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The Determinants of Apartment Prices in Strovolos

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The Determinants of Apartment Prices in Strovolos

by

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SUMMARY

This study applies a Multiple Regression Analysis Model (Log Transformed Data) to investigate the impact of the macro and microeconomy on the apartment sale prices in Strovolos, Nicosia, Cyprus. Focusing on the period between 2014 and 2018 our results show that for the specific period the changes in apartment prices are significantly dependent on property characteristics (apartment, block, and neighborhood characteristics), fiscal and monetary environment. Specifically, mortgage interest rate, VAT applied on sales transactions, age and construction quality of the block, the enclosed area, the area of the covered and uncovered verandas, the quarter that the property is located, and the presence of a storage room were found to be significantly correlated to the price.

Table of Contents

ACKNOWLEDGEMENT **1**

SUMMARY **2**

LIST OF TABLES **5**

LIST OF FIGURES **5**

INTRODUCTION **6**

AN OVERVIEW OF THE LITERATURE **8**

MACROECONOMIC DETERMINANTS 8

MICROECONOMIC DETERMINANTS 14

FORECLOSURES AND HOUSE PRICES 19

SUMMARY AND CONCLUSIONS 21

Housing Market and the Macroeconomic Determinants *21*

Housing Market and the Microeconomic Determinants *27*

METHODOLOGY AND DATA **29**

METHODOLOGY 29

Multiple Linear Regression *29*

Correlation Coefficient R - R-Squared - Adjusted R-Squared *30*

Assumptions for Multiple Regression *31*

STUDY AREA AND DATA 32

Macroeconomic Variables *33*

Microeconomic Variables *34*

REGRESSION ANALYSIS RESULTS **40**

MODEL 1 (DEPENDENT VARIABLE PRICE) 40

Model Summary *40*

ANOVA *41*

Coefficients *42*

Regression Equation *43*

MODEL 2 (DEPENDENT VARIABLE PRICE/SQM) 44

Model Summary *44*

ANOVA *45*

Coefficients *45*

Regression Equation *47*

CONCLUSIONS AND STUDY LIMITATIONS 49

REFERENCES 53

INTERNET REFERENCES 56

APPENDIX 57

MODEL 3 (DEPENDENT VARIABLE PRICE) 57

Model Summary *57*

ANOVA *57*

Coefficients *57*

MODEL 4 (DEPENDENT VARIABLE PRICE/SQM) 58

Model Summary *58*

ANOVA *58*

Coefficients *58*

CORRELATIONS 59

List of Tables

Table 1: Model variables and their expected sign 37
Table 2: Descriptive statistics for Macroeconomic Quantitative Variables 38
Table 3: Descriptive statistics for Microeconomic Quantitative Variables 38
Table 4: Descriptive statistics for Microeconomic Qualitative Variables 39
Table 5: Model 1 - Model Summary 41
Table 6: Model 1 - ANOVA 41
Table 7: Model 1 - Coefficients 42
Table 8: Model 2 - Model Summary 44
Table 9: Model 2 - ANOVA 45
Table 10: Model 2 - Coefficients 46
Table 11: Model 3 - Model Summary 57
Table 12: Model 3 - ANOVA 57
Table 13: Model 3 - Coefficients 57
Table 14: Model 4 - Model Summary 58
Table 15: Model 4 - ANOVA 58
Table 16: Model 4 - Coefficients 58
Table 17: Correlations 59

List of Figures

Figure 0:1:Map of Strovolos - Distribution of Quarters 35

INTRODUCTION

Both public sector and households are interested in the dynamics of the housing market, as housing is a significant part of the government income through taxes and transfer fees and a major part of the households' assets (Savva, 2015). In countries with high homeownership rate, like Cyprus, housing prices and their fluctuations strongly affect the household finance and spending (Sivitanides, 2015). The performance of the residential real estate market is also important for commercial banks and other financial institutions, since houses are a typical security for mortgages, and therefore their prices falls have a strong effect on loans portfolio (Nneji et al, 2013).

The research about house prices is divided into two different categories. The first one involves the whole of a country's economy since it studies the influence of macroeconomic factors such as GDP, inflation, interest rates, etc. on residential market over time. The second one investigates the determinants of house prices on a microeconomic level and is known as the hedonic approach. It particularly, examines the relationship between the house prices and the specific characteristics of houses, such as size, type, location etc. (Pashiardes and Savva, 2009).

Within this context, this study examines the impact of macro and micro economic determinants, on the apartment sale prices in Strovolos, Nicosia, for the period between 2014 and 2018 by employing a multiple linear regression analysis model. Using this statistical technique we aim, to estimate the relationship between the variables, to assess the power of the relationship, to predict the future values of the dependent variable and to measure the influence of each independent variable on the dependent one (price).

During the period under study (2014-2018), which represents the aftermath of the events of March 2013, the Cyprus economy was struggling to recover from a deep recession, when one of the largest banks of Cyprus closed and the largest one went through a significant restructuring. These events led to reduction of household wealth and income, to a substantial increase of non-performing loans, and severe lack of credit for real estate loans (Sivitanides, 2015). Public sector was forced to a deep reform and because of this reformation the climate changed and since 2015 the country's economy started recovering with growth rates that continued during the following years. However, an economic downturn in 2020 is expected due to the COVID-19 pandemic. According to estimations by PricewaterhouseCoopers Ltd (2020) Cyprus GDP contraction in

2020 is expected to be between 7.6% and 13.5% compared to GDP contraction of 8.5% during 2012-2014. Moreover, GDP in 2021 is expected to be well below the pre-pandemic expectations based on forecasts (PricewaterhouseCoopers Ltd, 2020).

For the years 2013-2018 real estate sector contributed 12.0% to 13.6% to the GDP, holding a prominent position in the Cyprus economy (AXIA Chartered Surveyors, 2020). Regarding real estate market the total transactions in the country reached a record high of 25,811 in 2019, showing a significant increase of 5.6% compared to 2018 and 120.4% compared to its lowest sales year, 2013 (AXIA Chartered Surveyors, 2020). However, a considerable number of sales, was related to release and repossession of collateral properties by banks. On a district level and for the period 2012-2019, Nicosia concentrates a 21%, share of all transactions, showing the lowest rate of foreign buyers among the districts and being extremely popular among locals, mainly home buyers (AXIA Chartered Surveyors, 2020). Residential property transactions for the period 2014-2019 account for 47% of all sales on a country level. Most of the transactions (68%) refer to apartments with the rest 32% refer to houses. Regarding apartments, the increase in transactions was followed by fluctuations in prices from 2014 onwards, with 2019 having the highest average selling price (AXIA Chartered Surveyors, 2020).

The importance of housing market in Cyprus makes it a popular topic of study for the public sector, firms operating in the financial market, many other companies involved with the real estate market and most of the households. Hopefully, this study can add to the existing literature regarding the influence of macroeconomic and microeconomic variables on apartment prices in Strovolos, Nicosia the second largest Municipality in Cyprus after Limassol, with a population of over 70.000 inhabitants (Strovolos Municipality, 2020)

The structure of this study is as follows: Section 2 discusses factors that affect house prices. Section 3 describes the data collected for the empirical analysis and the methodology employed. Section 4 presents the results of the econometric analysis while Section 5 summaries the main findings of the study.

AN OVERVIEW OF THE LITERATURE

Macroeconomic Determinants

The importance of the housing market outlined above in combination with the cyclical nature of it turns it to a key topic of study. In many countries, including UK, US, Japan Ireland and Spain, residential property markets experienced major cyclical changes in prices and volumes (Nneji et al, 2013). These cycles often depend on macro factors such as interest rate and economic growth (Nneji et al, 2013), money supply (Lastrapes, 2002), inflation (Beltratti and Moranna, 2009), level of unemployment and industrial production (Adams and Fuss, 2010). Most of the relevant papers as Savva (2015) states do not take into consideration how the macroeconomic variables could influence behavior of housing market depending on which part of the cycle the market is. To provide a clear understanding of the dynamics of real estate market, Savva (2015) and Nneji et al (2013) among others, investigated the drivers of the housing market in different phases. They applied a two and three-regime Markov switching model respectively, focusing on specific periods of time, to examine the response of the real estate market to economic changes. This methodology enables the authors to identify cycles in the housing market and to examine whether monetary policy makers have the tools to turn the housing market from a crash to a steady state.

Particularly, the aim of Nneji et al (2013) was to address the sensitivity of housing market to economic changes in boost and crash periods and to identify which factors have the most powerful effect in each stage of the housing market cycle. Additionally, they attempt to find monetary policy tools to direct the economy away from a crash state towards a steady state, by applying probit regression based on the estimated filtered probabilities from the Markov switching model. Using data for the period from 1960 to 2011 in US and contrary to the most of researchers they implemented a nonlinear model (three - state Markov switching nonlinear econometric model) to analyze the relationship between selected key economic factors and the changes of house prices. The variables used are inflation, disposable income growth, the short rate and the interest rate spread. They identified, through statistical analysis, the existence of three different phases, booms, busts, and tranquility. The results of their analysis show that changes to the independent variables influence the house prices in the steady and boom states, with prices being more sensitive during housing booms. No evidence of connection between

these variables and house prices during busts was found. Moreover, they estimated the probabilities of moving from one state to another with the steady state found to be the most persistent since the chance of remaining within it is 98%. They also concluded that reduction in the spread between long- and short-term interest rates (monetary policy influence) decreases the chance of being in the bust state.

Savva (2015) building on the approach of Nneji et all (2013) studies the house market in Cyprus over the period spanning from 2001 to 2014. The data used for the analysis were house price index, change in lending rate, consumption, stock price index, exchange rate, unemployment, and inflation. The results indicate that house prices are regime dependent. For the boom period the effect of the macroeconomic variables is statistically significant with the effect on the prices in recession period being not statistically significant. This according to Savva (2015) links the housing market with the economic recessions and additionally indicates that if negative growth carries house prices will likely fall.

Many studies about the macroeconomic determinants of residential real estate market focus on the relationship of the demand for and the supply of housing. According to this approach house prices are dictated by the interaction of supply and demand. Sivitanides (2015) applying the above framework examined the effect of the demand and supply drivers on house prices in Cyprus for the period from the first quarter of 2006 until the second quarter of 2014. As a result of the global financial crisis, Lehman Brothers collapse and the events of 2013 when one of the country's largest banks closed and the largest one was restructured, house market went through a deep recession (Sivitanides, 2015). Within this context the study explains the impact of macro economy to housing market in Cyprus to provide realistic answers about the factors that will drive its recovery. The model is formulated by equating demand with supply and solving for the price. Based on this equation, alternative percentage change model specification is estimated as well as error correction models and partial adjustment models (logarithmic version). The examined drivers from the demand side include real and nominal GDP, nominal GDP per capital, consumer price index, data on interest rate on deposits with up to one year maturity (as a proxy for intertemporal variations in mortgage rates), number of households, total population, total employment, outstanding balance of housing loans to households and total deposits of non-monetary financial institutions held with monetary financial institutions (In order to capture the significantly reduced availability of credit for house purchases after the events of March 2013).

On the supply side quarterly data on housing permits and construction costs were used. After applying different alternative combinations of the selected determinants and different lags, it was found that nominal GDP has the greatest influence on house prices with the construction cost and the number of households following. The findings indicate that the rise of GDP had significantly higher effect on house prices before the global crisis. This, as the researchers concluded, most probably happens due to the high quantities of equity and dept capital that were available for house purchase. It is pointed out that in the next few years due to the significantly reduced loan availability and the expected foreclosures of many properties, the response of house prices to GDP growth will likely be lower, than the ones the results of the study indicate.

