dummies and couldn't be analysed with principal component approach. As a result, 52 parameters have been assessed using factor analysis giving rise to 5 factor groups whose rotated factor loadings for each parameter are presented in Table 3. Regressing the factors with office rent, based on 17 Class A office contract data from Maslak, Kozyatağı and Kavacık region, the beta coefficients were determined (Table 4). The factor score coefficients which are used in defining the significance level of the determinants are also presented in Table 5. Applying the methodology, both influence scales from literature review and factor analysis are presented in Tables 6 and 7. Only 22 of the common parameters satisfy t-statistics, hence only these parameters could be compared. A comparison of the common parameters is shown in Table 8.

Results reveal that the vacancy rate (V) and office investment (OFBO) are the most important determinants regardless of any spatial difference. This finding proves further that in particular the vacancy rate can not be excluded from any viable office rent prediction model.

Table 3. Rotated factor loadings.

Parameters	Factors				
	1	2	3	4	5
PRO	0,997				
BLUE	0,997				
BFI	0,997				
COLLED	0,996				
CRIME	0,992				
EMP	0,991				
INCOME	0,991				
CONSM	0,991				
EMPRTL	0,988				
UNEMP	0,984				
EDUC	0,975				
DSQUAT	0,960				
SERVICE	0,941				
DBRIDGE	0,845				
TAX	0,782				
DMETRO	0,767				
SMGC	-0,715				
SF	0,681				
DCBD	0,610				
DCENTER		-0,979			
HEIGHT		0,975			
OFS		0,963			
ABS		-0,956			
GDP		0,945			
DAIRPORT		-0,929			
MNFT		0,859			
OF1		0,775			
DMALL		-0,722			
PBUS		0,627			
TERM		-0,457			
ELEVATOR			0,892		
TSQFT			0,863		
RC			0,863		
PARKING			0,771		
OFBO			-0,735		
AUT			0,731		
VERT			0,657		
TFLRS			0,613		
FREE			0,611		
E			0,582		
DPRESTIGE				0,836	
DFREEWAY				0,786	
FAR				-0,728	
LOSS				0,646	
HY				-0,634	
RETAIL				0,553	
AGE					-0,892
DR					-0,892
DSEA					0,680

Table 4. Regression results.

Parameter	Beta Coefficient (β)
Factor 1	0,086 (1,863)**
Factor 2	-
Factor 3	0,081 (1,473)*
Factor 4	0,041 (0,951)
Factor 5	0,166 (2,850)**

Note: *t*-statistics are reported below the coefficients; one, two and three asterisks denote significance at the 0.10, 0.05 and 0.01 levels, respectively.

Table 5. Factor score coefficient matrix (W_{nk}).

Parameters	Factors				
	1	2	3	4	5
AGE	,018	,001	,043	-,023	-,246
TSQFT	-,014	,000	,137	,017	-,048
SF	,032	-,005	-,017	,087	,066
LOSS	,019	,050	-,136	,198	,121
VERT	,012	,023	,127	-,080	-,034
TFLRS	-,003	,025	,070	,051	,017
ELEVATOR	-,008	,005	,142	,000	-,036
PARKING	-,010	,018	,159	-,085	-,069
TERM	,008	-,041	,061	-,048	,036
FREE	-,001	-,012	,074	-,003	,058
TAX	,040	-,003	-,021	,080	,053
E	,023	,006	,109	-,099	,006
DCENTER	-,013	-,097	,003	,037	-,008
DCBD	,026	-,049	,015	,079	,009
DAIRPORT	-,025	-,092	,004	,036	,052
DBRIDGE	,054	,045	,005	,059	-,014
DFREEWAY	,001	,023	-,012	,169	-,103
DSEA	,014	,031	-,006	,000	,167
DMETRO	,038	-,043	-,003	,050	,004
DMALL	-,027	-,076	-,036	-,048	-,017
HY	,017	,022	,071	-,170	-,171
AUT	-,010	-,021	,118	-,075	,047
PBUS	,007	,060	-,035	-,086	-,043
HEIGHT	,003	,096	-,002	-,029	,035
FAR	,008	,044	-,028	-,139	,115
OF1	-,022	,076	,003	-,010	,128
EMPRTL	,062	,024	,000	-,010	-,017
BLUE	,061	,013	-,001	-,014	-,015
PRO	,061	,012	-,001	-,014	-,015
BFI	,061	,013	-,001	-,014	-,015
SERVICE	,061	,043	,002	-,004	-,019
INCOME	,059	,002	-,002	-,017	-,013
COLLED	,060	,008	-,002	-,015	-,014
EDUC	,057	-,008	-,003	-,020	-,011
CRIME	,059	,003	-,002	-,017	-,013
SMGC	-,035	,057	,008	,030	-,001
DPRESTIG	,010	-,006	,019	,165	-,103

