Estimating commercial property rentals in the Greek Market, using Multiple Regression Analysis

By

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1. Introduction

A number of studies have been conducted aiming at the estimation of current or future rental values through statistical model building. The increased degree of subjectivity involved in the conventional methodologies, the fact that data from comparable evidence is difficult to acquire in certain cases or cannot be fully exploited when they exist, are some of the arguments presented by real estate researchers in addressing the need for the use of statistical methods, at least as supporting tools, for investment appraisals.

The scope of the paper is to present the possibility of applying multiple regression analysis for interpreting and predicting office rental values in the Greek Property market, with emphasis to Athens city centre. The particularity of the research performed was the exploitation of the database deriving from crude sources such as magazines and newspapers entries. Such a method of data collection is applicable to areas where specialized property databases do not exist, are difficult to assemble or impossible to access and the market imposes the need for sophisticated analysis of conditions and trends.

2. Literature Review

The existing bibliography on statistical analysis of property data, for the purpose of estimating the rental value of commercial properties, is very limited. The majority of the relevant articles derive from American real estate journals and present research accomplished mainly in the USA. The topics covered by the latter mainly concern residential property, with only few exceptions for retail properties (shopping centres etc.). Pagliari and Webb (1996) are summarising any previous regression applications for property pricing and valuation issues using five categories of research fields: "1. The appraisal of single-family homes (Blettner, 1969; Case, 1967; Dilmore, 1974, Emerson, 1972; Rosen and Smith, 1983), 2. The appraisal of multifamily projects (Hanford, 1966; Shenkel, 1969; Webb, 1982), 3. Estimating demand for retail space (Benjamin, Jud and Okoruwa, 1994; Whaley, 1990), 4. Estimating the natural vacancy rate for apartment markets (Gabriel and Nothaft, 1988; Harris, 1991; Miles, 1975;

Read, 1988) and 5. Estimating the market rents for apartment markets (Sirmans and Benjamin, 1991)".

It appears, thus, that the implementation of single or multivariate regression analysis for office valuation has not been until now a popular research object. Some possible reasons could be:

?? The characteristics of residential property, the property type which concentrates the majority of statistical research, are easier to standardise and use as independent variables.

?? Residential properties significantly exceed in number all types of commercial properties and consequently greater samples from transactions data can be collected.

?? Information about transactions for commercial property are normally more closely held and thus more difficult to acquire.

?? Probably, in the United States, where the majority of the research has taken place, the interest in the analysis of residential property is increased.

Nevertheless, some of the principles which have been used for the statistical analysis of other types of property could be implemented in the case of offices, as well, with the appropriate adjustments. For this purpose, any literature or articles, which were considered relevant in a wider sense, are presented in this chapter and at the end the potential for implementation in this project of any ideas collected, is examined.

The first existing articles on statistical analysis of property data go back to late 60's and early 70's. In 1969 and 1967, Muth and Mills respectively, introduced the idea of monocentric urban models based on the assumption of approximately equal distances of all suburban areas from the CBD, as well as, similar transportation costs. The monocentric urban models were used for describing several North American cities (Asabere and Huffman, 1996). After these early studies on the impact of location or other factors on residential property rents or values, an evolution in ideas and in the use of numerical and statistical tools can be observed. The estimation of the land value of a farm in Mississippi by Smith (1979) consists a representative example of the increasing interest towards statistical methods in real estate valuation.

In the '80s statistical modelling applications become more sophisticated, in an effort to improve the accuracy of the estimations. In 1986, Perry, Cronan and Epley presented an alternative regression technique called “rank regression” which appears to be more accurate for the analysis of small samples than conventional multiple regression. An analysis of the available data prior to the regression is followed in order for the ‘better’ comparables to be selected and used in the final model. The authors suggest, that the ranking of data prior to the application of multiple regression produces a methodology which complies more with the appraisal theory. “An appraiser compares heated areas, number of bedrooms, and lot value separately (that is, univariately) to arrive at the final ranking. Rank transformation regression performs a similar procedure except that it compares all the variables together (that is, multivariately) to arrive at the final ranking.” The method requires the ranking of the available data using a scale from 1 to 9, in accordance with a raking method first developed by Conover and Iman (1976). Finally, the significance of the deriving R^2 is compared against the one of Mean Square Error (MSE) and the way in which each one of them should be considered, are presented (both R^2 and MSE terms are explained in chapter 4). According to the authors, since the accuracy in the estimate is the overall objective, the MSE criterion must be given the greatest priority. Thus, even though conventional multiple regressions appear to produce higher R^2, the proposed ranking method produces a more desirable decreased MSE, at least in the case of smaller samples (with less than 30 comparables).