Focusing on the same market (Cyprus) and approximately the same period of time Savva and Michail (2017) examined the perspective of house prices volatility and the related risk. As referred in their study this is useful since high volatility leads to mortgage arrears, increase of repossession rates, and affects building industry, household income and macroeconomic stability. For their analysis they used quarterly data from 2001Q1 to 2016Q2 for house market price index and to model housing risk over time they applied the autoregressive (AR), ARCH-type models. To capture any potential structural changes in the data, they also used the AR-SWARCH model. Their results show that volatility is significant and hard to change and that house price behavior in Cyprus can be divided into two different volatility states, high and low. High volatility is associated to the period that preceded housing boom and low volatility was noticed during the period from 2010 to 2013. Furthermore, it is noted that high volatility relates to higher credit availability and increased systemic risk in the economy, implying that actions for a more regulated environment should be considered.

Based on the supply and demand framework Pashiardes and Savva (2009) used a multiple regression analysis on pooled cross-section timeseries data, to examine whether and to what extent each of the selected variables contributed to the great increase in housing market prices in Cyprus for the period from 1988 to 2008. Particularly, they included in their analysis variables such as tourism arrivals, general inflation, unemployment, population, material and labor cost, sterling – euro exchange rate, per capital GDP, number of foreign workers, interest rate on loans and the returns of the Cyprus stock exchange. Their results show that house prices in Cyprus are sensitive to fluctuations of population, labor cost, building material cost, GDP per capital and exchange rate, with the first four variables having the most significant positive effect. On

the other hand, an increase in the number of foreign workers, interest rate on loans and returns of the Cyprus stock exchange are all associated with decrease in house prices with the last two having the smaller in size negative effect.

Apergis and Rezitis (2003) analyzed the short- and long-term effects of macroeconomic variables on Greek housing sector for the period from 1981 to 1999. Among relevant studies they have implemented an Error Correction Vector Autoregressive Model (ECVAR) which considers the full interaction of the housing sector with the rest of the Greek economy. That means that this method considers the fact that the macroeconomic variables themselves are affected by demand and supply changes. The main purpose of the impulse response functions is to describe the response of a variable in reaction to a random shock in other variables. The dependent variable used in analysis is the housing price index of new one family houses sold. The key economy factors used are the mortgage interest rate, inflation, employment, and money supply. The results of the analysis show that the housing prices are affected by shocks in specific macroeconomic variables. The most influential determinant is housing loan rate followed by consumer prices and employment. While the mortgage rate has a negative effect in house prices at the same time housing prices respond positively to inflation.

The research of Panagiotidis and Printzis (2015) also focused on Greek housing market covering the time period 1997-2013. The results of their study show that mortgage loans have the most explanatory power on the housing price index. More specifically they examined the long run effect of key macroeconomic factors on house prices by employing a two stage Vector Error Correction Model (VECM) that allowed them to incorporate exogenous variables as well (Interest rates, Money Supply (M1) and the Unemployment rate). Additionally, the use of VECM provides the ability to directly estimate the level to which a variable can be brought back to equilibrium condition after a shock on other variables and is very useful to estimate the short and long run dynamics. After an equilibrium relationship was validated, a dynamic analysis was used, showing that the mortgage loans followed by retail trade and consumer price index shocks affect the house prices, while there is not a significant response to industrial production shocks. In the long run retail trade was found to be the most significant factor.

The econometric technique (VECM) used by Panagiotidis and Printzis (2015), was also employed by Arestis and Gonzalez (2014) to investigate the short- and long-run relationship between certain factors and house prices. As explained in the paper this technique allows dealing

with the problems of endogeneity and reverse causality in a better way than other econometric techniques. Considering the boost period of the residential real estate market in USA that preceded its collapse in 2007 and similar episodes observed in a substantial number of developed countries around the world at the same period, Arestis and Gonzalez (2014) focused their investigation in identifying the main factors that affect house prices in these economies. The first stage of their analysis includes basic factors of housing market such as disposable income, residential investment, mortgage rate and demographics. It also accounts for monetary and fiscal policy by using variables related to credit standards and taxation. At the second part of their analysis they tested the validity of their hypothesis by applying their model in a sample of 18 OECD countries from 1970 to 2011. Their conclusions on long run analysis suggest that real disposable income, real residential investment, and demographics are the main determinants of housing prices. Moreover, it was found that on a long run basis, fiscal policy, by means of taxation over property and income, has stronger influence on housing prices than monetary policy. Short run analysis shows that expectations (real housing prices in previous periods explain the housing prices in short run), real disposable income and demographics have an important role in the formation of prices.

Cleanthous et al (2017) applied the same analysis method (VECM) to investigate the linkages between loans, residential property prices and domestic macroeconomic conditions in Cyprus using quarterly data from 2005Q4 to 2016Q4. Specifically, they focused on the variables of loans to households for house purchase, Residential Property Price Index (RPPI), the unemployment rate, wages and interest rates charged on loans for house purchase. Special reference is made by the authors of the paper to the significant growth of credit, property prices and construction activity during the period from 2006 to 2008. The main drivers that led to this climate according to the writers were the lower foreign exchange risk and the expected harmonization of interest rates towards euro area rates following the fixing of Cyprus pound against the euro in July 2007. Moreover, the higher interest rates in comparison to other European countries let to the inflow of foreign deposits. As a result, credit growth, construction activity and property prices increased sharply from 2006 onwards. Overall, the empirical results of their analysis show that a link exists between credit, housing prices and the macro-economy. More specifically loans and house prices interact and influence each other at a similar magnitude. Macroeconomic conditions also influence the variables. A shock in unemployment is found to have significant effects on house prices and wages.

Savva (2018) outlines that in order to capture the true picture of the linkages between house prices and macroeconomic variables for a larger number of countries, it is important to apply an economic framework that considers as many countries as possible. Therefore, from data perspective he used a sample of 24 European countries, including Cyprus, and regarding methodology he applied a dynamic panel estimation approach. This method adapts the dynamic nature of most economic relationships since relevant models contain dependent variable with one or more lags. From data perspective Savva (2018) used quarterly data that spans from 2001Q1 to 2015Q4 to study the short run effect of the independent variables (lending rate, growth, construction cost, unemployment, stock returns, population and inflation) on housing prices. The results of the study suggest that population, economic growth, stock returns and inflation have the most significant positive effect on housing prices while at the same time housing prices respond negatively to interest rate and unemployment. The relationship between construction cost and house prices is also verified.

Grum and Govekar (2016) investigated the relation between the property prices and macroeconomic factors in the capitals of 5 different countries, i.e. Slovenia, Greece, France, Poland and Norway, since they were interested in observing their influence in different cultural, social and economic environments. In order to determine the relation between the economy factors and the housing prices they employed a Multiple Linear Regression Model using data for the period from 2003 to June 2012. Their results show that the effect of a variable on housing prices differs depending on the capital under study. For the capitals of France, Greece, Poland the results have shown that the housing prices are related only to unemployment and their respond is negative. For the capital of Norway their findings show that not only unemployment, but the current account of the country too is related to the price of residential properties. For the capital of Slovenia, the researchers found that the price of residential real estate responds only to share index. It should be noted that according to the authors the variables were found to influence residential properties prices less than expected. This is attributed to the observed time and the length of it, and to speculation and psychological effects (stakeholders in the housing market too often have unrealistic, and too optimistic or pessimistic outlook).

Microeconomic Determinants

The literature shows that further to the macroeconomic factors effect on house prices, microeconomic variables should be accounted for too. Though it is most likely the recent changes in house prices to be explained thru macroeconomic variables, the contribution of house characteristics to the determination of house prices should not be ignored (Pashiardes and Savva, 2009). Advanced valuation methods like artificial neural networks, hedonic pricing method and spatial analysis examine the market by resembling the way the market components make decisions (Pagourtzi et al, 2003).

The hedonic theory is based on Lancaster's (1966) consumer theory and it has been applied to the residential market by Rosen (1974). Since then it has become widely used in real estate valuation and house market research. House prices and rentals are mainly examined by hedonic methodology based on micro economic theory (Selim, 2008). First Lancaster (1966) investigated the idea of studying goods as packages of individual features instead of approaching them as homogeneous entities. Rosen (1974) developed the idea that goods, such as housing are differentiated by the unique properties composition that they have. A product by itself may be heterogeneous but we can estimate its value by decomposing it into homogeneous features, where each feature has a unique implicit price. According to Sirmans et al (2006) the most used physical attributes, in residential market research, are floor space, land area, age, bedrooms, bathrooms, garage, swimming pool, fireplace, and air conditioning. Another important attribute that describes a house, is location, therefore housing characteristics can be divided into two different categories, physical and locational (Hill, 2011). The introduction of spatial attributes to the hedonic models improves the accuracy of the estimated housing price and minimizes estimation errors for submarkets (Bourassa et al, 2007; Watkins, 2001).

Hill (2011) in his study about Hedonic Price Indexes for Housing, prepared for the OECD Statistics Working paper Series, examines the most significant changes in the last decades, in the hedonic approach as applied in house prices indexes construction. Before the construction of the hedonic model one must decide not only about the method to be followed but about the explanatory characteristics to be used too. The second is often determined by the availability of data. Overall, five different methods of implementation are discussed in Hill's paper (Time-dummy methods, Imputation methods, Characteristics index methods, nonparametric methods,

repeat sales and hedonic hybrid methods) and strengths, weakness and usage of each method are presented and evaluated. The main criticisms of the hedonic model according to the analysis are omitted variables problem (like state of maintenance, noise, sunlight exposure/orientation, the functionality of the layout, degree of damp damage, the quality of the building materials and workmanship, and the general ambience) functional form misspecification, data mining and lack of transparency and reproducibility and sample selection bias. Overall, the results of the analysis indicate that the advantages of the hedonic approach outbalance its disadvantages. Moreover, according to the author, the incorporation of geospatial data and non-parametric methods in future studies will improve reliability.

The above issue (assumption of a specific functional form in advance) is addressed by Koster et al (2010), in their paper regarding preferences of homeowners for mixed land use in the city region of Rotterdam, Netherlands, by using a semiparametric hedonic house price analysis. Moreover, their research adds to the literature by categorizing the employment variable in various sectors and by examining whether the impact of mixed land use on the prices differs over different residential types. The reason the authors used employment sector as a variable in their model is mainly because the variety of jobs (number and composition) in each neighborhood makes possible the diversification of functions (mixed land use). Furthermore, the addition of various employment sectors in the analysis captures the opposite effect of them on house prices. Their results show that the presence of manufacturing and wholesale affects negatively house prices in contrast with business services, education, healthcare, leisure, and retail activities that have a positive impact on them. Another important observation is that when household densities are too high, house prices are negatively affected. The results also show that the willingness to pay more for diversity is higher among apartment occupiers rather than the ones living in detached houses. As for the physical and locational characteristics it was found that size of a residential unit, single units, a garage, a garden, a central heating, short distance to the city center and low share of ethnic minorities also lead to higher prices.

Based on hedonic pricing model and building on previous studies of the Istanbul market Keskin (2008) examined the residential units price determinants in Istanbul. The dependent variable of their statistical analysis is the price of housing unit and in order to explain the house prices they incorporated into their model not only structural characteristics but also locational, environmental, socioeconomic and neighborhood quality characteristics. As referred in the

study, the hedonic price model is based on the assumption of heterogeneity, which means the variation of housing stock and consumers within a market. This implies the existence of submarkets in an urban housing system and different price for the same property characteristic in each submarket. A logarithmic linear function was used to overcome the problem of errors heteroscedasticity in regression analysis, in order to achieve a better parameter estimation. The results of the analysis show an overall 0.609 R^2 which is consistent with the findings of similar studies. The largest impact among the property attributes is living area with the site location coming next. As for the positive impact of site location this is attributed to the 1999 Marmara earthquake which made high income families turn to areas with less earthquake risk and low story buildings, forming gate communities with their own facilities. In contradiction with other studies age has a positive impact on house value. The researcher supports that this happens mostly because of the existence of more public facilities as the average age of the submarket increases. Other variables found to have positive impact on housing price is the length of time the inhabitants have lived in Istanbul, average income, and neighborhood quality.