Table 5. Factor score coefficient matrix (W_{nk}) (continued).

Parameters	Factors				
	1	2	3	4	5
DSQUAT	,058	-,013	-,009	,001	-,039
OFS	,005	,093	,010	,030	-,014
OFBO	-,001	,037	-,165	,084	,115
ABS	-,002	-,092	-,010	-,031	,013
RC	-,014	,000	,137	,017	-,048
DR	,018	,001	,043	-,023	-,246
GDP	,025	,095	,010	,025	-,019
EMP	,059	,002	-,002	-,017	-,013
RETAIL	-,013	,008	-,048	,141	,079
CONSM	,059	,002	-,002	-,017	-,013
MNFT	-,017	,079	,010	,032	-,008
UNEMP	,058	-,003	-,003	-,018	-,012

Table 6. Significance scaling according to literature review.

Very Influential		Influential		Not Influential	
Code	Significance	Code	Significance	Code	Significance
INVH	0,273	PRO	0,053	NEW	0,012
ESCAL	0,228	DCENTER	0,052	COMLAND	0,011
GDP	0,126	EXPSTOP	0,039	DCBD	0,010
BFI	0,113	BLUE	0,034	BROKER	0,009
CPI	0,102	WGLASS	0,034	TFLRS	0,009
SERVICE	0,087	DFREEWAY	0,024	DAIRPORT	0,009
IR	0,077	GROWTH	0,022	AGE	0,009
V	0,074	PARKDECK	0,021	ELEVATOR	0,008
EDUC	0,059	OFBO	0,021	PARKING	0,007
		CRIME	0,017	BANK	0,005
		EMPRTL	0,016	INCOME	0,004
		NET	0,015	INVFAR	0,004
		TAX	0,013	DSEA	0,003
				REST	0,003
				SF	0,002
				VERT	0,002
				DMETRO	0,001
				COMLEX	0,001
				DMALL	$7,966 \times 10^{-4}$
				HEALTH	$7,099 \times 10^{-4}$
				TERM	$6,221 \times 10^{-4}$
				HY	$4,266 \times 10^{-4}$
				MLT	$1,504 \times 10^{-4}$
				TSQFT	$2,421 \times 10^{-5}$
				COLLED	$2,984 \times 10^{-5}$

Table 7. Significance scaling according to factor analysis and regression analysis.

Very Influential		Influential		Not Influential	
Code	Significance	Code	Significance	Code	Significance
SF	0,0513	VERT	0,014	EMPRTL	0,006
AGE	0,024	DSEA	0,013	BLUE	0,006
DR	0,024	ELEVATOR	0,013	PRO	0,006
OFBO	0,018	E	0,012	BFI	0,006
PARKING	0,016	TSQFT	0,012	COLLED	0,006
V	0,88	RC	0,012	INCOME	0,006
		FREE	0,009	CRIME	0,006
		AUT	0,009	EMP	0,006
		DSQUAT	0,008	CONSM	0,006
		TAX	0,007	SERVICE	0,006
				TFLRS	0,006
				UNEMP	0,006
				EDUC	0,005
				DCBD	0,005
				DMETRO	0,005
				DBRIDGE	0,004
				SMGC	0,004

Table 8. Comparison between factor analysis and literature review results.