One example of statistical analysis for office rental value determination consists the paper "Estimation of Market Rent for Office Space" by Cannaday and Han Bin Kang (1984), where the location as well as the physical characteristics of the office building are introduced in a hedonic regression model and the effect of these variables on the level of rent is examined and evaluated. The term 'hedonic' is used to describe the pleasure which derives from a specific commodity and its particular characteristics. In the paper, the office building is considered as "a bundle of its locational and physical attributes" and the final hedonic-rental price is defined as "the implicit price of these attributes".

Two forms of regression were considered for the statistical analysis of the available data: linear and non-linear regressions. The results produced suggested that the log-linear model was superior to the linear one as it appeared to be more sensitive in capturing any increasing or decreasing marginal contributions of the locational and physical factors to the dependent variable - rental price.

Brennan, Cannaday and Colwell (1984) attempt to develop a hedonic regression model which explains the variation in rent for offices in the Chicago CBD. The authors initially consider five different functional forms for the data analysis, the following: linear, reciprocal, logarithmic, semi-log and log-linear, the latter producing the most statistically significant results. What differentiates this model from the one developed by Cannaday and Han Bin Kang (1984) is that the unit of analysis is the office unit and in the variables two additional factors were introduced: the specific lease terms of actual transactions and the specific location of the unit within the office building.

In Cannaday's and Han Bin Kang's work, lease was considered merely in terms of the required minimum lease term. Brennan, Cannaday and Colwell go further to suggest that lease terms should be more thoroughly considered as there are several "specific features of the lease contract which may have an important influence on the level of rental rates".

Hough and Kratz, (1983) present a similar study which attempts to estimate office rental values in the Chicago CBD and four functional forms are tried: linear, logarithmic (logarithm in characteristics), semi-log (logarithm in rent) and log-linear, (Brennan, Cannaday and Colwell, 1984). In their study the authors conclude that the linear and logarithmic models were superior to the other two forms.

Hekman (1985) using data which cover fourteen years, presents a model for estimating office rental values based on the assumption that market rents adjust in response to local, as well as national economic conditions. Hence, the author uses investment, as measured by building permits, and long-term growth rate of office employment, in a regression analysis, suggesting, thus, a completely different approach than the one presented in the previous paper.

One of the more recent examples of research on statistical determination of property values was published by Benjamin and Sirmans (1996). In their paper "Mass Transportation, Apartment Rent and Property Values" they attempt to determine the degree to which the available transportation - and particularly the distance from it - affects apartment rents. For this purpose they apply a hedonic model (based on Gutermann and Norrbin, 1987) in order to determine the extent to which transportation affects the dependent variable (rents). Specifically, the model calculates rent as a function of the physical characteristics of the apartment, the location, the occupancy rate, the security deposit and the distance from the Metrorail station. What is interesting in the structure of the model is that the physical characteristics, apart from figures about the number of bedrooms or bathrooms, comprise such information as the available parking, whether the apartment has a fireplace or all the utilities are paid etc. These latter information are inserted as dummy variables, always expressed as 0 or 1. The same technique is used for the 'deposit' variable as well as for the

'location' one, where different dummy variables exist for different zip codes. In the results produced by the regression analysis, the coefficients of the dummy variables express the significance of the latter in the explanation of the rental value and, for the particular case of the zip codes, they also represent the desirability of the particular area. The paper interprets the statistical results and concludes on the particular effect of public transportation accessibility on apartment rental values.

Nevertheless, an argument which would express a reservation about the actual power of such statistical models would be still difficult to contradict. The literature presented is revealing a confusion about the correct or more accurate form of analysis, about the factors to be introduced or about the interpretation that should be attributed to the results. Cases exist where the researcher has to omit factors that cannot be easily quantified or variables which do not produce a statistically significant result, which would otherwise be considered in the course of his common practice.

Furthermore, statistical models have been developed mainly for residential property, which may suggest that the particular market is of great significance in the USA, where most of the research has taken place, or that similar efforts for other types of commercial property have been unsuccessful and, thus, not reported in scientific papers.