Selim (2008) analyzed the determinants of house prices in Turkey for the whole country, the urban and rural areas, by employing a hedonic price regression model. Although a lot of guidance was available, at the time, about the implementation of hedonic price model, according to the author little information was provided regarding the proper functional form that should be selected. In their study they used the semi logarithmic model arguing that it fits the data sufficiently and in addition the estimated coefficients can be described as the proportion of a product's price that is directly attributable to the respective characteristics of that product. Furthermore, ordinary least square method was applied in determining the hedonic model. Forty-six variables were selected, including locational characteristic, type of house, age of the building, type of the building, saloon and living rooms floors, bathroom floors, heating system, number of rooms, size (square meters), and other structural characteristics. The results show that water system, pool, type of house, number of rooms, house size, locational characteristic and type of the building are the most significant variables that affect the house prices. As expected, the prices in urban area are higher than rural area and age has a negative impact to house value.

Pashiardes and Savva (2009) examined both micro and macro-economic factors impact on housing market in Cyprus. Their paper examines how specific characteristics of residences

influence their price and how changes in macroeconomic variables caused the rise of house prices during the period from 1988 to 2008 in Cyprus. Their results regarding the effect of macroeconomic variables are discussed in previous paragraphs. As for the effect of housing characteristics they examined (regression analysis, where (the log of) house prices is the dependent variable) the average price per square meter for different types of residential properties and they concluded that the square meter of housing for 2 and 3-bedroom apartments is more expensive in comparison to 1-bedroom apartment. Whereas the differences in price per square meter between detached and semidetached houses were attributed to land value, in the case of apartments of different number of bedrooms the variances were explained as a result of the additional materials and labor required per square meter in larger apartments.

Sirmans et al (2006) reviewed several studies that use hedonic pricing models for the determination of the residential units prices, in order to investigate whether the regression coefficients of the most used characteristics differ depending on location, time period and data source. It is generally believed that hedonic pricing model results are unique to the model especially across the above moderated variables, so the researchers seek to find whether they are more universal or undergo considerable fluctuation as conventionally assumed. To answer the above, they used Meta Regression Analysis (MRA). Meta-analysis is a statistical method that uses empirical results of existing studies to find the effect and interaction between variables and more specifically in this case the relationship between house prices and nine housing characteristics (square footage, lot size, age, bedrooms, bathrooms, garage, swimming pool, fireplace, and air conditioning). The relevant regression coefficients for these characteristics that are produced in hedonic pricing models are studied for variations across a set of moderator variables. Particularly they investigated the influence of geographical location, source of data, the time period of data and household income on characteristics coefficients. Overall, the results of the meta regression analysis suggest that in hedonic pricing models the estimated coefficients in a lot of cases are different in terms of size, significance and direction, even for the most significant variables but not to the extent that is traditionally believed.

The regression coefficients of housing characteristics also vary across a specified range of house prices. Zietz et al (2008) argued that for hedonic price functions the above issue can be addressed thru the implementation of a quantile regression that explains the factors of the dependent variable (house price) at any point across the range of its values. In their paper they applied the

suggested method and used sales data of 1366 homes from mid-1990 to mid-2000 for Uta area. Further to the standard characteristics, such as area and age they also added geographic and neighborhood variables. Their results confirm that some variables respond differently across different house prices. More specifically independent factors of square footage, lot size, bathrooms, and floor type have a greater impact on the price as the price increases. On the other hand, variables such as garage, exterior siding, sprinkler system, and distance to city center have the same effect at any level of selling price.

An alternative approach, for the estimation of house prices, to the standard technique of Hedonic Price Model, is Artificial Neural Networks (ANN) modeling. Neural networks are designed as systems that "copy" the way the brain performs tasks. Such machines learn to use prior knowledge without being programmed (Mimis et al, 2013). One of their uses is the modelling of unknown functional forms. The main advantages of this method are the handling of nonlinear relationships between variables, minimization of out of sample pricing errors and better extrapolation (Peterson & Flanagan 2009). As referred in previous paragraphs one of the main criticisms of Hedonic Price Model method is the pre specification of the functional form that may lead to unreliable estimation of coefficients in case of complex nonlinearities. As Mimis et al (2013) discuss in their paper, there are several studies that support the superiority of both the techniques. However, the most recent studies lean towards the use of the artificial neural network approach (Mimis et al, 2013).

Mimis et al (2013) employed an artificial neural network approach in property valuation in the metropolitan area of Athens. Moreover, they used a Geographic Information System (GIS) for a spatial analysis. Their data include 3150 cases of apartments in an area of about 300 Km^2 for the period spanning from 2000 to 2006. The independent variables that they used are floor space, the level of the apartment and the age of the property. For the neighborhood and transportation accessibility characteristics they included attributes like the mean income, land value and distance to metro station, respectively. GIS was used to extract the location of the properties. The results show that ANN approach performs better than the traditional methods. The relationship between the dependent variable (value of the property) and the independent variables of floor space and age was found to be nonlinear. Specifically, the age of the property causes a rapid decline of the value in the first years and tends to decrease linearly in the next years of the life of the property.

Foreclosures and House Prices

Global financial crisis, Lehman Brothers collapse and large decline in the values of mortgages, led to a significant increase of foreclosures rates in US. This great recession had a dramatic impact on the country's housing market. Particularly the house market crisis led to a 35% decline in housing prices and a 10% rise in credit defaults by the end of 2009 (Mian, et al, 2015). For the same period housing permits remained in a deep and steady decline (Calomiris et al, 2008). As a result, several recent studies investigated the effects of foreclosures on house prices and economy in general (Schuetz et al, 2008, Calomiris et al, 2008, Hartley, 2010, Campell et al, 2011, Mian, et al, 2015).

Calomiris et al (2008) are the first (as referred in their paper) that investigated the interactions of foreclosures with house prices and other economic factors in US for the whole country (at a state level). Specifically, they applied a panel vector autoregressive model (PVAR), using quarterly data from 1981 to 2007, and further to the variables of home price and foreclosure rate they added to their analysis variables related to employment, home sales and housing permits. Their results show that foreclosures have a statistically significant negative impact on house prices but the response even in extreme shocks is relatively small. Even in cases of high level of credit defaults the results of the analysis indicate that the housing prices will likely remain stable without any major fall.

The spillover effects of forced sales were also examined by Mian et al (2015). Their paper using the differences between states laws (judicial and non-judicial) in the foreclosure procedures examines the effect of foreclosure on house prices, residential investment, and consumer demand during the recent US housing market collapse. They found that increased supply of houses for sale due to foreclosures has a large negative impact on house prices. In addition, the decrease of housing wealth causes further fall in durable consumption and residential investment.

There is a number of mechanisms through which foreclosed units may negatively impact the value of nearby properties. First, homeowners who are unable to pay their mortgage, even before they receive a foreclosure notice, have fewer reasons to maintain or improve their houses. Inevitably these properties start to show signs of wear and tear that not only affect their value but the value of the surrounding properties too (Schuetz et al, 2008). As noted by Schuetz et al

(2008), even in the cases of reselling and rent of properties, investors lower the level of maintenance in order to maximize profit. Moreover, the properties sitting vacant after the eviction of the defaulted owners are more likely to be vandalized and attract illegal activities (Schuetz et al, 2008, Hartley, 2010, Campell et al, 2011). Further to the instability this causes to the neighborhood, the threat of it and the cost to protect the vacant properties makes the lenders to liquefy the assets the soonest possible and consequently sell in discount (Campell et al, 2011). The third mechanism is by adding to the local supply. Imbalance in the dynamics of demand and supply, drives down the prices (Schuetz et al, 2008, Hartley, 2010, Campell et al, 2011). Finally, the addition of forced sales to comparable data for the estimation of the value of nearby properties affects the price levels and the overall negotiation of sale (Schuetz et al, 2008, Campell et al, 2011).

Schuetz et al (2008) by applying a hedonic regression analysis for the city of New York and using property and neighborhood characteristics data for the period from 2000 to 2005 quantify the above influences. They concluded that surrounding properties to foreclosures are likely to be sold in lower prices but only above a critical number of foreclosures in the area and not in a linear way. Results also show that the values of residential units in areas that foreclosure will occur are lower even before foreclosure filing. This should be considered in empirical studies to avoid biased estimations across areas and to take into account reverse interaction phenomena.

Campell et al (2011) along with the examination of the sale price of houses after foreclosure in the state of Massachusetts also investigated their effect on unforced sales on a neighborhood level. Their study covers the period from 1987 to the first quarter of 2008 and their results show that not only residential units after foreclosure sell at a 28% discount of their value on an average but that each foreclosure within a 0.05 mile distance of a house decreases its price about 1%. Moreover, they found that for neighborhood with lower housing average price the discount is larger. The same applies to the effects of foreclosures on unforced transactions; they are larger in low prices neighborhoods.

Further to the magnitude of the neighborhood effects of foreclosures Hartley (2010) examined the nature of them too. They examined the effect of the first (pure maintenance and vacancy) and third (adding to local supply) mechanisms, as described above, on the value of single-family homes in Chicago from 1998- 2008. The foreclosed properties were also separated into two types, single family homes and renter-occupied multifamily buildings, and the way each type of

foreclosure affects the value of the properties was examined. In addition, several property characteristics and neighborhood dissimilarities were added to the analysis. The results show that when the vacancy rates are low any increase in supply (single family foreclosed unit) decreases the prices of neighboring units. When vacancy rate is high the effects are reversed.

Summary and Conclusions

The main objective of the previous chapter was to review the literature on real estate prices focusing on residential type of properties. The trends of real estate prices have long been a topic of interest and the review of literature implies that forecasting the behavior of real estate market is a complex and difficult task. The covered papers vary not only in the empirical methods and econometric models they use but also in the type of properties they investigate (apartments, houses, etc.), the independent variables, the geographical coverage of the data and the time period. The covered papers are separated into two main lines of research:

- The macroeconomic analysis that examines the influence of macroeconomic factors (GDP, unemployment, interest rate, inflation, etc.) on house prices at an economy-wide level and determines the latter changes in house prices, and
- The hedonic method analysis that considers the effect of the most important quality characteristics of houses (physical, locational, social, and environmental) on the house prices over time at a microeconomic level

Housing Market and the Macroeconomic Determinants

Conceptual Framework – Methodology - Functional Form

It is obvious that the most frequently adopted framework is the supply and demand framework. According to supply and demand perspective, prices at each point in time are determined by the interaction of supply and demand. By equating demand with supply and solving for the price we get the general form of price equation. In the next paragraphs we highlight the main methodologies used in the prediction of real estate prices, their underline assumptions and the advantages and disadvantages of each method.

Pashiardes and Savva (2009) and Grum and Govekar (2016), used Multiple Regression Analysis on pooled cross-section timeseries data, where (the log of) house prices is the dependent

variable, and all the other factors are the independent variables. The model allows the determination of the relative influence of one or more predictor variables to the criterion value and the identification of outliers, or anomalies. Any disadvantage of using a Multiple Regression Model usually comes down to the data being used and nonlinearities to the relationship between variables. In their model the continued independent variables are expressed in logarithms, except those expressed in rates. Multiple Regression Analysis on pooled cross-section timeseries data allows the use of raw data in estimation (without averaging that can cause loss of information), while the effects of housing characteristics (size, type, geographic location, etc.) are estimated together with those of macroeconomic variables.

Following the supply and demand classical approach Sivitanides (2015) estimated Alternative Percentage Change Model specifications in which all variables are expressed as percentages, as well as Error Correction Models (ECM) and Partial Adjustment Models (PAM). Furthermore, the logarithmic version of the Partial Adjustment Modeling Approach was estimated to capture non-linearities in the influence of independent factors. This also allows the direct estimation of short- and long-term elasticities from the estimated coefficients of the independent variables.

