Explaining House Price Changes in Greece

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Abstract

In this paper we use an empirical framework which allows us to analyze the major determinants of the house prices movement in Greece and then quantify the impact and explain the extent by which these determinants impinge upon this movement. We use quarterly data between 1985Q1-2008Q1 in the context of an error correction model. We find that the most important determinant in explaining house price movement is inflation while the unemployment rate, interest rates and stock prices follow. Nevertheless, a substantial proportion of house price movement is left to be explained by behavioral factors inherent in the Greek society.

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Introduction

Housing and building construction have always played a key role in Greece's industrial sector and have long been a major source of income, they account approximately for 7.5% of GDP. Average annual GDP growth in the last decade and a half was 3.8%, among the highest in the EU. Annual growth in construction output in 2007 was about 17%.House prices have been rising sharply for more than a decade in Greece. Between 1993 and 2007 they rose by approximately 214%. The rise in house values has produced a substantial wealth effect for homeowners, as housing is the single biggest component of household wealth, comprising 80-90 % of total household wealth. Homeownership rate stands at 80% of all households.

In the midst of the current financial crisis which was initiated by the collapse in the U.S real estate market, understanding the behavior of house prices is a key determinant for the maintenance of the financial stability of the system. In this paper we use an empirical framework which allows us to analyze the major determinants of the house prices movement in Greece and then quantify the impact and explain the extent by which these determinants impinge upon this movement.

Literature Survey

There are two main strands in the literature discussing and relating real estate dynamics with the economy as a whole. The first is concerned with the role of housing wealth on consumption and the relative importance between financial and housing wealth on consumption. There is widespread disagreement among the scholars, some (K.Case et.al, 2005,J.Aron

&J.Muellbauer,2006,C.Carroll et.al,2006,R.Green,2002) find that the housing wealth effect is substantially larger, while others (L.Boone & N.Girmard,2002,Kapopoulos &Siokis,2005) find mixed results or in favor of the stock wealth effect.

What one can say in general and for the case of Greece in particular is that for changes in equity values to have a measurable impact on consumption, stock holdings must be widespread, changes in stock prices must be unanticipated and changes in prices must be the result of something other than a change in the discount rate.

The other strand in empirical research investigates the housing price dynamics. They look at factors (business cycle variables and others) that determine the movement in house prices (K.Tsatsaronis & H.Zhu,2004, N.Apergis &A.Rezitis,2003) and therefore establish the channel through which real estate changes or shocks filter though the rest of the economy. Inflation was found to be the most important factor in driving house prices in a cross country study by K.Tsatsaronis & H.Zhu,2004, while interest rate and then inflation and employment were found important in that order in the case of Greece in a paper by N.Apergis &A.Rezitis,2003.

In this paper the case of Greece is reexamined using a larger set of data with quarterly frequency hoping to shed light on the issue from a different perspective.

Methodology

The specific model used in this study is an error correction model developed through testing for cointegration. The statistical concept of cointegration was introduced by

Engle and Granger,(1987), and developed further by Johansen,(1988). Since then it has been applied to test the validity of various theories.

If two or more series are cointegrated, then there exist common factors that affect them and their permanent or secular trends and so the series will eventually adjust to equilibrium.

This implies that even if in the short run the covariance between the dependent and the explanatory variables shows that they drift apart, in the long run, the series will eventually adjust to an equilibrium relationship.

Testing for cointegration involves the following steps:

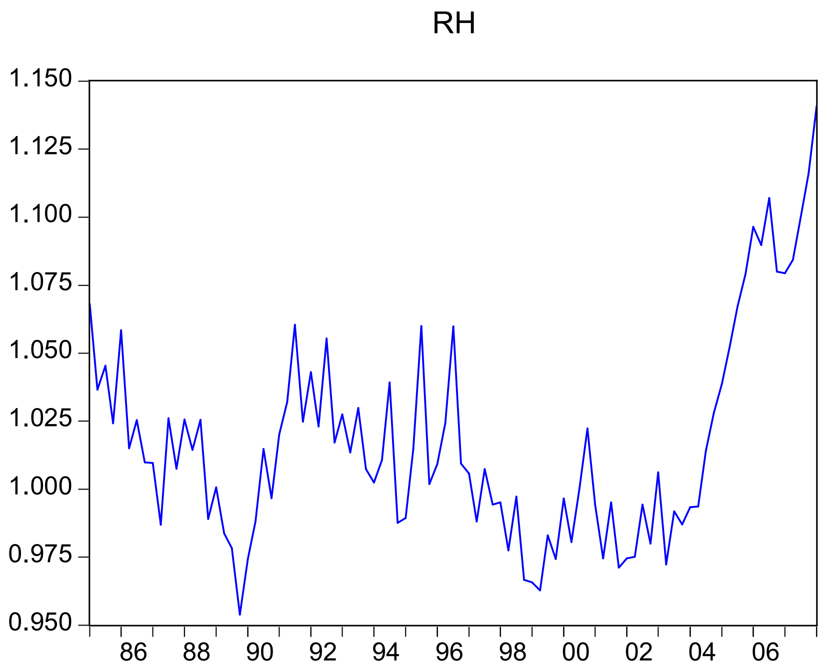
1. Determine the order of integration in each of the series,i.e conduct a unit root analysis.

2. Estimate the long-run equilibrium relationship (cointegration regression) and test for integration.

For our purposes we used as a dependent variable the housing price index, h. The set of variables which acted as regressors were chosen (on the basis of economic theory and the relevant literature) in order to create a decision making tool for the investor through the different phases of the business cycles.

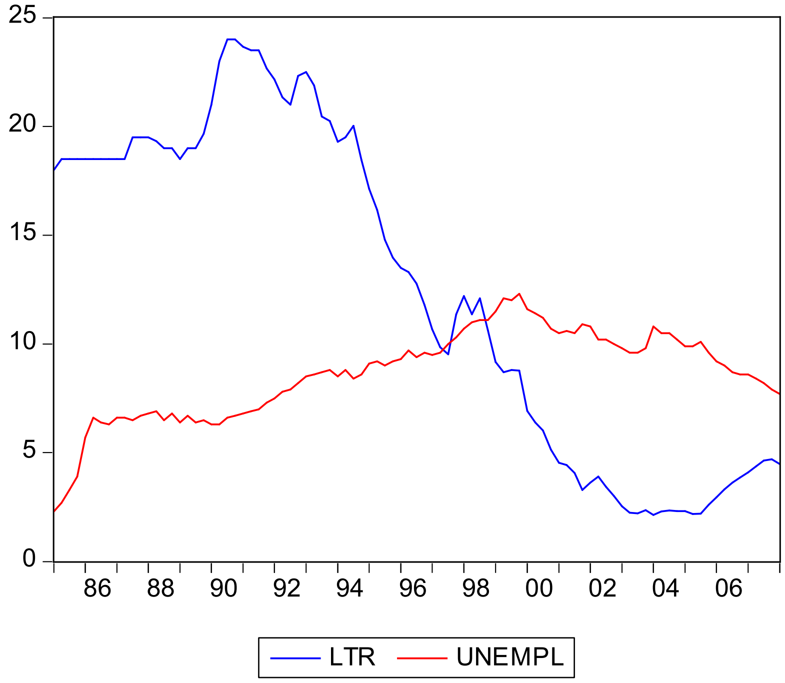
The real housing price index variability through time appears on the following chart:

figure 1: Real Housing Price Index, RH

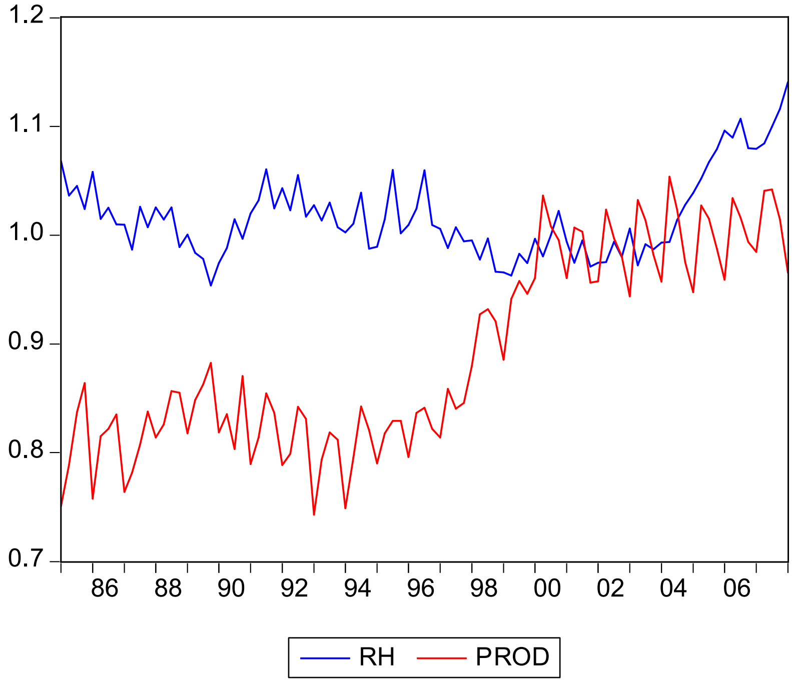


We observe that the real housing price index is overall subject to a positive trend throughout the period under examination 1985Q1-2008Q1. Growing demand for housing is almost a behavioral characteristic of the Greek society. We observe in the context of the graph that two periods can be distinguished 1989-1999 and 2000 up to today. During the first period the real housing price index, RH, reached heights that he had experienced before in the 1980's decade, since the year 2000 though where the real interest rates started to fall the RH experienced unprecedented heights. It appears from figure 2, that the expansion of the economy that followed the reduction in real interest rates was combined with falling unemployment rates. An interesting feature appears in figure 3, where the real production index of all other sectors apart from construction seems to have an almost inverse relationship with the RH. Especially since the year 2000 large amounts of funds have been invested in construction leaving the rest of the industry behind.

<u>figure 2</u>: Real Long Run Interest Rate, LTR and the Unemployment Rate



<u>figure 3</u>: Real Housing Price Index,RH and Real Production Index,PROD



The mean equation of the general model is of the following form:

$$(\mathbf{RH})_t = \mathbf{b_0} + \mathbf{b_1 ASE_t} + \mathbf{b_2 UN_t} + \mathbf{b_3 LR_t} + \mathbf{b_4 CPI_t} + \mathbf{b_4 PROD_t} + \varepsilon_t \quad \mathbf{(1)}$$

Where:

RH: Housing Price Index expressed in real terms

ASE: The General Athens Stock Exchange Index

UN: The Official Unemployment Rate

LTR: The real Long-Run Interest Rate

CPI: The Consumer Price Index.

PROD: The Production Index in real terms of all other sectors apart from construction

All variables as already mentioned are found non-stationary apart from the UN, the unemployment rate and the ASE, the Athens Stock Exchange. We maintain the two stationary variables, UN and ASE in the model, since they will not influence the outcome, Enders,(1995). A linear combination of I(1) variables will be I(0), in other words stationary, if the variables are cointegrated. If we regress an I(1) variable on a number of I(1) variables and I(0) given that they are cointegratd, then the residuals are stationary,I(0). A cointegrating relationship is a long-term or equilibrium phenomenon. It is possible that cointegrating variables may deviate from their relationship in the short run, but their association would return in the long-run.

We keep the variables in levels and run OLS models to test for cointegration. If the variables are cointegrated (i.e if the null hypothesis of no cointegration is rejected), the residuals from the equilibrium regression can be used to estimate the error correction model. The value of the residual lagged by one period, estimates the deviation from long-run equilibrium in period, t-1.The residuals of the regression when all variables are in levels are found stationary, so we develop the following general dynamic, error correction model according to the Engle-Granger procedure.