Very Influential		Influential		Not Influential	
Literature	Factor Analysis	Literature	Factor Analysis	Literature	Factor Analysis
BFI	SF	PRO	VERT	DCBD	EMPRTL
SERVICE	AGE	BLUE	DSEA	TFLRS	BFI
V	OFBO	OFBO	ELEVATOR	AGE	BLUE
EDUC	PARKING	CRIME	TSQFT	ELEVATOR	COLLED
	V	EMPRTL	TAX	PARKING	PRO
		TAX		INCOME	CRIME
				DSEA	INCOME
				SF	SERVICE
				VERT	TFLRS
				DMETRO	EDUC
				TSQFT	DCBD
				COLLED	DMETRO

Similar with the literature review scale findings, insignificant location parameters distance to CBD (DCBD), distance to metro (DMETRO), college educated household (COLLED), average household income (INCOME) and the building parameter of number of storeys (TFLRS) are also determined as insignificant for İstanbul. The reported loss of importance for CBD observed in many global centres is also seen in İstanbul. Secondary centres are also gaining ground in İstanbul. Distance to underground (DMETRO) surprisingly reveals little importance but the reasoning in İstanbul is rather different than other global cities. Bollinger, et. al [2] , explains the little importance of this parameter with the high crime rate around this focal point. However, for İstanbul, this can be explained by the lack of a proper underground metro network. Other unimportant parameters such as, college educated household (COLLED)

and average household income (INCOME) are usually regarded as the major indicators for the desirability and quality of the region nearby [2, 25, 26]. The highly skilful work force of office workers has both qualities and therefore, the influence of these parameters may appear to be more obscured. The parameter (TFLRS) is also found insignificant, because most Class A office block are already high rises.

In contrast to general findings from various global centres determinants such as, service sector employment (SERVICE), banking, finance and insurance sector employment (BFI) and primary education expenditure (EDUC), are highly insignificant determinants for İstanbul.

It is surprising to the note that a number of insignificantly rated building determinants, namely office floor area (SF), building age (AGE), parking space (PARKING), total building area (TSQFT), number of elevators (ELEVATOR), the storey level of office (VERT), are found highly influential for İstanbul. This is attributed to the fact that architectural standards in Turkey are not carefully controlled by codes and regulations which leads to great fluctuations in building quality. In contrast to other major centres from which the literature review data are derived these standards are carefully monitored and therefore, little discrepancy in terms of architectural quality exist [13]. In cities like Tel-Aviv, the reported significance of these building parameters is also found highly influential which may also be attributed to the varying architectural quality. Another interesting outcome of this comparison is that no contract parameter is found particularly important in either scale.

Finally, best office investment in İstanbul, according to the findings of this study, may be summarised as follows; certain aspects which may not be necessarily in line with general common sense may need to be considered for İstanbul. Summarising the desirable aspects for an optimal office site selection in İstanbul, the investor should monitor mainly the micro economic indicators (V, OFBO) and keep an eye on new developing secondary centres providing easy access to transportation nodes. The office building should have maximum usable office space with minimum common shared areas and sufficient parking facilities. No recreational facilities around the office are necessarily required. There also appears to be little need to seek for the positive influences of locational parameters such as, the concentration of certain type of employment, (BFI, BLUE, SERVICE, EMPRTL) nearby the office block and, wealth, social status and quality indicators such as, the level of education or income of the

residents in the vicinity of the office region. These parameters have no effect on dictating where the office block should be located or, for any reason, the rental value it is worth of.

The scale provided a quantified approach for the insight of office determinants in İstanbul, in comparison with other major centres around the world. The inclusion of most micro econometric parameters is found vital in understanding the office market behaviour in İstanbul. It is also verified that locational and building parameters are geographically sensitive and cannot be generalised. Future work in the subject should incorporate a wider context of office development regions and possibly exclude contract parameters which are both not influential and hard to obtain due to confidentiality and also restrict the extent of sample size.

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Appendix A. Parameter codes.