Based on VAR modelling Apergis and Rezitis (2003) examined the short and long term effects of macroeconomic variables through the estimation of Error Correction Vector Autoregressive Model (ECVAR) which considers the full interaction of the housing sector with the rest of the economy. This method considers the fact that the macroeconomic variables themselves are affected by demand and supply changes. In the spirit of ECVAR estimation they performed Impulse Response Function Analysis. The main purpose of the impulse response functions is to describe the response of a variable in reaction to a random shock in other variables and is especially important since it can be used for economic policy evaluation.

Panagiotidis and Printzis (2015) employed a two stage Vector Error Correction Model (VECM) that allows to incorporate exogenous variables as well (Interest rates, Money Supply (M1) and the Unemployment rate). The fact that this technique is based on VAR modeling allows the relaxation of the assumptions regarding the exogeneity or endogeneity of the explanatory variables. Additionally, the use of VECM provides the ability to directly estimate the level to which a variable can be brought back to equilibrium condition after a shock on other variables and is very useful to estimate the short and long run dynamics. The same econometric technique (VECM) was employed by Arestis and Gonzalez (2014) and Cleanthous et al (2017). They also

explained in their papers that this technique allows dealing with the problems of endogeneity and reverse causality in a better way than other econometric techniques. In the VECM case, there is no need to make assumptions about the direction of the causality and the existence of temporal causality relationships amongst the variables involved, since all variables are jointly determined at the same time.

Nneji et al (2013) and Savva (2015) used a nonlinear econometric model (Three and Two - state Markov Switching Nonlinear econometric model) and a Probit Model based on the estimated filtered probabilities from the Markov Switching Model (Nneji et al, 2013). The method enabled them not only to identify different cycles in the housing market (booms, busts and tranquility) and have a better understanding regarding the drivers of the housing market during different states, but also to examine whether monetary policy makers have the tools to turn the housing market from a crash to a steady state.

Savva (2018) applied a Dynamic Panel Estimation Approach aiming to study the short-run factors of the change in housing prices in various economies. The Panel Estimations he employed use various data techniques. The advantage of the model is the ability to follow the dynamic nature that we meet in most economic relationships (i.e. dependent variables with one or more lags).

Savva and Michael (2017) used Autoregressive (AR), ARCH-Type Models to model housing risk (price volatility states) in Cyprus. These models allow to examine whether housing volatility changes over time. They overcome the main disadvantage of the method (the fact that the overmentioned models may not be appropriate in the case of structural changes in the data) by employing the AR-SWARCH model that allows to examine the existence of different states of volatility in the housing market and to assess the probabilities of changes in these states.

Building on the papers of Pashiardes and Savva (2009) and Grum and Govekar (2016) in this study we apply a Multiple Linear Regression Model which establishes relationship between the house prices and several macro and micro economic determinants. The methodological approach is described in detail in Methodology and Data chapter that follows.

The Effect of Macroeconomic Variables on House Prices - Independent Variables

Real estate literature suggests that the price of real estate assets is correlated to the fluctuations of the overall economic activity, business and monetary conditions and it can be modelled using available public economic information. The key macroeconomic variables are commonly used in the existing literature as indicators of future economic and monetary conditions. The papers examining the effect of macroeconomic variables on house prices have revealed that among macroeconomic factors related to the real estate prices, the key factors are the GDP, Household Disposable Income and Wages, Unemployment Rate, Inflation, Money Supply, the Interest Rate on Mortgages, Construction Cost and Demographic Factors. In the next paragraphs, based on literature review and economic/finance theory we report the expected sign and the overall effect of these variables on housing prices.

GDP - Wages - Disposable Income

The strong relationship between GDP and the housing market has been examined in the literature. GDP growth which generally accounts for the prosperity of households is found to have a positive and significant effect on housing prices (Sivitanides, 2015; Pashiardes and Savva, 2009; Nneji et al, 2013; Savva, 2018; Savva, 2015; Grum and Govekar, 2016). Any increase in households' real disposable income makes it more affordable to purchase a home. Specifically, an increase in affordability driven by an increase in wages, could encourage borrowing and increase demand. Since the supply is fixed in the short run due to the time it takes to construct new housing units the increase in demand will eventually result into higher residential property prices (Arestis and Gonzalez, 2014; Cleanthous et al,2017; Nneji et al, 2013; Savva, 2015).

Unemployment

An increase in unemployment is expected to decrease the demand for housing. Rising unemployment reduces disposable income and the purchasing power of the household. Furthermore, unemployment causes other secondary impacts in the residential market. For example, unemployment is used by agents as an indicator of the economic conditions to form their expectations. When the rates of unemployment are high, some households make the decision to put off their real estate investments until the economic conditions change. At the

same time, commercial banks will be more skeptical to issue new mortgages since the risk of default is increasing. All the above have as a consequence the reduction of demand for housing, and the decrease of housing prices. Moreover, since some homeowners are unable to serve their mortgages are forced to sell their properties to get rid of the obligation before defaulting. Grum and Govekar (2016), Cleanthous et al (2017) and Apergis and Rezitis (2003) findings show that unemployment is related to the price of residential properties that responds negatively as expected.

Inflation

The results of Apergis and Rezitis (2003) for Greek housing sector and Savva (2018) for 24 European Countries identify inflation as one of the most important explanatory variables with significant positive effect on house prices. According to Savva (2018) inflation is expected to positively correlate to housing prices since higher cost in materials and labor leads to higher prices. However, based on the review of several studies Apergis and Rezitis (2003) indicate that regarding the effect of inflation on the housing prices different aspects are held. Some papers show that a rising inflation rate decreases people's motive to invest in real estate, which in turn decreases housing demand. In addition, others argue that inflation causes nominal housing payment to rise, also implying lower housing demand.

Money Supply - Mortgage Interest Rate

In many papers the mortgage interest rate is found to be one of the most important variables affecting the housing prices. An increase in the mortgage rate is expected to decrease the ability of individuals either to serve their mortgage or to buy a house. These drive to a decrease in demand for properties that in turn effects negatively the houses price. On the other hand, when rates go down the cost of housing decreases and demand for housing loans increases since more potential buyers will attempt to enter the housing market. The result of the rising demand for housing is the increase of housing prices (Nneji et al, 2013; Apergis and Rezitis, 2003; Panagiotidis and Printzis, 2015; Cleanthous et al, 2017; Savva, 2018; Sivitanides, 2015).

The economic literature suggests that monetary authorities, especially after the recent great recession which clearly revealed that financial and macroeconomic instability are related, should develop more effective policies followed by appropriate banking regulations, in the form

of interest rate in order to keep interest rates as low and stable as possible (Arestis and Gonzalez, 2014; Cleanthous et al, 2017; Savva, 2015). An increase in the money supply decreases interest rates, and considering any other variable stable, the cost of servicing mortgage falls, while demand for housing gets higher. Another effect of this policy is the decrease of non-performing loans that use houses as a collateral. When the mortgage rates are lower, more borrowers would be able to repay their lenders (Savva, 2015).

Construction Cost - Cost of Material - Labor Cost – Number of Foreign Workers

Construction cost is expected to positively correlate to housing prices since higher cost in materials and labor leads to higher prices (Savva, 2018). The results of the reviewed papers confirm the above since they point out to statistically positive effect from construction cost (Sivitanides, 2015; Savva, 2018). Pashiardes and Savva (2009) concluded that house prices in Cyprus are sensitive not only to construction costs (materials and labor) but foreign workers too with the second one having lower correlation with the house prices. This was attributed to the fact that after the year 2000 a rather large amount of low paid foreign workers entered the construction industry. This had two opposite effects on house prices. The first, is a negative one, since foreign workers prevent the wages from raising and the second one is positive as foreign workers raise the demand for accommodation.

Demographics

Finally, papers suggest that population is a good candidate to explain the fluctuations in housing market. Number of households and population were found to affect positively the house prices (Sivitanides, 2015; Pashiardes and Savva, 2009; Savva, 2018). An increase in population due to the natural trend of growth of population or inflows of immigrant, push demand for housing higher. Whereas the supply of houses is inelastic the increase in demand leads to higher prices in the short run since more people must share the existing number of housing properties (Savva, 2018; Arestis and Gonzalez, 2014).

Housing Market and the Microeconomic Determinants

Conceptual Framework – Methodology - Functional Form

As one would expect, the hedonic approach has been routinely used in the housing market literature to assess the relationship between house prices and the characteristics of both the house and its neighborhood. Moreover, most of the studies carried out with hedonic modelling are based on Multiple Regression Analysis which is suitable to a straightforward assessment of the relation between price and several characteristics. The main criticisms of the hedonic model analysis according to Hill (2011) are omitted variables problem, functional form misspecification, data mining and lack of transparency and reproducibility and sample selection bias. However, overall, the results of Hills (2011) analysis indicate that the advantages of the hedonic approach outbalance its disadvantages. Furthermore, the incorporation of geospatial data and non-parametric methods improves reliability. The most common functional form recommended in the hedonic literature is the semi-logarithmic form. Selim (2008) in his study used the semi logarithmic model arguing that it fits the data sufficiently and in addition the estimated coefficients can be described as the proportion of a product's price that is directly attributable to the respective characteristics of that product. Keskin (2008) overcomes the problem of errors heteroscedasticity to achieve a better parameter estimation in regression analysis, by utilizing a logarithmic linear function. Therefore, in this study we use Multiple Regression Analysis and a logarithmic linear form for the models.

The Effect of Microeconomic Variables on House Prices - Independent Variables

Another key element in the implementation of hedonic models is the choice of the appropriate set of characteristics. A property can be decomposed into a bundle of homogeneous features (both physical and locational) divided into three different categories: The Characteristics of the Housing Unit, the Neighborhood Quality Characteristics, and the Locational Characteristics.

The Characteristics of the Housing Unit

Independent factors of floor space, the level of the apartment, the age of the property, land area, number of bedrooms, number of bathrooms, floor type, exterior siding, garage, swimming pool, fireplace, garden, central heating and air conditioning were found to have the greater impact on

house prices (Koster et al, 2010; Mimis et al, 2013; Sirmans et al, 2006; Zietz et al, 2008; Selim, 2008).

Neighborhood Quality Characteristics (Including Socioeconomic and Environmental Characteristics)

For the neighborhood quality characteristics, attributes such as transportation, accessibility, existence of public facilities, the mean income, land value, demographics, share of ethnic minorities and household densities are included (Keskin, 2008; Mimis et al, 2013; Koster et al, 2010). Furthermore, Koster et al (2010) added to their analysis various employment sectors mainly because the variety of jobs (number and composition) in each neighborhood makes possible the diversification of functions (mixed land use). Their results show that the presence of manufacturing and wholesale affects negatively house prices in contrast with business services, education, healthcare, leisure, and retail activities that have a positive impact on them.

Locational Characteristics

Another important attribute that describes a house, is location. As for the locational characteristics it was found that the site location, short distance to the city center, distance to metro station and the presence of factors such as proximity to schools, parks, malls and public facilities are important (Koster et al, 2010; Mimis et al, 2013; Sirmans et al, 2006; Zietz et al, 2008; Selim, 2008).

METHODOLOGY AND DATA

Methodology

Multiple Linear Regression

Regression Analysis is one of the most widely used statistics methods in all aspects (science, medicine, social sciences, etc.) (Ghani & Ahmad, 2010). According to Ghani & Ahmad (2010), there are six different types of Linear Regression Analysis which are simple linear regression, multiple linear regression, logistic regression, ordinal regression, multinominal regression, and discriminant analysis. The method that was selected to build the model in this study is the Multiple Linear Regression (MLR), which is an extended form of the simple linear regression method (Latt & Wittenberg, 2014). The regression models are called multilinear when there are multiple independent, explanatory variables (Uyanık & Güler, 2013).