$$\Delta(RH)_t = b_0 + b_1\,\Delta(ASE)_t + b_2\,\Delta UN_t + b_3\Delta(CPI)t + b_4 VARE_t +$$
$$b_4\Delta(PROD)_t + b_4\Delta(LTR)_t + \gamma(ECT)_t + \varepsilon_t \qquad (2)$$

where **ECT** is the error correction term and **VARE** is a volatility measure of the **ASE**.So we develop the above model and run the following tests.

a) We test for asymmetries in the speed of adjustment to the long-run equilibrium price ratio path. We do that by separating positive and negative error correction terms.
b) We investigate whether the adjustment to the equilibrium price is faster for a rise in X (co integrating variable) compared to a fall (sign asymmetry).
c) We investigate whether the adjustment to the equilibrium price is faster for large changes in X compared to small (size asymmetry).

Next, to assess model adequacy, for each vessel type we judge and select the best model on the basis of the following criteria:

Adjusted R^2, the AIC (Akaike's Information Criterion), the SBC(Schwarz Bayesian Criterion), the Joint Significance Wald Test for the added variables, and the Wald test to investigate sign and size asymmetry as well as asymmetry between positive and negative deviations from equilibrium.

Our choice of the Engle and Granger procedure was made on the following grounds: First of all it is very straightforward to implement. Secondly, if the decision variable is the RH, then it is a natural choice to assume that it is the dependent variable in the cointegrating regression. Furthermore, in this particular application the Engle-Granger criterion of minimum variance is rather more important than the Johansen, criterion of maximum stationarity. Finally, the Engle-Granger small sample bias is not necessarily a problem, since the sample size is quite large and the cointegrating vector is super consistent. Nevertheless, out of purely academic interest and for purposes of further validation of our procedure we did implement the Johansen approach. In this context we run the co integration test between all the I(1) variables included in the co integrating relationship. We then used the trace and maximal eigenvalues tests to determine the number of co integrating vectors present. Both tests showed the presence of one cointegrating equation.

Data set- Variable Selection

Quarterly times series data was collected for the years 1985Q1 to 2008Q1 from the DSI data basis . Specifically, we collected the housing price index, the unemployment rate, the long-run interest rate and the General Athens Stock Exchange Index, ASE. We also collected the production index of all sectors apart from construction, PROD, and the CPI which we used to transform variables into real. More specifically, the following variables were chosen for our model:

RH: The real Housing Price Index. This is used as a proxy for the decision variable.

ASE: The General Athens Stock Exchange Index. It is used as a proxy for activity in the financial sector of the economy.

UN: The Official Unemployment Rate. It is used as a proxy for the business cycles of the economy

LTR: The real Long-Run Interest Rate to indicate periods of expansion or contraction in the economy

CPI: The Consumer Price Index. It is a proxy for the general price level

PROD: The Production Index in real terms of all other sectors apart from construction. It is used as a proxy for the output growth in the economy apart from construction.

VARE: It is a measure of the volatility of the Athens Stock Exchange Index, ASE, obtained by estimating the AR(2) of the ASE, saving the residuals and constructing their variance.

Furthermore, we used the E-Views statistical package for the data set formation and model estimation. All the data series were checked for stationarity using the ADF unit root test.

table 1: ADF-test, Variables in levels

Variable	
RH	-1.02
LTR	-0.52
PROD	-0.51
UN	-3.87
ASE	-6.33
CPI	-1.03
VARE	-3.69

MacKinnon critical values for rejection of hypothesis of a unit root at 1% is -3.48, at 5% is -2.88, at 10% is -2.58.

The figures in Table 1 show that all variables apart from the Unemployment rate and the ASE were found non-stationary .

Estimation Results

The RH is negatively related with the business cycle variable of unemployment and the change in ASE and the change in the long run interest rate as expected.

Volatility in the Athens Stock Exchange, VARE, was found to be positively correlated with the RH. The more volatile the index is the higher the demand for housing and the higher the price index change. This is in accordance with the theory of Finance since investment becomes riskier and funds find refuge in the housing market. Inflation is highly correlated with the price of housing but a negative relation prevails with the change in the price index. All the variables were found significant. Furthermore, the error correction term was found strongly significant in the model. This implies that the quarterly speed of adjustment of the real housing price index to its equilibrium level will be 33.6 percentage points.