Finally, it appears that the factors introduced to each model, which refer to properties in different localities with different characteristics, cannot be generalized and standardized for every case. Even with variables, such as location, which are always present in the models, the variation can be significant: location can be introduced in the form of zip-code as a dummy variable, as distance from a point or area of reference, as distance from transportation means, etc. Consequently, a standardized model for a type of property cannot be extracted from the existing studies, requiring, thus, a new model to be created for each particular application, tailored to the different locational circumstances, the format in which the data are available or the personal preferences of the individual. However, consistency actually exists in several methodological aspects and, in certain occasions, in findings presented. Characteristically, statistical results consistently attribute high significance to variables related to location, which is in turn consistent with the empirical knowledge. Furthermore, where a comparative evaluation of different forms of regression analysis is attempted, log-linear models appear to have the highest explanatory power.

Apparently, the literature reveals a variety of regression-based approaches for the determination of either rental prices or property values. Nevertheless, the majority of papers deal with residential property, whereas relevant research on commercial and specifically office property appears to be limited.

The methods presented mainly differ in aspects such as the degree of complexity of any steps followed, the size of sample used for the analysis, the nature and content of variables introduced in the models, or the quantitative expression of the latter. In fact, this differentiation reflects the different ways in which the authors deal with the difficulties of this particular type of analysis.

Among the different techniques presented certain ones, such as the quality rating, the use of dummy variables or some kind of sample segmentation appear in the available literature more than once. On the other hand, techniques such as the data ranking (Perry, Cronan and Epley, 1986), or the implementation of the Stein rule (Knight, Carter Hill and Sirmans, 1993) prior to the analysis consist proposals, which have not been further investigated, but still with considerable potential. Further differentiation can be observed to the regression type used for the determination of the model, even though opinions seem to converge towards linear and log-linear forms.

Nevertheless, it becomes apparent that ultimately all authors use the same measures of reliability to assess the power of their statistical models, giving emphasis to the adjusted coefficient of determination (R^2), the level of confidence ensured and the standard error of the regression. All the papers examined in the previous paragraphs can normally explain a percentage higher than 60% - 65% of the variability of the dependent variable, a level which is considered satisfactory, considering the limited samples on which they are based and the inevitable subjectivity in the selection of variables or the quantification of qualitative factors.

The number and nature of factors considered by different authors reflect the scope, the extent and the depth of their work or research. The variables introduced in the statistical models can be either general factors with universal application or characteristics which can only apply under particular, very specialized circumstances. Nevertheless, most of these latter factors could be expressed in more general terms, adjusted to different circumstances or even combined together to produce new potential variables.

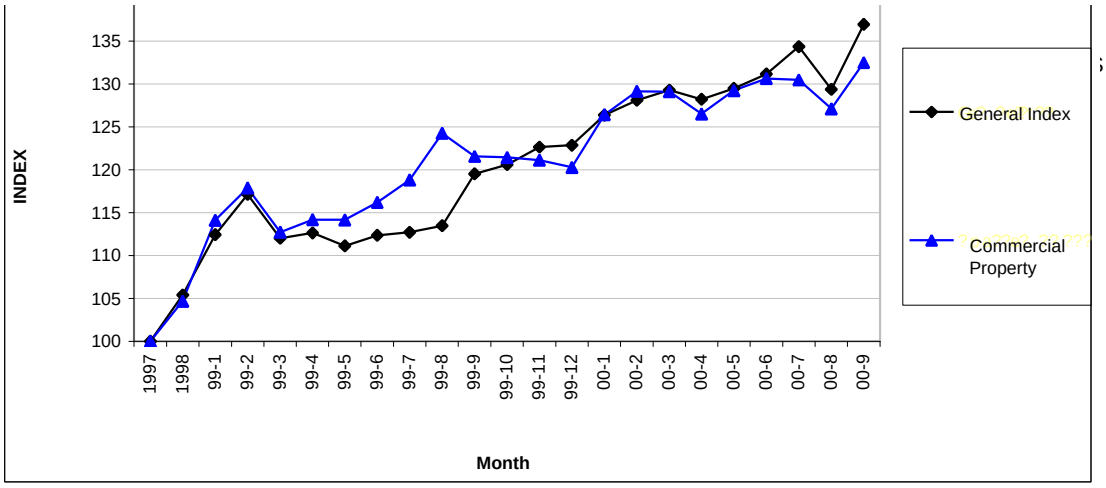
3. Overview of the current Greek property market

Before determining the specific factors which affect office rental values in Athens, it would be worthwhile identifying the current trends in both the general property sector and the office sector, as well as their growth potential.