The MLR technique is useful for the estimation of the relationship between variables which have cause effect relation (reason and result) (Uyanık & Güler, 2013). The method aims to answer questions regarding the existence of a relationship between dependent and independent variables, the power of it if there is any, the possibility to make future oriented predictions for the dependent variable and finally what is the influence of a selected variable or variables over another variable or variables when certain conditions are controlled (Uyanık & Güler, 2013). The goal of MLR is to explain as much as possible of the variation observed in the dependent (y) variable, leaving as little as possible to unexplained “noise” (Helsel and Hirsch 2002). The main objective of this study is to find the most suitable independent variables to forecast the apartments prices (response/dependent variable) in Strovolos, Nicosia.

Multilinear Regression Analysis Model general form for k independent variables is given by

$$y = \beta 0 + \beta 1\ x1 + \beta 2\ x2 + ... + \beta k\ xk + \varepsilon$$

where

y is the dependent variable

β0 is the intercept

β1 is the slope coefficient for the first explanatory variable

β2 is the slope coefficient for the second explanatory variable

βk is the slope coefficient for the kth explanatory variable, and

ε is the remaining unexplained noise in the data (the error)

(Helsel and Hirsch 2002).

When the MLR is used to valuate residential property, the ordinary least squares methodology is most of the times used to estimate the parameters of the model. Least squares method is widely used to calculate the best fitting line for the observed data by minimizing the sum of squares of the vertical deviations from each observed point to the predicted ones by the fitted model (for example if a point lies on the fitted line exactly then the vertical deviation is 0) (Latt & Wittenberg, 2014).

In this study a linear relationship is assumed between log transformed (natural logarithm) dependent variable and a group of independent variables (part of the independent variables are Log Transformed too). The main reason for log transforming data when using multiple regression analysis is to meet the assumptions of the method, such as normality and linearity. Specifically, models consider the Log Transformation of variables: Price, Area1, 2, 3, and Age.

Mathematically the general form of the equation takes the following form:

$$Log(y) = \beta 0 + \beta 1\ Log(x1) + \beta 2 Log(x2) + \beta 3 Log(x3) +. \beta 4 Log(x4) + \beta 5 x5 +... + \beta k\ xk + \varepsilon$$

Correlation Coefficient R - R-Squared - Adjusted R-Squared

In statistical analysis correlation shows linear relationship between two quantitative variables. It also indicates the intensity of the association and it is measured by a correlation coefficient called Pearson's correlation coefficient (r). Correlation could be positive or negative and its values vary between -1 (perfect negative) to +1 (perfect positive) ($-1<r<0$ $0<r<1$). Correlation equal to zero means the complete absence of linear association between variables (Armitage & Berry, 1994).

Cohen (1992) proposed the below guidelines for the interpretation of a correlation coefficient:

- -0.3 to +0.3 Weak
- -0.5 to -0.3 or 0.3 to 0.5 Moderate
- -0.9 to -0.5 or 0.5 to 0.9 Strong
- -1.0 to -0.9 or 0.9 to 1.0 Very strong

Whereas Correlation indicates the intensity of the association between variables, R-Squared (R^2) is a measure of the percentage of the variance of a dependent variable that is explained by an independent variable or variables in a regression model.

The adjusted R-squared is a modified version of R-squared that has been adjusted for the number of predictors in the model. The adjusted R-squared increases only if the new term improves the model more than would be expected by chance.

Assumptions for Multiple Regression

To build the model firstly the assumptions of multiple regression must be met; linearity, homoscedasticity, normality of errors (Osborne et al, 2002) and multicollinearity (Ghani & Ahmad, 2010).

First we need to check whether there is a linear relationship between the independent variables and the dependent variable in our multiple linear regression model. To do this, we can check scatter plots of the standardized residuals as a function of standardized predicted values (available in SPSS software) (Osborne et al, 2002).

Heteroscedasticity is indicated when the distribution of errors differs across different values of the explanatory variables. The errors should not vary systematically across values of the explanatory variables. This assumption can be checked by visual examination of a scatterplot of the errors (standardized residuals) against the explanatory variables. When the residuals are not evenly scattered around the horizontal line of independent variables levels the assumption is not fulfilled (Osborne et al, 2002).

Moreover, residuals should be normally distributed. To test this assumption a researcher could use the histogram, the P-P plot of Normality Test (probability-probability plot) and Kolmogorov-Smirnov tests (Osborne et al, 2002).

The last assumption that should be checked is multicollinearity. Multicollinearity refers to when two or more of the predictor variables are highly correlated. This is an issue, as our regression model will not be able to accurately explain variance of dependent variable. It can be tested either by creating a correlation matrix or by checking the value of variation inflation factor (VIF). For the first case when correlation coefficient is higher than 0.70 multicollinearity is substantial and for the second case when the value of VIF is less than 5, multicollinearity is not serious while for VIF more than 10 it is considered serious (Ghani & Ahmad, 2010).

Study Area and Data

This section provides an overview of the data used in our analysis, based on reviewed literature and data availability. Our study employed quarterly data for the period from 2014Q1 to 2018Q4 to investigate how the selected macroeconomic variables influence the price of apartments in Strovolos, Nicosia, Cyprus. Data on mortgage rate, were obtained from the Central Bank of Cyprus website, while data for all the other macroeconomic variables were obtained from the Cyprus Statistical Service.

Further to macroeconomic variables, the dataset includes data on changes in ownership of apartments that were provided to us by the Department of Lands and Surveys and microeconomic data that were directly obtained from the Department's website. The data used, cover the period from January 2014 to December 2018 and consists of information on 262 transactions (apartments with issued title deed and lodged contract of sale, whole share). The data record the sales price (declared and accepted) and basic property, block, and neighborhood characteristics. We have carefully removed from the dataset the debt for asset swap transactions, since they are a part of a loan restructuring agreement between financial institutions and borrowers and do not reflect the open market value of the assets (forced sales). Observations with missing variable values were also removed from the dataset. Moreover, three locational characteristics were calculated and imported in the dataset by us, since they are only available by manual work for each individual property, using the geographical functions of the Google Maps mapping service.

Macroeconomic Variables

In this study we employ GDP, Wages, Inflation, Unemployment rate, Construction Cost and the Interest Rate on Mortgages as key macroeconomic variables that influence housing demand and supply, as suggested in the literature. The likely impact of these variables is in detail explained in previous section and is shown in Table 1 below together with the expected sign of microeconomic variables influence. The explanatory variables are retrieved from the online database of the Cyprus Statistical Service and are constructed as follows:

GDP: Gross Domestic Product in million Euros (Chain-linked Volume Measures). Chain-Linking is a method that is used to produce volume measures for the economy and thus to calculate the growth of the economy and its various activities in real terms, without the effects of monetary inflation

ChangeGDP: Growth Rate of GDP at constant prices (in real terms), Quarterly data, compared to the same quarter of the previous year (percentage change)

Wages: Average gross earnings of employees by Quarter in Euros (Seasonally Adjusted Data)

CPI: Consumer Price Index. The Index reference period is 2015, Base Year (In the base year, the average of the index for the four quarters is set to 100). The Consumer Price Index (CPI) is compiled to measure the changes of prices over time of consumer goods and services acquired, used, or paid by households. Specifically, the national CPI of Cyprus covers the consumption expenses of specific goods and services (shopping basket of goods and services), of the resident households and of the households that intend to live in Cyprus for at least one year. CPI is the official index for the estimation of inflation

Inflation: The inflation rate is computed from the Consumer Price Index (CPI) series. Quarterly data, compared to the same quarter of the previous year (percentage change)

Unemployment: Unemployment Rate (15+) (expressed as a percentage)

CostMat: Price Index of Construction Materials, Base Year 2015. The objective of the Price Index of Construction Materials is to show the evolution of the cost of construction materials incurred by the contractor. The price indices are based on the year 2015, meaning that they show the evolution of the price of a certain material in relation to its average price in 2015=100.

LaborCost: Index of Hourly Labor Cost in Construction, Base 2015

ConstProd: Index of Production in Building Construction, Base Year 2015. The Quarterly Index of Production in Construction serves as a tool for monitoring short-term developments in construction activity. It is a volume index that approximates the changes in value added at constant prices. It can, therefore, be considered as an indication of the growth rate of construction relevant to a specific reference year. The base year in our case is 2015=100

MIR (Mortgage interest rate): Monetary Financial Institutions Interest Rates (Floating Rate and up to 1-year initial rate fixation) on euro-denominated loans for house purchase to households to euro area residents (retrieved from Central Bank of Cyprus)

Microeconomic Variables

In the present study each apartment is described by the following variables:

Apartment Characteristics

PriceAcce (Accepted Price - Dependent Variable): Apartment price in euros. The value that the Land Registry Department determines that it is the Open Market Value of the property on the day of the original transaction

PriceDecl (Declared Price - Dependent Variable): Apartment price in euros. The price in the private agreement (contract of sale) between the vendor and the purchaser

TAX: VAT placed on each transaction in euros

Area1: Total area of the apartment in square meters

Area2: Total area of covered verandas in square meters

Area3: Total area of uncovered verandas in square meters

Floor: Floor on which the apartment is located

Storage: Dichotomous variable indicating whether the apartment has a storage space (Yes means that the apartment has one or more storage spaces). The variable has only two values 0, 1 for the absence/presence of the storage attribute

Parking: Indicates the number of private parking spaces as a qualitative variable in three levels. "NO PARKING" means that the apartment has no private parking space. "ONE" means that the apartment has one private parking space. "TWO OR MORE" means that the apartment has 2 or more private parking spaces

View: View from the apartment (categorical variable). Can be described as "NORMAL" or "INTERRUPTED"

Block Characteristics

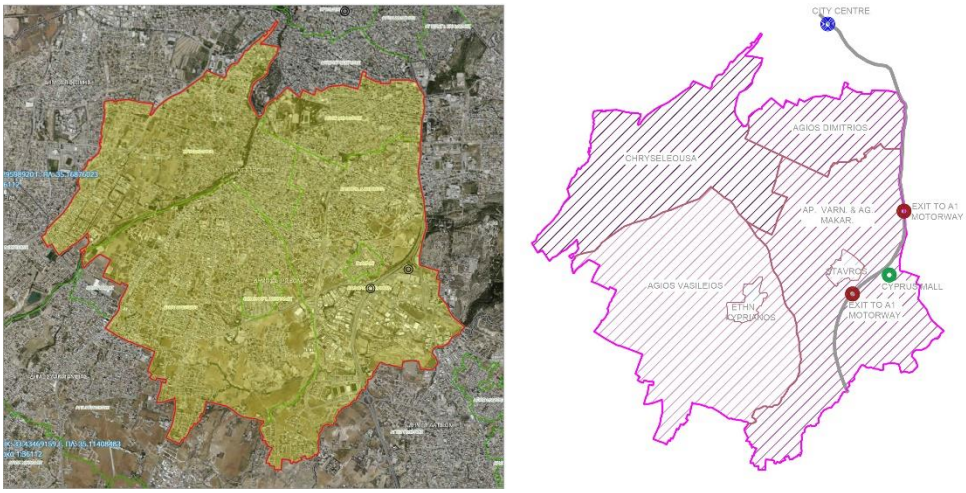
Quality: Describes the quality of the block construction as an ordinal variable. Three levels are considered: "FAIR", "GOOD" and "VERY GOOD".

Age: Age of the block, in years, on the day that the contract of sale was filed to the Land Registry Department

Neighborhood Characteristics

Quarter: This qualitative variable is included to capture differences between quarters and price levels. The Apartments in the database are nested within 4 different geographical areas, quarters of the municipality, namely "AGIOS VASILEIOS", "APOSTOLOS VARNAVAS & AGIOS MAKARIOS", "CHRYSELEOUSA" and "AGIOS DIMITRIOS" (Figure 1 shows a map of Strovolos Municipality and the distribution of its Quarters).

