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Urban sprawl processes characterize the landscape of the areas surrounding cities. These landscapes show different features according to the geographical area that cities belong to, though some common factors can be identified: land consumption, indifference to the peculiarities of the context, homogeneity of activities and building typologies, mobility needs exasperatedly delegated to private cars.

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THE EFFECT OF CENTRAL METRO STATIONS ON REAL ESTATE VALUES.

A CASE STUDY OF THESSALONIKI, GREECE

ABSTRACT

Almost all of the most populated cities in the world have invested heavily on high capacity urban public transit systems.
Apart from the direct economic benefits –travel time reduction, environmental benefits, some indirect benefits are the increase in real estate values (residential and commercial), improved accessibility and possible land use changes towards the development of an area. This study investigates the impact of the future central metro stations of Thessaloniki on real estate values. Real estate values can increase up to 11,3% at a distance shorter than 50 m and gradually decrease up to -14% for a distance greater than 500 m. A hedonic analysis is presented so as to determine the influence of metro stations to 52 commercial properties.
The results of the investigation indicate that the changes in market are not necessarily connected or totally attributed to the construction of the metro stations. Instead interesting results show that in some cases common belief about the impact of urban public transit systems can be slightly different.

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1 INTRODUCTION

Public transport systems have always been a vivid economic sector for investment. Public transport is a shared passenger transportation service which is available for use by the general public so as to facilitate the transportation of huge masses between two destinations (Debrezion G., Pels E. and Rietveld P. 2007).

Apart from this primal goal, public transit systems provide benefits such as environmental protection, vehicle cost savings and economic development of commercial and residential areas (Swamy 2010). More specifically, after the construction of the first metro subway line in London in 1890, almost all large cities have constructed such metro lines.

Thessaloniki is the second largest city in Greece with an average population of 1300000 residents. The bus company operating in the city is O.A.S.TH. and is the only public means of transportation in the city. Therefore, after numerous studies and debates, in 2006 the construction of the Metropolitan Railway began with a time schedule of completion in 2015.

The main line will cover 9,6 km with 13 platform station which will cover the central part of the city. Moreover, at the first phase of the construction an extension to the east (Kalamaria) and another one to the west (Stauroupoli) of 5 km and 5 stations each will complete the first phase of the most important transportation system in Thessaloniki.

Lastly, the completion of the Metropolitan Railway will finish with the construction of the connective line to the Thessaloniki Airport Macedonia and the hospital "Papagerorgiou".

A good transit system provides a high level and quality of access to work and other activities for households and for customers and employees for businesses. One way to acknowledge the value of this access is to examine the value of a home or a business, in addition to the value of other features such as the specific physical attributes of the building, the neighborhood characteristics and the surrounding environmental conditions (i.e. air pollution, cleanliness etc.) (Smith and Gihring 2011).

The impact of rail transit on property values has been studied from many perspectives, including analyses of different types of systems (e.g., rapid, commuter, light rail), of residential and commercial impacts and studies that have attempted to isolate both positive and negative effects.

As a result, many contradictory results have appeared mostly due to the different methods of analysis.

Yet, almost all studies show that transit systems are valued by property owners and, more specifically, they are positively valued increasing the property values in turn (Parsons Brinkerhoff 2001).

2 METHODOLOGY

Two central platform stations were chosen for the examination of their impact on commercial values (Venizelou and Agia Sofia) and a more eastern station of the main line (Flemigk) was chosen for the examination of its impact to residential values.

The property transactions, both for commercial and residential, are based on sales from 2000 to 2010 in a short distance from the studied stations.

The first two stations are believed to be ideal for such research because of the large number of commercial and office uses in their area. The main roads from which data was collected are Egnatia Street, Venizelou, Valaoritou, Ionos Dragoumi and Karolou Ntil. RICS states that the impact area of a metro station could extent up to 1000 m (RICS, 2004). Nevertheless, this statement is based on studies in much more populated cities around the world, so the findings should be adapted to Thessaloniki. Due to the fact that these stations are close to each other, a buffer of influence of 250 m is more than enough so as to avoid overlapping between the stations.

Fig. 1 Metro stations of Venizelou (left) and Agia Sofia (right)

The data were collected via questionnaires and interviews.

Firstly, a number of real estate agencies, offices, consumers and shop owners were interviewed in order to acquire a general idea of the economic situation, the market power, their knowledge of the characteristics of a transit system and their opinion about Thessaloniki's future subway line.

Secondly, specific questions were made especially to shop owners (private and on rent), which referred to the general economic state and specifically the market activity.

The questions that were asked are:

– What is the exact rent per square meter (rent rates)?