To test for sign and size asymmetries we have tried all the cointegrating variables of the model and found the most significant of them to be, INF, the inflation rate, so models (2) and (3) are run on the basis of this variable.

To run model (2) we constructed two additional variables apart from the error correction term. The first, $\Delta X1$, was constructed by the positive changes in the inflation rate and zero anywhere else. Then we multiplied it by the lagged error term and got the variable DINF(+ve).

Similarly, $\Delta X2$, was constructed by the negative changes in the inflation rate and zero anywhere else. Then we multiplied it by the lagged error term and got the variable DINF(-ve).

table 2: Estimation of the Decision Making Model with Dependent Variable the Δ(RH)

Variable	Coefficient (1)	Coefficient (2)	Coefficient (3)	Coefficient (4)
C	0.007 (2.74)	0.012 (4.34)	0.006 (2.00)	0.005 (2.29)
Δ(ASE)	-0.0008 (-2.50)	-0.0004 (-1.71)	-0.0008 (-2.68)	-0.0006 (-2.21)
Δ(UN)	-0.02 (-3.01)	-0.016 (-2.97)	-0.016 (-3.53)	-0.02 (-2.89)
Δ(LTR)	-0.0002 (-2.44)	-0.0002 (-2.37)	-0.0007 (-2.64)	-0.0004 (-2.87)
Δ(CPI)	-0.61 (-4.32)	-0.64 (-4.69)	-0.57 (-3.90)	-0.56 (-4.41)
Δ(PROD)	-0.04 (-1.97)	-0.04 (-1.99)	-0.04 (-2.26)	-0.03 (-1.96)
VARE	0.0009 (1.86)	-	0.0001 (2.08)	0.0006 (1.98)
ECT	-0.33 (-4.39)	-	-0.47 (-4.14)	
ECT(+ve)		-0.58 (-4.18)		
ECT(-ve)		-0.07 (-0.61)		
DINF(+ve)			-0.001 (-0.07)	
DINF (-ve)			-0.04 (-1.99)	
DINF(big)				0.001 (0.829)
DINF(small)				-0.017 (-0.659)
Adj.R^2	0.43	0.45	0.40	0.38
AIC	-5.17	-5.20	-5.18	-4.98
SBC	-4.95	-4.98	-4.90	-4.32
WALD(joint sign.)		23.66	5.72	3.47
WALD TEST	8.75	9.44	7.59	6.74

*(t-statistic in brackets)

To examine sign asymmetry we tested the joint significance first of the two additional variables and then applied the Wald test to see if the coefficients of the two additional variables differ among themselves.

To run model (3) we constructed two more variables $\Delta X1$, to stand for big changes in the inflation rate i.e. greater than the average in absolute terms and zero elsewhere. Then we multiplied it with the lagged error term and got DINF(big) in Table 2.

Similarly, $\Delta X2$,stood for small changes in the inflation rate i.e. smaller than the average in absolute terms and zero elsewhere. Then we multiplied it with the lagged error term and got DINF(small) in Table 2.

To examine size asymmetry, that is, if a large change in the inflation rate will make the price adjust faster to equilibrium compared with a small change in the inflation rate, we run a Wald test after we test for the joint significance, of the additional variables.

Of the four models tested, according to the criteria we have set, we choose model(2) where we have separated positive from negative error correction terms.

The results show that if there is a positive deviation from equilibrium the speed of adjustment of the price ratio towards its long-run equilibrium will be much faster. The gap will close by 58.6% in a quarter, compared to 7.6% following a negative deviation from equilibrium.

Conclusion

This paper has examined the extent by which house price fluctuations can be attributed to fluctuations in unemployment, the inflation rate, rates of interest and stock prices. The most important empirical finding is that a growing economy as it is reflected by these variables appears to account substantially for the recent housing price increase. It must be pointed out though that the house price increase experienced in Greece over the last decade has gone beyond what is implied by the set of macroeconomic variables under consideration.

We believe that behavioral factors, endogenous and inherent to the Greek society are responsible for the excess growing of house prices over the last decade in Greece.

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