Figure 0:1:Map of Strovolos - Distribution of Quarters



Source: Department of Land and Surveys

Green: This binary variable (Yes or No) indicates the presence of public green spaces (Proximity to Public Green Space). The variable has only two values 0, 1 for the absence/presence of the attribute

Walkway: This binary variable (Yes or No) indicates the presence of a pedestrian walkway (Proximity to Pedestrian Walkway). The variable has only two values 0, 1 for the absence/presence of the attribute

Locational Characteristics

DistMW: Distance to the nearest exit to A1 motorway in Km

DistCC: Distance to the city center, ZARA clothing Store Arch. Makarios III Avenue, Nicosia in Km

DistSM: Distance to the Mall of Cyprus (shopping mall) in Km

A list of variables that were used in estimating the model, and their expected signs are shown in Table 1.

Table 1: Model variables and their expected sign

Table 1: Model Variables		
Symbol	**Variable**	**Expected Sign**
Continuous Microeconomic Variables		
PriceAcce	Accepted Price - Dependent Variable (euros)	
PriceDecl	Declared Price - Dependent Variable (euros)	
PrAcceSQM	Accepted Price per Square Meter - Dependent Variable (euros/m2)	
PrDeclSQM	Declared Price per Square Meter - Dependent Variable (euros/m2)	
TAX	VAT placed on each transaction (euros)	(?)
Area1	Total area of the apartment (square meters)	(+)
Area2	Total area of covered verandas (square meters)	(+)
Area3	Total area of uncovered verandas (square meters)	(+)
Floor	Floor on which the apartment is located (0-5)	?
Age	Age of the block (years)	(-)
DistMW	Distance to the nearest exit to A1 motorway (Km)	(-)
DistCC	Distance to the city centre, ZARA clothing Store Arch. Makarios III Avenue (Km)	(-)
DistSM	Distance to the Mall of Cyprus (shopping mall) (Km)	(-)
Continuous Macroeconomic Variables		
GDP	Gross Domestic Product (GDP) (million euros)	(+)
ChangeGDP	Growth Rate of GDP	(+)
Wages	Average gross earnings of employees by quarter (euros)	(+)
CPI	Consumer Price Index (base year 2015=100)	?
Inflation	Inflation (percentage)	?
Unemployment	Unemployment (percentage)	(-)
CostMat	Price Index of Construction Materials (base year 2015=100)	(+)
LaborCost	Index of Hourly Labour Cost in Construction (base year 2015=100)	(+)
ConstProd	Index of Production in Building Construction (base year 2015=100)	(?)
MIR	Mortgage interest rate (percentage)	(-)
Discrete Microeconomic Variables		
Storage	Presence of Store Space (Yes=1 No=0)	(+)
View	View from the unit (Interrupted=1 Normal=0)	(-)
Green	Presence of public green space (Yes=1 No=0)	(+)
Walkway	Presence of a pedestrian walkway (Yes=1 No=0)	(+)
NO PARKING	Private Parking Dummy Variable - No Private Parking (Default Variable ONE)	(-)
TWOORMORE	Private Parking Dummy Variable - Two or More Private Parking (Default Variable ONE)	(+)
FAIR	Quality of the Block Dummy Variable (Default Variable GOOD)	(-)
VERYGOOD	Quality of the Block Dummy Variable (Default Variable GOOD)	(+)
AGIOS VASILEIOS	Located in Quarter AGIOS VASILEIOS	(?)
	Quarter Dummy Variable (Default Variable AGIOS DIMITRIOS)	
AP.VARNAVAS & AG.MAKARIOS	Located in APOSTOLOS VARNAVAS & AGIOS MAKARIOS	(?)
	Quarter Dummy Variable (Default Variable AGIOS DIMITRIOS)	
CHRYSELEOUSA	Located in Quarter CHRYSELEOUSA	(?)
	Quarter Dummy Variable (Default Variable AGIOS DIMITRIOS)	

Statistical analysis was performed using IBM SPSS Statistics 25. All data were stored in Excel 2016 and were properly formatted to be imported into SPSS. Following previous studies to overcome the problem of nonlinearity we also considered the log transformation for several variables: Price, Area, Floor and Age. Moreover, categorical variables with more than two levels were recoded to numeric data by creating dummy variables (dummy coding - Table 1). A dummy variable is one which has a value of one when a categorical event occurs (reference category) and a zero when it does not occur. When introducing dummy variables into the model, one of the values of the predictor is left unaccounted (default variable), so when there are C possible values of the predictor only C-1 dummy variables are used. For example, for the variable Quarter (4 values) by default if an apartment is not in the quarter "AGIOS

VASILEIOS", is not in "APOSTOLOS VARNAVAS & AGIOS MAKARIOS", is not in "CHRYSELEOUSA" it means that is in "AGIOS DIMITRIOS" (default variable) so we don't need to have this fourth category as a dummy variable in the model.

Descriptive statistics for both quantitative and qualitative variables are given in Tables 2 to 4 below:

Table 2: Descriptive statistics for Macroeconomic Quantitative Variables

Table 2: Descriptive Statistics for Macroeconomic Quantitative Variables					
	N	Minimum	Maximum	Mean	Std. Deviation
GDP	262	4190,50	5279,50	4802,02	322,59
ChangeGDP	262	-3,35	6,95	4,08	2,57
Wages	262	1877,00	1950,00	1897,96	24,44
CPI	262	97,72	102,83	99,80	1,30
Inflation	262	-2,93	2,67	-0,44	1,58
Unemployment	262	7,30	17,60	12,16	2,93
CostMat	262	98,17	102,50	99,71	1,28
LaborCost	262	89,69	100,50	99,17	3,16
ConstProd	262	80,65	225,93	143,01	42,10
MIR	262	2,23	4,59	3,08	0,64
Valid N (listwise)	262				

Source: Cyprus Statistical Service and Central Bank of Cyprus

Table 3: Descriptive statistics for Microeconomic Quantitative Variables

Table 3: Descriptive Statistics for Microeconomic Quantitative Variables					
Variable	N	Minimum	Maximum	Mean	Std. Deviation
PriceDecl	262	26000,00	595000,00	140336,72	88234,73
PriceAcce	262	30000,00	595000,00	153899,01	88897,94
TAX	262	0,00	95000,00	2938,81	8859,17
Age	262	0,00	44,00	15,65	11,47
DistMW	262	0,35	7,80	2,71	1,36
DistSM	262	2,00	9,50	4,24	1,35
DistCC	262	1,10	8,10	4,00	1,33
Floor	262	0,00	5,00	1,99	1,16
Area1	262	31,00	258,00	93,87	37,28
Area2	262	0,00	59,00	16,11	9,88
Area3	262	0,00	197,00	8,27	24,62
Valid N (listwise)	262				

Source: Department of Land and Surveys

Table 4: Descriptive statistics for Microeconomic Qualitative Variables

Table 4: Descriptive Statistics of Microeconomic Qualitative Variables		
Variable	**N**	**%**
Parking		
No Parking	24	9,16
ONE (default)	209	79,77
TWOORMORE	29	11,07
Quality		
FAIR	8	3,05
GOOD (default)	128	48,85
VERYGOOD	126	48,09
Quarter		
AGIOS VASILEIOS	44	16,79
APOSTOLOS VARNAVAS & AGIOS MAKARIOS	71	27,10
CHRYSELEOUSA	65	24,81
AGIOS DIMITRIOS (default)	82	31,30
View		
Normal	249	95,04
Interrupted	13	4,96
Green		
Yes	33	12,60
No	229	87,40
Walkway		
Yes	25	9,54
No	237	90,46
Storage		
Yes	168	64,12
No	94	35,88

Source: Department of Land and Surveys 1

REGRESSION ANALYSIS RESULTS

This section discusses the results obtained from applying Multiple Linear Regression Analysis. Statistical analysis was performed using IBM SPSS Statistics 25. All data were stored in Excel 2016 and were properly formatted to be imported into SPSS. Categorical variables with more than two levels were recoded to numeric data by creating dummy variables (dummy coding - Table 1). We also considered the log transformation for several variables: Price, Area, Floor and Age. The main reason for log transforming data when using multiple regression analysis is to meet the assumptions of the method, such as normality and linearity.

To estimate the best regression model alternative analysis and combinations were implemented. We ended up to the best fitting models considering, among other factors, the effect of multicollinearity when introducing variables into the model, the expected sign of the variables as false positives and negatives are part of the analysis, the values of the R-Square and Adjusted R-Square and the p values for the independent variables since in regression, low p values indicate statistical significant variables.

Final analysis considers two models that both include macro and microeconomic variables as explanatory variables. Both models consider the Log Transformation of variables: Price, Area and Age. In the first Model (Model 1) Apartment Price (the Log of it) is the dependent variable and in second Model (Model 2) the dependent variable is the Apartment Price per Square Meter (the Log of it).

Model 1 (Dependent Variable Price)

After the implementation of Multiple Linear Regression Analysis, we focus on three sets of statistics from the SPSS output: The R square statistic, the significance tests, and the coefficients (Tables 5 to 7 below).

Model Summary

The model summary is based on Table 5.

Table 5: Model 1 - Model Summary

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,929[a]	0,863	0,858	0,184478291

a. Predictors: (Constant), VeryGood, Ln(Area3), Mortgage Interest Rate, Agios Vasileios, Ln(Area1), VAT, Storage, Ln(Area2), Ln(Age)

The R Square statistic measures the regression model's usefulness in predicting outcomes. The model summary in Model 1 shows the R Square is 0.863. The adjusted R Square, which is a modified version of R Square that considers the number of independent variables in the model, has approximately the same value (0.858), meaning that a 85.8% of the variation of the dependent variable (Log of Accepted Price) can be explained by the nine independent variables in the regression model (Very Good Quality, Log of Area 3, Mortgage Interest Rate, Agios Vasileios Quarter, Log of Area 1, VAT, Storage, Log of Area 2, Log of Age). The remaining 14.2% of the variation of the dependent variable can be explained either by other important factors that are not included in the model or unexplained noise in the data. The Standard Error of the Regression (Se) also tells us how well the model fits the data. The value of 0.18 represents the average distance that the observed values fall from the regression line in dependent variable's units and is considered low.

ANOVA

The second table of the output is the ANOVA table (Table 6). In a regression model the ANOVA F statistic, examines whether the model is significant. In Model 1 the p value is less than 0.001 so we can say that the model is statistically significant F (9,252) =175.869 p<0.001.

Table 6: Model 1 - ANOVA

Table 6: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	53,867	9	5,985	175,869	,000[b]
	Residual	8,576	252	0,034		
	Total	62,443	261			

a. Dependent Variable: LnPriceAcce

b. Predictors: (Constant), VeryGood, Ln(Area3), Mortgage Interest Rate, Agios Vasileios, Ln(Area1), VAT, Storage, Ln(Area2), Ln(Age)

Coefficients

The absolute value of β (Standardized Beta Coefficient) in Table 7 indicates the order of importance of the independent variables. The variable with the highest β value is relatively the most important independent variable. The Beta coefficients obtained from our regression analysis (Model 1) show that Enclosed Area of the Apartment (Log transformation) has made the biggest contribution (β= 0.695) followed by Age (Log transformation, β= - 0.267) and VAT placed on transactions (β= 0.146). All the other variables, although they were significant, they were found to have less contribution to the model.