– If they believe that there will be positive, negative or neutral influences on their stores when the metro is going to be operational.

– If there was a decline in their incomes after 2008 and if yes with what percentage.

– If they tried to reduce the rental rate they pay because of the current difficult economic conditions and if so with w hat percentage.

A number of 52 shops were questioned about their opinion for the construction of the station, the reasons for any change in the market and the possible reduction of the rent.

At the same time they had the opportunity to express their opinion about the construction of the metro network, the problems that they faced the last five years and their ambitions in the near future.

The year 2008 is the crucial year for the Agia Sophia district because even though the whole project started in June 2006, the constructive operations in this specific area started in 2008.

So, comparisons are made over the period before and after 2008 and property values refer to before or after 2008 transactions.

During the research, a question emerged about which streets are more important for the current study.

For instance, according to a number of shops questioned at Ermou street, it was obvious that the construction of the metro in Egnatia street did not influence them (negatively) this specific period of time, so it was not necessary to expand the research in that street.

At this point, the used software is the IBM SPSS Statistics 19. A hedonic model is organized so as to present the influence that the changes in market due to economic crisis, construction of the subway or both, the positive/negative future effects of the subway to the market, the rent and the percentage of decrease of the rent have on the income of the shop owners.

The eastern station, Flemink, is located in an area where the most common use is the residential.

The studied streets are Delfon, Makedonias, Flemigk, 28th Septembriou and some other small roads.

The influence buffer is measured up to 300 m in this case because the two closest metro stations are far from Flemigk and there is no overlapping in this case.

The residential values ara based on data of transactions from 2000 to 2010 which were collected by specially designed questionaires. The survey included a large number of inquiries, including questions on the floor, the area, the antiquity and of course the value of the property.

The interviews were conducted face to face and the interviewed people were composed by assessing offices, homebuilders, commercial developers, leasing agents, appraisers, real estate brokers, development offices, land economists and land use planners.

The sample comsists of 100 values from which a small number was removed as unsuitable and inaccurate.

The methodology of the study follows a simple pattern. Answers of the questionnaires are organized and inserted in Microsoft Excel. The most important year for the Flemigk station of 2009 as it was the year that the construction started in the area.

Fig.2 Buffer area of the metro station of Flemigk

The goal of this study is to identify if the general belief that transportation infractures influence and sometimes form a city's economic status.

Many studies have shown that investment in transportation provides a development boost in major cities (City UEZ 2011; Cavill et al., 2008; California Infracture Coalition 2006).

So the question is if and in what extent the construction of the subway line in Thessaloniki, a city of much smaller population and in a country of great economic instability, has an economic impact in real estate values and if this impact is attributed only to the subway line or if the general economic crisis plays its role as well.

3 RESULTS AND DISCUSSION

The hedonic model is based only on data for commercial uses.

The number of the entered data is 40.

The reason for which all 52 data were not entered is that 12 shop owners were private owners of the shop and, therefore, they did not pay any rent and no data were available for the variable "SqrootRsqm".

	DESCRIPTION	MEAN	STD. DEVIATION	N
SqrootRsqm	Rent/ sqm*	3,8971	3,54972	40
Road	Road on which the shop is located	1,6154	0,78188	40
Expect	Positive, negative, neutral influence of the metro when operational	1,6410	0,77755	40
Chmark	Changes in market (%)	47,5000	22,63846	40
Csfall	Causes of market fall	2,6154	0,71139	40
Nerent	Negotiation of rent	1,3333	0,47757	40
Prent	Percentage of rent change (%) after negotiation	-5,2949	10,87472	40

*After many transformations, the Square rout of the variable ($\sqrt{R/sqm}$) proved to be most suitable for the prediction equation of the model.

Table 1 Descriptive statistics

The variables primarily entered in the model are shown in Table 1 but according to the model only the "Nerent" remained in the equation, as its significance was lower than 10%. Special reference must be made to the variable "Chmark" which almost entered the model, as its significance was 10,5%. However, for reasons of suitability and propriety of the model, the variable was not entered.

This indicates that at least in Thessaloniki the rent that the shop owners pay and the change in their income is not attributed to the construction of the metro, a belief that is proved by the fact that in smaller roads where the construction does not take place the decrease in rent and income is present too. Moreover, the changes in market activity are attributed to other factors as well, such as high prices, unwillingness of consumers to make transactions etc.