It was not until recently that investment in commercial property has emerged the market as a valid vehicle, a trend apparently supported by the amelioration of the county's financial circumstances. Decreased interest rates along with the significant increase in the national GDP have affected demand and favoured investments. Property development started to expand to forms other than traditional residential blocks and offices. Sophisticated and often speculative developments have started to make a successful appearance in a difficult market with traditional aspects, inverting past failures recognised in dozens of deserted shopping malls throughout the wider Athens area.

Actually, the Greek property market presents a few irregularities and particularities as it is merely during the past two or three years that it has become to move towards a maturity stage where analysis is applicable and accurate data are available. Property has traditionally consisted an important asset especially for individuals and families. Its potential as alternative investment means was considered merely in the form of the apartment, often leased for a definite period of time until it was used by family members or sold. Property values have always moved upwards, with the general trend differing only in terms of rate of increase. No systematic effort of collecting market information has taken place in the past, therefore all assumptions that can be made about the increase in property values, even during the last decades, are merely empirical.

Characteristics such as lack of transparency in transactions, non-revealed fees which cannot be traced, reluctance by professionals to disclose any kind of information and deal performed between individuals without intermediation, consist typical examples of the mechanisms developed within the Greek property market. These particularities make monitoring, or even predicting, problematic and even impossible. In a first attempt to overcome the practical limitations, a new index was produced, under private initiative, named PROPINDEX. The latter uses data based on current property supply, from the wider Athens area and consists an indicator of the market growth, from 1997 until today (Diagram 1).



Currently, Athens appears in the list of the European cities with the highest prime office rental values with a rental growth for the first quarter of 2001 exceeding 15% (source: FPD Savills). Prime office rents in the wider Athens area range between 8.000 GRD per sq.m. (280 Euro per annum) and 15.000 GRD per sq.m. (530 Euro per annum), higher than ever before.

Diagram 1

Demand remains at very increased levels, with both public and private sector seeking for new or adequately refurbished space of high standards in terms of accessibility, specification and prestige.

According to FPD Savills European Office Market Report (Spring 2001) an increased investment activity, especially in North and Northeastern Athens is predicted, especially due to the new airport, the adjacent infrastructure works and especially the Olympic Games of 2004. New accommodation remains however in short supply, pushing significantly up the rental values. Furthermore, taking into account the institutional investment interest by both Greek and international investors, as well as the restricted availability of prime space for purchase, yields are subsequently expected to fall.

4. Research methodology

The scope of the research process followed is to examine the potential of multiple regression analysis to explain and assess office rental values, in the Greek property market. Such research has never been attempted before, even though it is most popular for European and U.S. property markets. The original hypothesis on which the study is based and which needs to be examined, is that office rental prices, at a certain point in time, can be adequately explained by several characteristics of the property. The proposed statistical analysis is going to consist the tool for assessing the soundness or the extent to which this hypothesis is valid.

Even though several differentiations exist in the way that authors and real estate researchers have dealt with this subject in the past, simpler forms of analysis appear to have the advantage of using simpler and more familiar statistical terms, not requiring, thus, in depth knowledge of statistics and mathematics. Therefore, an effort has been made so that the levels of complexity and specialisation of this study are kept to a minimum.

Data collection

The difficulty of availability of data was dealt with by using press as the main source of information. During the past few years and especially since 1998, financial newspapers have developed and enriched real estate specialized sections, whereas a significant range of real

estate magazines has gradually penetrated the market. As a result, nowadays, one can have access to ample data, yet with some obvious drawbacks such as insufficient detail, increased demand values, and often misleading information. Nevertheless, this sort of data has a significant advantage, as the researcher is able to have access to a substantial percentage of the current supply, deriving from different sources (individuals, agents, developers etc.)

In an effort to take advantage of this opportunity we gathered information about office properties offered for leasing, from a 6-month period, i.e. from October 2000 to March 2001. For the analysis we assumed that this is the maximum time period for which we can practically have steady rentals, unaffected by actual growth.

The data were selectively collected from the wider area of Athens city center and along or around its major commercial routes. Such transactions are representative of the overall commercial property activity and as Shilton and Stanley (1999) suggested in their work, it appears the highest concentration of major firms is found in the largest metropolitan cities, although technological changes could normally favor the decentralization towards lower-cost areas.

Data analysis

The information comprised in newspaper entries deal mainly with locational and physical characteristics of the properties, such as whether they are new, refurbished or obsolete, the existence of car-parking spaces, and their gross lettable area. Apart from the actual area of the property the rest of the information is qualitative and therefore quantification was required before introduced in any statistical model.