Table 7: Model 1 - Coefficients

Table 7: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8,075	0,159		50,680	0,000
	VAT	0,000008049	0,000	0,146	5,562	0,000
	Ln(Age)	-0,148	0,017	-0,267	-8,741	0,000
	Storage	0,103	0,027	0,102	3,893	0,000
	Ln(Area1)	0,888	0,034	0,695	26,482	0,000
	Ln(Area2)	0,085	0,017	0,139	5,085	0,000
	Ln(Area3)	0,039	0,008	0,110	4,607	0,000
	Mortgage Interest Rate	-0,078	0,019	-0,101	-4,010	0,000
	Agios Vasileios	-0,072	0,032	-0,055	-2,287	0,023
	VeryGood	0,117	0,026	0,120	4,468	0,000

a. Dependent Variable: LnPriceAcce

The results given in Table 7 show that most of the variables that describe Apartment Characteristics (VAT, Enclosed Area, Covered Verandas Area, Uncovered Verandas Area and Storage) and Block Variables (Very Good Block Quality and Age of Block) are highly significant ($p<0.001$). The coefficient signs are as expected. Age coefficient is negative showing that the older the block the lower the price. On the other hand, Apartment Space, the presence of a Storage and "Very Good" Quality of the Block worth higher prices. Regarding taxation the positive effect on prices of VAT placed on transactions shows that the extra cost is incorporated in price by the Vendor.

The significant Neighborhood Variable (at a significance level of 5%) is Quarter Agios Vasileios. The Quarters were included in the analysis as dummy variables. Quarter Agios Dimitrios was excluded as the default categorical variable, so the regression output allows us to

compare other quarters to Agios Dimitrios. The negative coefficient means that Apartments located in Agios Vasileios have lower prices than Apartment prices in Agios Dimitrios, provided all other variables remain the same.

Among macroeconomic variables the Mortgage Interest Rate was the only one found to have statistically significant effect on prices (negative). Most of the macroeconomic variables were excluded from the model because of multicollinearity issues, Table 17 Appendix (r>0.7, GDP, Unemployment, Labor Cost, Production in Building Construction). The negative effect (demand effect) means that an increase in the Mortgage Interest Rate decreases the ability of individuals either to serve their mortgage or to buy a house. These drive to a decrease in demand for properties that in turn effects negatively the houses price.

Regression Equation

Based on the Regression Analysis Results the regression equation is as follows:

Ln (Accepted Price) = 8.075 + 0.000008049*VAT – 0.148*Ln (Age) + 0.103*Storage + 0.888*LnArea1 + 0.085* Ln (Area2) + 0.039*Ln (Area3) – 0.078*Mortgage Interest Rate – 0.072*Agios Vasileios Quarter + 0.117*Very Good Quality

The unstandardized coefficient of the independent variables (slope) measures the strength and direction of its relationship with the dependent variable. It is interpreted as the size of the average difference in the dependent variable that corresponds with a one-unit difference in the independent variable. In the general form of the regression equation for every one-percent increase in the independent variable, there is a predicted increase in the percentage of the dependent variable of B (unstandardized coefficient). In our case and since the dependent variable is Log Transformed, we need to "transform" the coefficients as well before interpreting them.

In the cases where the dependent and independent variables are both Log Transformed, we interpret the coefficient as the percent increase in the dependent variable for every 1% increase in the independent variable. Therefore, for every 10% increase in Enclosed Area (Area 1), Covered Verandas (Area 2) and Uncovered Verandas (Area 3) Price increases by 8.89%, 0.85% and 0.4% respectively. Moreover, for every 10% increase in the Age of the Block the Price of the Apartment decreases by 1.48%.

When only the dependent variable is Log Transformed, we exponentiate the coefficient, subtract one from this number, and multiply by 100. This gives the percent increase (or decrease) in the dependent variable for every one-unit increase in the independent variable. Therefore, for a one-unit (in euros) increase in VAT there is a predicted increase in Price of 0.0008% (0.8% increase in price for every 1000 euros increase in VAT). In the same way, for a one-unit increase (%) of Mortgage Interest Rate there is a predicted decrease in price of 8.11%.

Moreover, regarding Storage variable in terms of percent change we can say that we expect to see about 10.85% increase in price when switching from an Apartment without a Storage Room to an apartment with a Storage Room, holding other variables constant. Likewise, Apartments in Blocks characterized by a Very Good Quality of building construction are expected to be 12.41% more expensive than Apartments in Blocks characterized by a Good Building Quality. Finally, the expected percent decrease in Apartment Price in "Agios Vasileios" Quarter is about 7.47% (in comparison to Agios Dimitrios), holding other variables constant.

Model 2 (Dependent Variable Price/sqm)

Model Summary

The model summary is based on Table 8.

Table 8: Model 2 - Model Summary

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,813[a]	0,66	0,648	0,184478291

a. Predictors: (Constant), VeryGood, Ln(Area3), Mortgage Interest Rate, Agios Vasileios, Ln(Area1), VAT, Storage, Ln(Area2), Ln(Age)

The model summary in Model 2 shows the R Square is 0.66. The adjusted R Square, which is a modified version of R Square that considers the number of independent variables in the model, has approximately the same value (0.648), meaning that a 64.8% of the variation of the dependent variable (Log of Accepted Price per Square Meter) can be explained by the nine independent variables in the regression model (Very Good Quality, Log of Area 3, Mortgage Interest Rate, Agios Vasileios Quarter, Log of Area 1, VAT, Storage, Log of Area 2, Log of Age). The remaining 35.2% of the variation of the dependent variable can be explained either

by other important factors that are not included in the model or unexplained noise in the data. The Standard Error of the Regression (Se) also tells us how well the model fits the data. The value of 0.18 represents the average distance that the observed values fall from the regression line in dependent variable's units and is considered low.

ANOVA

The second table of the output is the ANOVA table (Table 9). In a regression model the ANOVA F statistic, tests whether the model is significant. In Model 2 the p value is less than 0.001 so we can say that the model is statistically significant F (9,252) =54.411 p<0.001.

Table 9: Model 2 - ANOVA

Table 9: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16,666	9	1,852	54,411	,000[b]
	Residual	8,576	252	0,034		
	Total	25,242	261			

a. Dependent Variable: LnPrAcceSQM

b. Predictors: (Constant), VeryGood, Ln(Area3), Mortgage Interest Rate, Agios Vasileios, Ln(Area1), VAT, Storage, Ln(Area2), Ln(Age)

Coefficients

The absolute value of β (Standardized Beta Coefficient) in Table 10 indicates the order of importance of the independent variables. The variable with the highest β value is relatively the most important independent variable. The Beta coefficients obtained from our regression analysis (Model 2) show that Age (Log transformation) has made the biggest contribution (β= -0.419) followed by VAT (β= 0.229) and Area of Covered Verandas (Log transformation, β= 0.219). All the other variables, although they were significant, they were found to have less contribution to the model.

Table 10: Model 2 - Coefficients

Table 10: Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8,075	0,159		50,680	0,000
	VAT	0,000008049	0,000	0,229	5,562	0,000
	Ln(Age)	-0,148	0,017	-0,419	-8,741	0,000
	Ln(Area1)	-0,112	0,034	-0,137	-3,332	0,001
	Ln(Area2)	0,085	0,017	0,219	5,085	0,000
	Ln(Area3)	0,039	0,008	0,173	4,607	0,000
	Mortgage Interest Rate	-0,078	0,019	-0,159	-4,010	0,000
	Storage	0,103	0,027	0,160	3,893	0,000
	Agios Vasileios	-0,072	0,032	-0,087	-2,287	0,023
	VeryGood	0,117	0,026	0,189	4,468	0,000
a. Dependent Variable: LnPrAcceSQM						

The results given in Table 10 show that most of the variables that describe Apartment Characteristics (VAT, Enclosed Area, Covered Verandas Area, Uncovered Verandas Area and Storage) and Block Variables (Very Good Block Quality and Age of Block) are highly significant ($p<0.001$).

The coefficient signs are as expected. Age coefficient is negative showing that the older the Block the lower the Apartment Price per Square Meter. In contrast to Model 1 in this case we see that as Square Meters (Area 1 - Enclosed Apartment Space) increase, Price per Square Meter decreases. This is expected, since the larger properties benefit from economies of scale. Moreover, there are fixed costs such as land and costs for making construction possible that remain the same regardless the square meters. On the other hand, since Price per Square meter considers only the enclosed area of the Apartment the larger the external areas (Area 2 and 3 - covered and uncovered verandas) the higher the Price per Square Meter.

Storage Space, "Very Good" Block Construction Quality and VAT, as expected, and in agreement with the results of Model 1 have positive effect on per Square Price. Also, the negative coefficient of Agios Vasileios Quarter variable shows that apartments located in Agios Vasileios have lower price per square meter than Apartments located in Agios Dimitrios, provided all other variables remain the same.

Among macroeconomic variables the Mortgage Interest Rate was the only one found to have statistically significant effect on prices (negative effect). Most of the macroeconomic variables

were excluded from the model because of multicollinearity issues, Table 17 Appendix (r>0.7, GDP, Unemployment, Labor Cost, Production in Building Construction).

Regression Equation

Based on the Regression Analysis Results the regression equation is as follows:

Ln (Accepted Price per Square Meter) = 8.075 + 0.000008049*VAT – 0.148*Ln (Age) + 0.103*Storage - 0.112*Ln(Area1) + 0.085* Ln (Area2) + 0.039*Ln (Area3) – 0.078*Mortgage Interest Rate – 0.072*Agios Vasileios + 0.117*Very Good Quality

Same way as Model 1, since the dependent variable is Log Transformed, we need to "transform" the coefficients as well before interpreting them.

Therefore, for every 10% increase in Covered Verandas (Area 2) and Uncovered Verandas (Area 3) Price per Square Meter increases by 0.85% and 0.4% respectively. Moreover, for every 10% increase in the Area of Enclosed Space and the Age of the Block, the Price per Square Meter decreases by 1.12% and 1.48% respectively, with all other factors held constant.

For a one-unit (in euros) increase in VAT there is a predicted increase in Price per Square Meter of 0.0008% (0.8% increase in price per sqm for every 1000 euros increase in VAT). In the same way, for a one-unit increase (%) in Mortgage Interest Rate there is a predicted decrease in Price per sqm of 8.11%.

Regarding Storage variable in terms of percent change we can say that we expect to see about 10.85% increase in price per sqm when switching from an apartment without a storage space to an apartment with a storage space, holding other variables constant. Likewise, Apartments in blocks characterized by a Very Good Quality of building construction are expected to be 12.41% more expensive than apartments in Blocks characterized by a Good Building Quality. Finally, the expected percent decrease in Price per square meter when switching from "Agios Dimitrios" to "Agios Vasileios" Quarter is about 7.47%, holding other variables constant.

Before selecting the best fitting Models (Model 1 and Model 2) we ran the same linear regressions (same dependent variables) without Log Transforming the Data. The relevant Model Summary, ANOVA and Coefficients Tables are included in Appendix (Table 11 to Table 16).

Both Model 3 (Dependent Variable Accepted Price) and Model 4 (Dependent Variable Accepted Price per Square Meter) give statistically significant results with slightly lower Adjusted R Square than the Models with Log Transformed Data (Models 1 and 2). There are also minor differences between the statistically significant independent variables. Variable Storage was not found significant in Models 3 and 4 and the significant locational variable was the distance from the Shopping Mall and City Center respectively instead of the Quarter the Block is located. We consider the inclusion of Variable Quarter in Models 1 and 2 more meaningful since it incorporates not only locational characteristics (such as distance from the city center, motorway etc.) but neighborhood quality characteristics too.

CONCLUSIONS AND STUDY LIMITATIONS

This study examines the impact of macro and micro economic determinants, on the apartment sale prices in Strovolos, Nicosia, for the period between 2014 and 2018. A multiple linear regression analysis model was employed. The method allows the estimation of the relationship between the variables, the assessment of the power of the relationship, the prediction of future values of the dependent variable, and measures the influence of each independent variable on the dependent one. Final analysis considers two models that include macro and microeconomic variables as explanatory variables. The two models differ in terms of dependent variable since in Model 1 the dependent variable is price and in Model 2 the dependent variable is price per square meter. First, we confirmed that a linear relationship exists. For this purpose, Log Transformed data were used. Secondly, the statistically significant independent variables were found, and the relevant coefficients and equations were estimated and interpreted.