The R coefficient (78,6%) indicates the correlation between observed and predicted values of the dependent variable. The next indicator is the R square (61,9%), which shows the percentage of dispersion that can be interpreted by the dependent variable. Both indicators are considered satisfactory. The next indicator is the adjusted R square (60,8%). The higher the value of the indicator, the better the regression model is, due to the fact that the indicator shows the predictive power of the regression model (Wooldridge 2003).

In this case, the indicator is satisfactory too.

R	R SQUARE	ADJUSTED R SQUARE	STD. ERROR OF THE ESTIMATE	DURBIN-WATSON
0,786	0,619	0,608	2,22187	1,513

Table 2 Model Summary

Table 3 indicates the amount of influence each variable has on the value. More specifically, the only entered value in the equation has a B coefficient equal to -5,846 which shows that the rent decreases by this amount each time that the answer to the question of whether there has been a negotiation of the rent or not changes.

MODEL	UNSTANDARDIZED COEFFICIENTS		T	95,0% CONFIDENCE INTERVAL FOR B		COLLINEARITY STATISTICS	
	B	STD. ERROR		LOWER BOUND	UPPER BOUND	TOLERANCE	VIF
(Constant)	11,691	1,067	10,954	9,529	13,854		
Negotiation of rent	-5,846	0,755	-7,745	-7,375	-4,316	1,000	1,000

Table 3 Coefficients table

The function of the hedonic model is:

$$SqrootRsqm = 11,691 - 5,846 \; Nerent$$

At this point, it is crucial to verify the appropriateness of certain hypothesis on which the method of least square is based on.

Independence test

Durbin-Watson indicator identifies if the variables are positively, negatively or not at all correlated, as wanted. The values of this indicator vary between 0 and 4. When the values vary between 1,5 and 2,5, the variables are independent and, therefore, no related problem exists in the model (Harrel 2002). In this case, the value is 1,513 (Table 2).

Residuals' normality test

In every linear regression analysis, the existence of outliers is very dangerous for the stability and the accuracy of the model. Chart 3 and 4, which include the std. residuals, are very satisfactory ways of proving the normality of the model. Through these charts, it is clear that approximately normality is satisfied. The histogram shows a tendency to the right but, according to the figures, this tendency does not play a significant role to the results or incapacitate the model.

Linearity test

Both charts are sufficient for the linearity test.

Collinearity test

The indicators used for the collinearity diagnostics are the Tolerance factor and VIF. If the tolerance factor is near 1, then no problem of collinearity is observed. On the hand, if VIF exceeds 10, then there is a problem of collinearity (Luchters and Chakrabarty 2006). In this case of study, both indicators prove the absence of collineraity or multicollinearity.
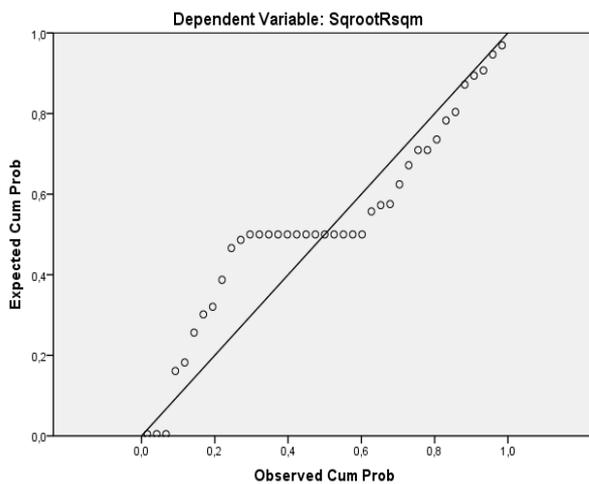
Normal P-P Plot of regression standardized residual
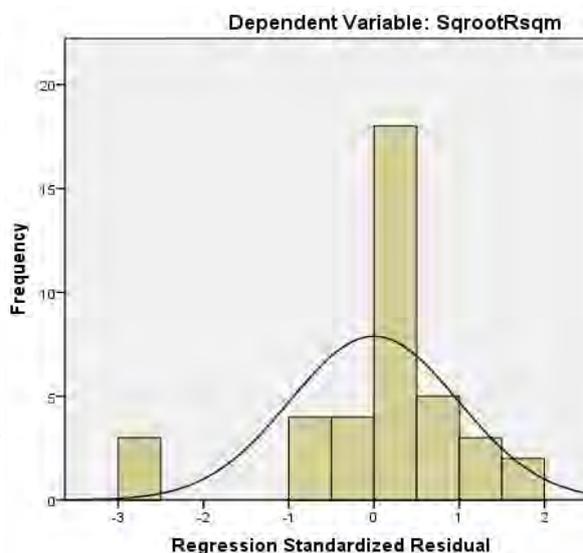
Histogram for the normality of the residuals