Car-parking was introduced as a dummy variable expressing whether there is adequate provision for parking, either covered or external. As a dummy variable was also introduced the information about whether property is listed or not.

For the rest of the variables a method, referred in literature as quality point rating was applied: a scale has been selected, the range of which is used for the expression of the quality of each characteristic (Pagliari and Webb, 1996). For this study, a scale from 1 to 5 was selected, as it was considered adequate for the expression of the entire possible range of qualitative variations. Value 0 was purposely excluded as it would be an invalid value for logarithmic forms of regression analysis. Value 1 is used to express very low quality, whereas 5 represents the highest quality standard.

The obvious disadvantage of this approach is the subjectivity involved to the attribution of a value to a variable. In order for this subjectivity to be reduced to the lowest possible level, standard criteria were set for the quantification of each characteristic.

Characteristically Athens city was divided into 20 areas, all with significant business activity, but with varying demand volume. Each area was attributed a rating from 1 to 5, depending on the overall current concentration and quality of business activity. Based on the same criteria the most active commercial streets were identified, and were attributed values from 3 to 5, whereas the rest of the streets in areas of interest were attributed values 1 and 2 , depending on characteristics such as proximity to main routes, street length, footage etc. Especially for the age parameter and considering the fact that the important factor is the degree of obsolescence rather than actual age we selected a special scale between 1 and 3 for representing obsolete, refurbished and new properties respectively.

For purposes of uniformity with the rest of the variables the area of the properties were adjusted as to receive values from 1 to 3, using the following criterion: for area < 500 sq.m. value=1, for 500< area< 1000, value = 2 and for area>1000, value =3. The categorization

used is based on the empirical knowledge, which shows that the subject grading refers to different target groups in the Greek office market, with differentiated space needs.

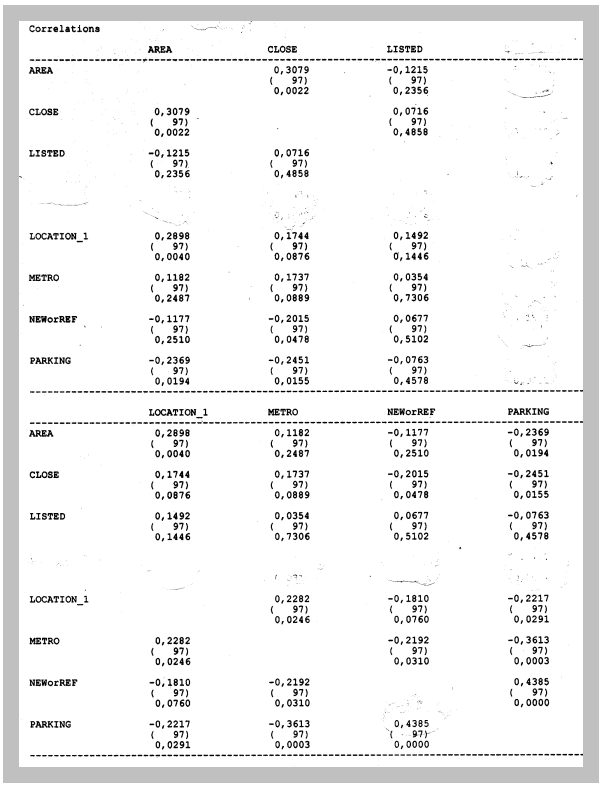
The initial dataset comprised 92 observations, which were expected to represent the total existing supply at a percentage higher than 60%.

The initial independent variables selected for the analysis were:

AREA:	representing the scale of the gross area of the property, taking values for 1 to 3
LOCATION_1:	representing the area of interest in which the property is located and their perceived demand for office spaces, taking values from 1 to 5
ROAD:	representing the concentration of business acrivity along particular streets, roads and avenues, within the areas of interest, taking values for 1 to 5
CLOSE:	representing whether the property has a facade along a main street of interest or it is just situated in very close proximity to the latter, used as a dummy variable
METRO:	representing the proximity to the Metro stations of Athens, used as a dummy variable
PARKING:	representing whether the property has adequate car parking spaces, used as a dummy variable
NEWorREF:	representing the condition state of the property, taking values form 1 to 3
LISTED:	representing whether the property is listed, used as a dummy variable

The dependent variable of the model is RENT expressing rent per sq.m.