	Code	Parameter ^{References}	Type
Econometric Parameters	ABS	Average unlet duration of the office in the region (absorption) ^{24,34}	Numeric (month)
	CONSM	Annual consumer expenditure per person in the district ¹⁷	Numeric (US\$) ^b
	DR	Annual depreciation rate of the building ¹⁶	Numeric
	EMP	Growth in employment rate in the district ^{14,15,17,28,33}	Numeric (%)
	GDP	Growth Domestic Product ^{6,7,8,11,12,15,28}	Numeric (%)
	IR	Annual interest rate ^{6,7}	Numeric (%)
	MNFT	Annual manufacturing output in the district ¹⁷	Numeric (%)
	OFBO	Annual office construction investment in the region, proxied by new office area underconstruction ^{24,28}	Numeric (m ²)
	OFS	Office stock in the region ^{8,11,17}	Numeric (m ²)
	RC	Replacement cost of building ¹⁶	Numeric (US\$)
	RETAIL	Annual retail sales per person in the district ¹⁷	Numeric (US\$)
	UNEMP	Number of annual unemployment in the district ^{6,15}	Numeric
	V	Vacancy rate ^{10,14,15,16,17,20,22,23,24,33,34}	Numeric (%)
Building Parameters	AGE	Building age ^{2,5,10,13,18,25,26,27,32,34}	Numeric (year)
	BANK	The building contains a bank (1-0) ^{2,18}	Dummy
	COMPLEX	The building is part of a complex (1-0) ^{2,27,32}	Dummy
	CONFER	The building has a conference room (1-0) ²	Dummy
	ELEVATOR	Number of elevators in the building ²⁶	Numeric
	ID	Percentage of common space in the building (lobby, elevator, atriums etc.) ¹⁰	Numeric (%)
	LOSS	Percentage of unused space in the office ³	Numeric (%)
	MLT	The building has multiple tenants (1-0) ²	Dummy
	PARKDECK	The building contains a garage (1-0) ^{2,5,18,26}	Dummy
	PARKING	Parking space per person in the building ³¹	Numeric (m ²)
	PRESLOC	The office is situated in a prestigious location in the building (1-0) ³	Dummy
	REST	The building contains a restaurant (1-0) ^{2,18}	Dummy
	SF	Office floor area ^{2,3,5,18,26,27,32,34}	Numeric (m ²)
	SHOP	The building contains a shop (1-0) ¹⁸	Dummy
	TFLRS	Number of floors ^{2,5,10,13,27,32,34}	Numeric
	TSQFT	Total area of the building ^{2,3,14}	Numeric (m ²)
	VERT	The storey level the office is situated in the building ³	Numeric
WGLASS	The building has a cladding (1-0) ²⁶	Dummy	
Locational Parameters	AUT	Number of lanes on the road leading to the building (proxy for easy access by car) ⁵	Numeric
	BFI	Number of employees in banking, finance, insurance sector in the district ²⁸	Numeric
	BLUE	Number of blue collar workers in the district ^{2,25}	Numeric
	COLLED	Percentage of college educated household in the district ^{2,32}	Numeric
	CRIME	Reported annual crime incidents in the district ^{25,26}	Numeric
	DAIRPORT	Distance from major airports ^{25,26}	Numeric (km)
	DBRIDGE	Distance from Bosphorus Bridges <i>Specific to Istanbul</i>	Numeric (km)
	DCBD	Distance from CBD ^{10,25,26}	Numeric (km)
	DCENTER	Distance from the nearest secondary centres ^{2,13,26}	Numeric (km)
	DFREEWAY	Distance from the nearest highway ^{3,5,10,25,26}	Numeric (km)
	DMALL	Distance from the nearest shopping centres ³	Numeric (km)
	DMETRO	Distance from the nearest metro station ²	Numeric (km)
	DPRESTIGE	Proximity to prestigious districts namely Etiler, Bagdat St. or Bosphorus ^{5,26}	Numeric (km)
	DSEA	Distance from the sea ^{25,26}	Numeric (km)
	DSQUAT	Proximity to the squatter settlements ^{2,13}	Numeric (km)

Appendix A. Parameter codes (continued).