It is clear that after taking into consideration the characteristics of the shop (size, floor, layout etc.) the value of commercial properties is not always directly connected to the most common reasons, such as road where the shop is located. As far as residential properties are concerned, the most influential factor is the

distance to a metro station which is measured- in most cases- by the walking distance that the residents are willing to walk. Many studies have shown that this distance is approximately between 150-500 m (Dittmar and Ohland 2004). Some of the findings in several studies are shown below (Planning Commission TOD Committee 2011):

JURISDICTION	WALKING DISTANCE
Mass Transit Administration (Maryland)	500 m
Mid-America Regional Council (Kansas City, Missouri)	500 m
NJTransit (New Jersey)	400- 800 m
Ontario Ministry of Transportation	400 m
Regional Plan Association (NY, CT, NJ Tri-metro area)	400 m
Snohomish County Trans. Authority (Snohomish City, Washington)	300 m

Table 4, TOD Manuals from other Jurisdictions/Transit Agencies

In Thessaloniki, the results differ as far as the walking distance is concerned due to its much smaller population. Therefore, values differ within a very small walking distance from the Flemink station. More specifically, the crucial distance at this phase of construction -as it is expected to maximize after the beginning of the operation of the transit system- is approximately 60 m. This result is attributed to the dissatisfaction of the residents during the construction (noise, air pollution etc.) and the perspective that after such nuisance during the construction each resident wants the metro station to be as close to him as possible.

Therefore, if the distance is less than 50 m, residential values increase up to 4% and in some cases extremely more. If the distance is between 50-100 m, the values can decrease up to -11% and, finally, if the distance reaches 300 m and more, values can drop up to 22,5%. At this point, it must be pointed out that these percentages refer only to the walking distance to the metro station if taken for granted that the properties have the same or almost the same characteristics.

4. CONCLUSION

High level transit systems are a need to all major cities especially after the expansion of the urban sprawl in America at the beginning of the 19th century (Arbury 2005) and in Europe from the second half of this decade (EEA 2006).

Their effects can expand in various sectors, such as mobility benefits, efficiency benefits, travel time impacts, land use impacts, economic development impacts, environmental benefits etc (Litman, 2012). Therefore, it was unlikely that transit systems did not affect property values, commercial or residential.

Proximity to transit systems' platforms can affect property values. Any property close to a metro station is probably overestimated. Depending on how close the property lies to the station, whether the station is constructed or under construction, the value of a common property can be affected in many different ways (Ghebreegziabiher et al. 2006).

Devalued or not affected properties can gain some of their value after some time from the beginning of the operation of the transit system as its advantages are more perceptible and observable after its practical operation.

Thessaloniki is a city of many difficulties, one of the most important of which is the traffic problem.

Almost 1300000 residents move every day with their vehicles causing huge traffic conjunctions as the only transportation system in the city is the bus service.

After the construction of Athens metro line, it has become clear that many positive (i.e. decrease in private vehicle use, improved air quality etc.) effects alter the quality of the residents' lives.

Although negative effects are evident too (i.e. unsuccessful utilization of the park and ride system) (Spillar 1997), they are not connected with the failure or the unsuitability of the transport (OMEGA 2010).

In this study, Thessaloniki's transit system construction had some effect on property values.

It is fact that the economic crisis in Greece influences the markets of Thessaloniki simultaneously with the construction of subway line.

Therefore, it is difficult to state and present the real effects of the transit system on commercial and residential values. Furthermore, the negative aspect that must be taken into account is the delay of the constructions.

People are very disappointed and they do not have clear and certain future ambitions because there is no standard organized time schedule by the construction company or the government.

Residential values drop up to an average of 15% and commercial (as far as their transactions are concerned) drop up to an average of 19%.

Apart from the figures, an important factor of influence is the psychological. When residents and users view a worksite as the façade of their property, they tend to exaggerate for its impact (visual impact, noise nuisance etc). Moreover, the fact that the transit system was scheduled to finish earlier but, on the contrary, it will last 2 more years, influence the public opinion as well.

These are the main results and reasons for which the construction of the subway has to deal with most negative opinions. It is obvious that there will be influences in the area but the fact that current information was collected and people who were asked are not that objective proves that the survey is circled around the current problems in the area.

Therefore, these impacts associated with Thessaloniki's Metro development should be studied again after the completion of the whole project and after a period of time of its operation in order to permit the complete adjustment of the real estate market. However, the majority of the citizens –if not all– in every part of Thessaloniki believe that the subway will have a very positive effect to the city and to one of its most important problems, the traffic conjunction.

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