The first step of the analysis was to identify any multicollinearity among the dependent variables. In cases where increased correlations exist, the regression results may be confusing and misleading (Sincich, 1996), and highly correlated depended variables should be selectively excluded from the analysis. Therefore the correlation matrix has been calculated as presented below (Table 1) which reveals the PARKING variable presenting relatively increased correlations with most variables, reaching a maximum with the NEWorREF variable. The correlation between the two parameters is justifiable, considering the fact that almost all new office buildings are designed to have ample car parking provision. Hence, the parameter PARKING was subsequently removed from the analysis and a new correlation matrix was calculated revealing no significant correlations among the rest of the variables.



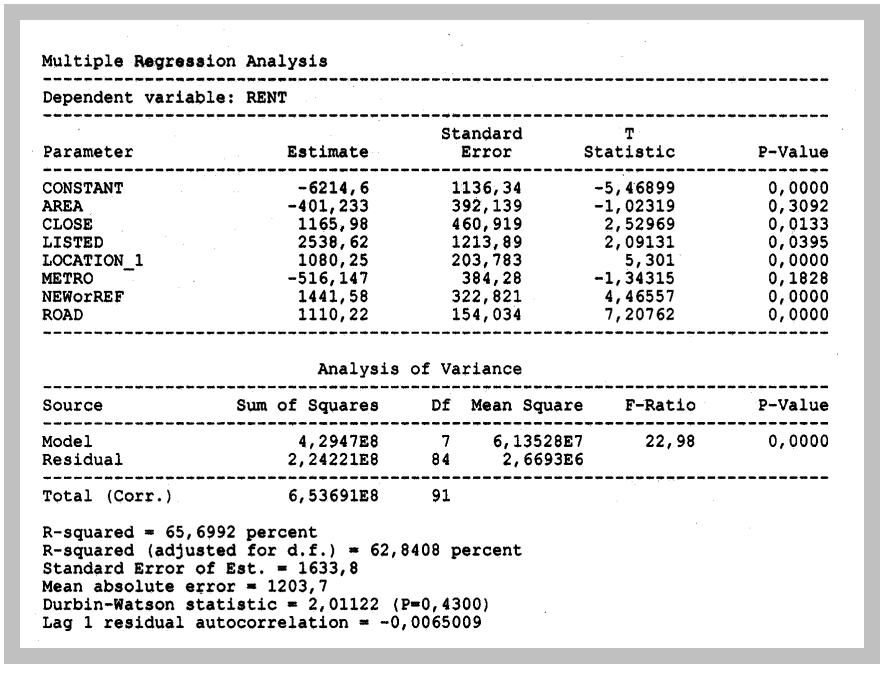
Correlations

	AREA	CLOSE	LISTED
AREA		0,3079 (97) 0,0022	-0,1215 (97) 0,2356
CLOSE	0,3079 (97) 0,0022		0,0716 (97) 0,4858
LISTED	-0,1215 (97) 0,2356	0,0716 (97) 0,4858	
LOCATION_1	0,2898 (97) 0,0040	0,1744 (97) 0,0876	0,1492 (97) 0,1446
METRO	0,1182 (97) 0,2487	0,1737 (97) 0,0889	0,0354 (97) 0,7306
NEWorREF	-0,1177 (97) 0,2510	-0,2015 (97) 0,0478	0,0677 (97) 0,5102
PARKING	-0,2369 (97) 0,0194	-0,2451 (97) 0,0155	-0,0763 (97) 0,4578

	LOCATION_1	METRO	NEWorREF	PARKING
AREA	0,2898 (97) 0,0040	0,1182 (97) 0,2487	-0,1177 (97) 0,2510	-0,2369 (97) 0,0194
CLOSE	0,1744 (97) 0,0876	0,1737 (97) 0,0889	-0,2015 (97) 0,0478	-0,2451 (97) 0,0155
LISTED	0,1492 (97) 0,1446	0,0354 (97) 0,7306	0,0677 (97) 0,5102	-0,0763 (97) 0,4578
LOCATION_1		0,2282 (97) 0,0246	-0,1810 (97) 0,0760	-0,2217 (97) 0,0291
METRO	0,2282 (97) 0,0246		-0,2192 (97) 0,0310	-0,3613 (97) 0,0003
NEWorREF	-0,1810 (97) 0,0760	-0,2192 (97) 0,0310		0,4385 (97) 0,0000
PARKING	-0,2217 (97) 0,0291	-0,3613 (97) 0,0003	0,4385 (97) 0,0000	

Table 1

Using the initial dataset comprised of 92 observations and introducing 7 independent variables in the model, a multiple regression analysis was run with the following results:



Multiple Regression Analysis

Dependent variable: RENT

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	-6214,6	1136,34	-5,46899	0,0000
AREA	-401,233	392,139	-1,02319	0,3092
CLOSE	1165,98	460,919	2,52969	0,0133
LISTED	2538,62	1213,89	2,09131	0,0395
LOCATION_1	1080,25	203,783	5,301	0,0000
METRO	-516,147	384,28	-1,34315	0,1828
NEWorREF	1441,58	322,821	4,46557	0,0000
ROAD	1110,22	154,034	7,20762	0,0000

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	4,2947E8	7	6,13528E7	22,98	0,0000
Residual	2,24221E8	84	2,6693E6		
Total (Corr.)	6,53691E8	91			

R-squared = 65,6992 percent
R-squared (adjusted for d.f.) = 62,8408 percent
Standard Error of Est. = 1633,8
Mean absolute error = 1203,7
Durbin-Watson statistic = 2,01122 (P=0,4300)
Lag 1 residual autocorrelation = -0,0065009

Table 2

Unusual Residuals

Row	Y	Predicted Y	Residual	Studentized Residual
9	14213,2	9712,34	4500,85	3,05
37	7142,86	10546,7	-3403,81	-3,18
53	4444,44	9062,51	-4618,06	-3,14
55	10972,2	7620,93	3351,3	2,21
69	9375,0	5486,21	3888,79	2,51
70	14213,2	10809,4	3403,81	3,18
86	11932,6	8270,76	3661,79	2,39

Table 3

The equation of the fitted model is

RENT = -6214.6 - 401.233*AREA + 1165.98*CLOSE + 2538.62*LISTED+1080.25*LOCATION_1- 516.147*METRO+1441.58*NEWorREF+1110.228ROAD

Since the P-value in the ANOVA table is less than 0.01, there is a statistically significant relationship between the variables at the 99% confidence level. The R-Squared statistic indicates that the model as fitted explains 65.70% of the variability in RENT. The adjusted R-Squared statistic, which is more suitable for comparing models with different numbers of independent variables, is 62.84%.

The results, however, revealed the possibility for further improvement of the model. First of all, the variable AREA presented an increased P-value, greater than 0.10, which indicates that the variable is not statistically significant at the 90% or higher confidence level and therefore it could be removed. Furthermore, in the produced table of unusual observations (table 3), 7 outliers could be traced, 4 of which had an absolute studentized residual greater than 3. Since information was restricted by the nature of the data, these particular observations were omitted from the dataset, without further investigating the existence of special reasons that leaded to the extreme values.

Applying the aforementioned variations, the second run of the multiple regression analysis produces the results as presented in table 4.

Multiple Regression Analysis

Dependent variable: RENT

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	-6023,43	997,346	-6,03945	0,0000
CLOSE	729,163	383,022	1,90371	0,0605
LOCATION_1	1108,81	169,639	6,53631	0,0000
METRO	-858,222	330,649	-2,59557	0,0112
NEWorREF	1528,77	279,611	5,46749	0,0000
ROAD	1055,66	131,4	8,03391	0,0000

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	3,40905E8	5	6,8181E7	35,78	0,0000
Residual	1,56239E8	82	1,90535E6		
Total (Corr.)	4,97144E8	87			

R-squared = 68,5727 percent
R-squared (adjusted for d.f.) = 66,6564 percent
Standard Error of Est. = 1380,35
Mean absolute error = 1051,34
Durbin-Watson statistic = 2,14427 (P=0,2225)
Lag 1 residual autocorrelation = -0,0729133

Table 4

The R-Squared statistic indicates that the improved model as fitted explains 68.57% of the variability in RENT, whereas the adjusted R-Squared statistic is 66.66%.

Taking into account the fact that most studies on multiple regression analysis applications on properties, indicate that the log- linear model generally performs better than the other models (Slade, 2000), we examined the latter potential to the present research with the results presented in table 5.

Using the initial dataset comprised by 92 observations we acquired improved statistical indices, indicating the superiority of the log-linear analysis. It is worth mentioning that in this case we had to exclude from the beginning any independent variables formed as dummy variables, as the value 0 does not permit logarithmic treat. Therefore, we only dealt with 3 independent variables: Location (LOCATION_1), the condition state of the property (NEWor REF) and the street in which it situated (ROAD).