	Code	Parameter ^{References}	Type
Locational Parameters	EDUC	Expenditure for primary education in the district ²⁵	Numeric (US\$) ^a
	EMPRTL	Number of retail sector employees in the district ^{25,26}	Numeric
	FAR	The floor area ratio restriction on office commercial development ²⁵	Numeric
	HEIGHT	The height restrictions on office commercial development ²⁵	Numeric (m)
	HY	Number of streets within 1 km square area ^{2,32}	Numeric
	INCOME	Annual average household income in the district ^{2,26}	Numeric (US\$)
	OF1	Total office space within 1km square area ⁵	Numeric (m ²)
	PBUS	Number of bus services to the region (proxy for easy access by public transport) ⁵	Numeric
	PRO	Number of professional employees in the district ^{2,25,26}	Numeric
	SERVICE	Number of service sector employees in the district ^{2,6,26}	Numeric
	SMGC	The air pollution rate in the district (SO ₂) ⁵	Numeric (µg/m ³)
Contract Prmt.	CPI	CPI adjustment in the lease (1-0) ^{3,31}	Dummy
	E	Operational expenses (electricity, water, gas, security etc.) ²³	Numeric (US\$/m ²)
	ESCAL	Contract contains a rent escalation clause (1-0) ^{2,3}	Dummy
	FREE	Duration of free rent ³	Numeric (US\$/m ² /month)
	NET	Offered rent is net (1-0) ^{2,25,34}	Dummy
	TAX	Annual tax rate of the office ^{2,5,25,32}	Numeric (US\$/year)
	TERM	Duration of contract ^{3,34}	Numeric (year)

Appendix B. Details of previous academic work on office rent models.

Author(s)	Study Area	Duration	Parameter Categories			
			Econometric	Building	Locational	Contract
Clapp, (1980)	Los Angeles	1974		X	X	X
Rosen, (1984)	San Francisco	1961-83	X			
Wheaton, (1984)	Boston	1980		X	X	X
Brennan, et. al., (1984)	Chicago	1980-83		X	X	X
Hekman, (1985)	14 U.S. cities	1979-83	X			
Shilling, et. al., (1987)	17 U.S. cities	1960-75	X			X
Wheaton and Torto, (1988)	USA	1968-86	X			
Frew and Jud, (1988)	North Carolina	1984	X	X	X	
Gardiner and Henneberry, (1988)	England	1977-84	X			
Glascocok, et. al., (1990)	Louisiana	1984-88	X	X	X	X
Gardiner and Henneberry, (1991)	England	1977-84	X			
Pollakowski, et. al., (1992)	21 US metropolitans	1981-90	X		X	
Mills, (1992)	Chicago	1990		X	X	
Wheaton and Torto, (1994)	50 US metropolitans	1979-91	X	X	X	X
Sivitanidou, (1995)	Los Angeles	1990		X	X	X
Sivitanidou, (1996)	Los Angeles	1990		X	X	
Webb and Fisher, (1996)	Chicago	1985-91		X		X
Hendershott, (1996)	Sydney	1970-92	X			
D'Arcy, et. al., (1996)	25 European cities	1982-94	X			
D'Arcy, et. al., (1997)	22 European cities	1982-94	X			
Sivitanides, (1997)	24 U.S. cities	1980-88	X			
Bollinger, et. al., (1998)	Atlanta	1990-96		X	X	X
Gat, (1998)	Tel-Aviv/Israel	Not indicated		X	X	
Tsolacos, et. al., (1998)	England	1980-95	X			
Dunse and Jones (1998)	Glasgow	1994-95	X	X	X	
D'Arcy, et. al., (1999)	Dublin	1970-97	X			
Slade, (2000)	Phoenix	1991-96		X		
Chaplin, (2000)	UK	1985-95	X			
Hendershott, et. al., (2002)	London-Sydney	1977-1996	X			