Our results show that changes in apartment prices are significantly dependent on property characteristics (apartment, block, and neighborhood), fiscal and monetary environment. Overall, age of the block, enclosed area, VAT applied on sales transactions, mortgage interest rate, construction quality of the block, the location of the block and the quality of the neighborhood (both Quarter wise), the presence of a storage room and the area of the covered and uncovered verandas, are the variables to watch if you want to forecast the apartment prices in Strovolos. Our findings are consistent with the findings of Sirmans et al (2006), Selim (2008), Mimis et al (2013), Koster et al (2010), and Keskin (2008). They also concluded that floor space, age, neighborhood quality and location have a significant effect on residential property prices.

The findings of the two models are in harmony regarding direction and importance of independent variables. In the case of Model 1, Enclosed Area of the Apartment has made the biggest contribution, followed by Age and VAT placed on transactions. For Model 2, the Beta coefficients show that variable Age has made the biggest contribution, followed by VAT and Area of Covered Verandas. As expected, and in contrast to Pashiardes and Savva (2009) findings, the major difference between the two models is the effect of the enclosed area to the dependent variable. In contrast to Model 1, in Model 2, as square meters (Area 1 - enclosed apartment space) increase, dependent variable, i.e. price per square meter decreases. This is expected, since the larger properties benefit from economies of scale. Also, fixed costs, such as

land, that remain the same regardless the square meters, result in a decrease of the price per square meter as the volume increases. Furthermore, there is a remaining percentage of the variation of the dependent variable that remains unexplained in the two final Models. For Model 1 (dependent variable price) the percentage is limited to 14.2% but for Model 2 (dependent variable price/sqm) the remaining unexplained variation of the dependent variable is 35.2%. This can be explained either by other important factors that are not included in the model or unexplained noise in the data.

Microeconomic variables related to private parking, view, floor, distance from key locations and the proximity to public green area and pedestrian walkway, did not give statistically significant results in the best fitting models. Having in mind the percentage of variation of the dependent variable that remains unexplained It would be useful for future research to examine the effect of the above and similar factors by including in the analysis alternative property and locational variables, such as the number of apartments in the block, the number of bedrooms, distance from the nearest school, supermarket, park and other amenities. Especially, regarding the number of bedrooms, the data were available only for a limited number of apartments and thus we could not include the variable in the analysis.

Nevertheless, distance to shopping mall and distance to city center were found statistically significant, with negative effect in Models 3 and 4, respectively (Models 3 and 4 are equivalent non log versions of Models 1 and 2 and are briefly presented in the Appendix). Though the final models do not include variables that measure the distance of properties from key locations, they include a Quarter variable (Agios Vasileios) which incorporates locational and neighborhood quality characteristics too. The relevant findings show that apartments in Agios Vasileios cost about 7.47% less than apartments in Agios Dimitrios, holding other variables constant.

In contrast to the findings of other studies (Sirmans et al, 2006; Koster et al, 2010; Zietz et al, 2008) private parking variable does not enter the best fitting models. However, the correlation results and the findings of significant alternative models (with lower adjusted R Square than the final models), show that apartments with no private parking cost less than apartments with one private parking and apartments with more than one private parking cost more than apartments with one private parking. In addition, variable “No Parking” is significantly and positively correlated to variable Age (moderate correlation, r=0.429). This may be due to the fact that in most of the cases the apartments without private parking belong to older buildings.

Regarding the proximity to green public area, we estimated alternative models but even in the cases we obtained statistically significant coefficients the direction of the relationship (the sign) was wrong.

According to the results of the final regression models and in relation to the macroeconomic factors, the dependent variables (price and price per square meter) were linked only to mortgage interest rate and taxation (VAT placed on transactions). It was also identified that most of the macroeconomic variables; GDP, Unemployment, Labor Cost and Production in Building Construction were affected by multicollinearity (strong correlation with mortgage interest rate, $r>0.7$, Table 17 Appendix). Moreover, in contrast to the results of similar studies regarding material cost (Pashiardes and Savva, 2009), CPI (Apergis and Rezitis , 2003; Panagiotidis and Printzis, 2015), inflation (Apergis and Rezitis , 2003; Savva, 2018)) and wages (Arestis and Gonzalezm 2014) we obtained only statistically insignificant coefficients.

Regarding taxation, the positive effect on prices of VAT placed on transactions, shows that the extra cost is incorporated in price by the Vendor. As for the effect of mortgage interest rate (demand side effect) the findings are consistent with the findings of Pashiardes and Savva (2009), Apergis and Rezitis (2003), Sivitanides (2015) and Savva (2018). Economic literature suggests that when the interest rate is rising, the cost of borrowing increases and potential buyers are discouraged. As a result, housing demand and hence house prices decrease. When on the other hand, interest rates go down, the cost of housing decreases and demand for housing loans increases (Apergis and Rezitis, 2003). Based on these findings and according to several researchers suggestions (Arestis and Gonzalez, 2014; Cleanthous et al, 2017; Savva, 2015) monetary authorities, should develop more effective policies followed by appropriate banking regulations, in the form of interest rate in order to keep interest rates as stable as possible.

Any differences between our findings and the results of other studies regarding macroeconomic effects should be examined having in mind the nature and length of the period under study, since the period from 2014 to 2018 represents the aftermath of the events of March 2013. During that period, the Cyprus economy was struggling to recover from a deep recession, when one of the largest banks of Cyprus closed and the largest one went through a significant restructuring. These events led to reduction of household wealth and income, to a substantial increase of non-performing loans, and severe lack of credit for real estate loans (Sivitanides, 2015). At the same

time public sector was forced to a deep reform that gradually changed the climate and since 2015 the country's economy started recovering.

Moreover, in the context of this study we examined only the contemporaneous effect of macroeconomic factors to the dependent variable. It has been verified by many researchers that different lags may work better for the different variables, as one variable can influence another with a time lag (Savva, 2018; Sivitanides, 2015).

Finally, several articles measuring the effects of foreclosures on the value of neighboring properties, concluded that foreclosures affect the price levels thru several mechanisms (Schuetz et al, 2008, Calomiris et al, 2008, Hartley, 2010, Campell et al, 2011, Mian, et al, 2015). For this study, such effect was ignored. In fact, data from relevant transactions (dept for asset swaps) were removed from the data set, since they do not reflect the market value of the assets (forced sale value). Adding variables, such as the proximity to forced sales properties, to analysis may be useful for a future study.

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APPENDIX

Model 3 (Dependent Variable Price)

Model Summary

Table 11: Model 3 - Model Summary

Table 11: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,891[a]	0,794	0,788	40950,49375

a. Predictors: (Constant), Very Good, Distance to Shopping Mall, Area3, Area1, Mortgage Interest Rate, VAT, Area2, Age

ANOVA

Table 12: Model 3 - ANOVA

Table 12: ANOVA[a]

Model		Sum of Squares	df	lean Squa	F	Sig.
1	Regression	1,63838E+12	8	2E+11	122,125	,000[b]
	Residual	4,24267E+11	253	2E+09		
	Total	2,06264E+12	261			

a. Dependent Variable: PriceAcce

b. Predictors: (Constant), Very Good, Distance to Shopping Mall, Area3, Area1, Mortgage Interest Rate, VAT, Area2, Age

Coefficients

Table 13: Model 3 - Coefficients

Table 13: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	72314,455	19551,101		3,699	0,000
	VAT	2,649	0,307	0,264	8,627	0,000
	Age	-2143,236	319,86	-0,277	-6,701	0,000
	Distance to Shopping Mall	-4793,5	1903,368	-0,073	-2,518	0,012
	Area1	1570,822	85,681	0,659	18,333	0,000
	Area2	1162,155	339,785	0,129	3,42	0,001
	Area3	313,325	103,548	0,087	3,026	0,003
	Mortgage Interest Rate	-15228,985	4304,03	-0,109	-3,538	0,000
	VeryGood	12179,871	6097,58	0,069	1,997	0,047

a. Dependent Variable: PriceAcce

Model 4 (Dependent Variable Price/sqm)

Model Summary

Table 14: Model 4 - Model Summary

Table 14: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,796[a]	0,634	0,622	373,5470557

a. Predictors: (Constant), VeryGood, Area3, Area1, Mortgage Interest Rate , VAT, Distance to City Centre, Area2, Age

ANOVA

Table 15: Model 4 - ANOVA

Table 15: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61067187,13	8	7633398,391	54,705	,000[b]
	Residual	35302962,92	253	139537,403		
	Total	96370150,05	261			

a. Dependent Variable: PrDeclSQM

b. Predictors: (Constant), VeryGood, Area3, Area1, Mortgage Interest Rate , VAT, Distance to City Centre, Area2, Age

Coefficients

Table 16: Model 4 - Coefficients

Table 16: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2379,425	186,837		12,735	0,000
	VAT	0,028	0,003	0,406	9,951	0,000
	Age	-21,797	3,038	-0,411	-7,176	0,000
	Distance to City Centre	-47,831	18,952	-0,105	-2,524	0,012
	Area1	-1,988	0,783	-0,122	-2,539	0,012
	Area2	13,132	3,093	0,214	4,245	0,000
	Area3	4,1	0,95	0,166	4,316	0,000
	Mortgage Interest Rate	-183,347	39,194	-0,192	-4,678	0,000
	Very Good	156,744	55,682	0,129	2,815	0,005

a. Dependent Variable: PrDeclSQM

Correlations

Table 17: Correlations

Table 17: Correlations											
		GDP	ChangeGDP	Wages	CPI	Inflation	Unemployment	CostMat	LaborCost	ConstProd	Mortgage Interest Rate
GDP	Pearson Correlation	1	,463**	,637**	-0,0542	,769**	-,965**	-,266**	,558**	,933**	**-,929**
	Sig. (2-tailed)		2,7027E-15	3E-31	0,3822	2,157E-52	2,1531E-152	1,24E-05	7,425E-23	9,522E-118	2,3E-114
	N		262	262	262	262	262	262	262	262	262
ChangeGDP	Pearson Correlation		1	-,175**	-,676**	0,0894397	-,369**	-,883**	,795**	,271**	**-,636**
	Sig. (2-tailed)			0,004	3E-36	0,1488289	7,21767E-10	3,44E-87	1,944E-58	8,565E-06	4,31E-31
	N			262	262	262	262	262	262	262	262
Wages	Pearson Correlation			1	,468**	,703**	-,750**	,463**	0,0973616	,738**	**-,516**
	Sig. (2-tailed)				1E-15	2,203E-40	1,39374E-48	2,48E-15	0,1159187	2,4998E-46	3,36E-19
	N				262	262	262	262	262	262	262
CPI	Pearson Correlation				1	,305**	-0,038544313	,832**	-,603**	0,07307136	**,308**
	Sig. (2-tailed)					4,963E-07	0,534506238	1,41E-68	2,232E-27	0,23852396	3,69E-07
	N					262	262	262	262	262	262
Inflation	Pearson Correlation					1	-,751**	,124*	,240**	,817**	**-,647**
	Sig. (2-tailed)						9,01734E-49	0,045141	8,791E-05	3,2026E-64	1,62E-32
	N						262	262	262	262	262
Unemployment	Pearson Correlation						1	,157*	-,500**	-,914**	**,900**
	Sig. (2-tailed)							0,010678	6,075E-18	5,153E-104	5,6E-96
	N							262	262	262	262
CostMat	Pearson Correlation							1	-,659**	-0,0643299	**,451**
	Sig. (2-tailed)								4,485E-34	0,2995653	1,68E-14
	N								262	262	262
LaborCost	Pearson Correlation								1	,483**	**-,764**
	Sig. (2-tailed)									1,064E-16	2,11E-51
	N									262	262
ConstProd	Pearson Correlation									1	**-,872**
	Sig. (2-tailed)										1,85E-82
	N										262