Multiple Regression Analysis

Dependent variable: RENT

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	2,78799	0,0682065	40,8757	0,0000
LOCATION_1	0,751294	0,0955171	7,86554	0,0000
NEWorREF	0,638787	0,0871776	7,32742	0,0000
ROAD	0,546087	0,0678579	8,0475	0,0000

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	2,69049	3	0,896829	72,94	0,0000
Residual	1,08205	88	0,012296		
Total (Corr.)	3,77254	91			

R-squared = 71,3177 percent
R-squared (adjusted for d.f.) = 70,3399 percent
Standard Error of Est. = 0,110887
Mean absolute error = 0,0868356
Durbin-Watson statistic = 1,84238 (P=0,2098)
Lag 1 residual autocorrelation = 0,0750588

Table 5

The analysis produced a 71.31% explanatory capability of the model and an R squared statistic, which can be directly compared with the initial model, of 70.34%. T-statistic of the model indicates than no variable should be removed as they all are statistically significant at the 99% confidence level and the only possibility of improvement could come from the removal of the sole unusual studendized residual with a value greater than 3 (table 6).

Unusual Residuals

Row	Y	Predicted Y	Residual	Studentized Residual
53	3,64782	3,9996	-0,351782	-3,44
69	3,97197	3,69316	0,278813	2,61
70	4,15269	3,88711	0,265577	2,50

Table 6

Applying the removal of the one significant outlier the results produced by the new analysis are presented in table 7.

Multiple Regression Analysis

Dependent variable: RENT

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	2,75469	0,0650774	42,3295	0,0000
ROAD	0,563132	0,0642168	8,76923	0,0000
LOCATION_1	0,781318	0,0905438	8,62917	0,0000
NEWorREF	0,675149	0,0829297	8,14123	0,0000

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	2,81751	3	0,939171	85,80	0,0000
Residual	0,952337	87	0,0109464		
Total (Corr.)	3,76985	90			

R-squared = 74,738 percent
R-squared (adjusted for d.f.) = 73,8669 percent
Standard Error of Est. = 0,104625
Mean absolute error = 0,0846274
Durbin-Watson statistic = 1,92534 (P=0,3407)
Lag 1 residual autocorrelation = 0,0341341

Table 7

This last analysis produces improved results, using almost the entire initial dataset and a limited number of variables. What is most important is the fact that the information, on which the independent variables are based, can be easily accessed through press, avoiding all practical limitations deriving from disclosure of data by professionals.

5. Conclusion

Multiple regression analysis was been widely tested as a tool for determining and predicting property values based on their microeconomic or macroeconomic characteristics, depending on the scope of the research. Such applications, examining the behaviour of U.S. and particular European property markets, has not been officially applied for the Greek property market, which during the past few years is experiencing a significant development.

Recognising that identification of factors affecting property values consists the first step in monitoring and predicting future trends, the largest possible dataset of properties, which are currently on the market, was assembled, introduced in a statistical model and tested. The limitation of the lack of organised and concentrated database, was partially overcome by using incomplete information from the press, which actually consists the only source of massive information concerning the Greek property market.

The factors, which explanatory capability was analyzed, were determined merely by the extent of information included in the relative press entries. The independent variables thus introduced in the model were the location of the property, the street on which it is situated, the proximity to a metro station, the condition state of the building, the existence of parking spaces and the area of the property. The explanatory capability of the variables on the office rentals exceeded 60% in all steps of analysis. Particularly, the results attained by the final log-linear model formed, were unexpectedly successful, compared to respective previous research carried out using real data from actual transactions with complete information.

It should be noted however that the actual form of the model expresses the relationship between the independent variables and the asked rentals rather than the actual price. Considering a difference between the latter and the former of 10%, one could make a crude

assessment of the actual rental value of the property by only introducing an assessment of the property's main locational and physical characteristics.

What is most important, however, is not actually the explanatory capability of the model at a particular time period. The main uses of such an analysis can be twofold. Firstly, applying the analysis for distinctive periods in the past, information which could be again accessed through past press, one could trace the differentiation of the degree of influence of the independent variables on the dependent one, though time. If a particular pattern is located this could be related to macroeconomic influences and be subsequently used for prediction using general macroeconomic forecasts. A second application could be the direct insertion of the time variable to the final model, using time series collected by past press data. Using again the significant variables isolated by the initial analysis, research can reveal patterns through time, which appropriately handled could be used for prediction of future behaviour of the Greek property market.

Even though it is empirically known that the Greek property market has always moved upwards and no significant cycles are expected to be traced in the past, and kind of analysis of past data is useful and desirable in describing a market that is currently accomplishing its most sound steps towards maturity.

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