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Sophocles N. Brissimis
Thomas Vlassopoulos

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BANK OF GREECE
Economic Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

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Sophocles N. Brissimis
Bank of Greece and University of Piraeus

Thomas Vlassopoulos
European Central Bank

ABSTRACT

Although the close empirical relationship between the evolution of mortgage lending and housing prices is well established in the literature, the direction of causation is less clear from a theoretical standpoint. We apply multivariate cointegration techniques in order to address this issue empirically for the Greek economy. Our results, based on a cointegration relationship that we identify as a mortgage loan demand equation, indicate that housing prices do not adjust to disequilibria in the market for housing loans. This suggests that in the long run the causation does not run from mortgage lending to housing prices. In the short run we find evidence of a contemporaneous bi-directional dependence.

Keywords: Housing loans; Housing prices; Multivariate cointegration
JEL Classification: G21, R21, C32

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Correspondence:
Thomas Vlassopoulos
European Central Bank,
Kaiserstrasse 29,
60311 Frankfurt am Main, Germany.
Tel.: +49 69 13447195
Fax: +49 69 13445757
e-mail: thomas.vlassopoulos@ecb.int

1. Introduction

The close empirical relationship between the evolution of property prices and credit aggregates has been well established, mainly in the policy-oriented literature (see, for example, Borio *et al.*, 1994; BIS, 2001). What is much less clear is the direction of causality between these two variables, given that, from a theoretical perspective, causal relationships running from property prices to credit and vice-versa are both plausible.

Property price increases can directly drive the demand for credit up, as the acquisition of real estate will require increased amounts of financing. Moreover, higher property prices stimulate economic activity via wealth effects, thereby encouraging investment and consumption spending and, as a result, indirectly increasing the demand for credit. The existence of financial frictions, such as agency costs and informational asymmetries, highlights the relevance of collateral constraints on the amount of borrowing that agents can obtain (Bernanke and Gertler, 1989 and Kiyotaki and Moore, 1997), thereby providing another causal link between property prices and credit. Thus, increased property valuations will raise the value of borrowers' collateral and therefore their borrowing capacity – a mechanism identified in the literature as the "financial accelerator" (see, for example, Bernanke *et al.*, 1999). Gerlach and Peng (2005) also identify a supply-side influence of property prices on credit, as fluctuations in real estate prices affect the capital position of banks, either directly through the valuation of their own real estate portfolio or indirectly through the effect of property prices on non-performing loans.

The increased availability of credit, on the other hand, will raise the demand for property. Given that in the short run the supply of real estate is relatively fixed, this will tend to drive real estate prices up.[1] Moreover, ample credit can also affect property valuations indirectly, as it will encourage investment and consumption spending, increasing economic activity and creating favourable expectations for future income flows from assets, thus boosting valuations (Borio *et al.*, 1994).

The interaction of credit and property prices is of particular relevance for central bank policy. The financial accelerator mechanism which is part of the nexus of

[1] The role of credit developments in driving asset prices has been stressed, for example, by Kindleberger (1996).

this interaction, is central to the monetary policy transmission mechanism. Moreover, fluctuations in asset prices, and housing prices in particular, pose challenges to monetary policy makers in calibrating the appropriate response.[2] Finally, this interaction can have important implications for financial stability. As indicated above, developments in property prices affect the capitalisation of the banking system. In addition, rapid credit growth, which can be triggered by rising property prices, is one of the most consistent and robust leading indicators of future financial crises (see Borio and Lowe, 2002 and the references cited therein).

In this paper we aim to empirically investigate the pattern of causality between credit and property prices, focusing on housing loans and housing prices in the case of Greece. This is of particular interest, given that the deregulation of mortgage lending in Greece, which was followed by a rapid increase in housing loans, went hand-in-hand with a continuous increase in housing prices that, in nominal terms, averaged 11% per annum between 1995 and 2005.[3] This led some observers to suggest that the growth in residential property valuations was spurred by the increased availability of mortgage lending.[4] Moreover, the issue of housing prices is of great importance in Greece, since residential property represents more than 80% of total household wealth, a share far greater than that in other comparable countries.

The question of the interaction between credit aggregates and property prices has only recently started to be addressed in the empirical literature. From a multiple-country perspective, Hofmann (2001)[5] uses a multivariate cointegration approach to examine the role of commercial and housing property prices in explaining developments in credit to the private sector in 16 industrialised countries. From a single-country viewpoint, Fitzpatrick and McQuinn (2004) study the relationship between mortgage credit and house prices in Ireland using a single-equation approach and report evidence of a long-run mutually reinforcing relationship. Gerlach and Peng (2005) use a Vector Error Correction Model (VECM) to examine the interaction between credit to the private sector and residential property prices in Hong Kong and conclude that the direction of causality runs from property prices to bank credit.

[2] See, for example, Bernanke and Gertler (2001) and Cecchetti *et al.* (2000) for two representative, opposite views on this issue.
[3] A more detailed analysis of developments in the Greek housing market during this period is provided in Section 2.
[4] See, for example, Himoniti-Terroviti (2005).
[5] See also, Hofmann (2004).

Finally, Gimeno and Martínez-Carrascal (2006) study the same question in the case of Spain, focusing however on mortgage credit rather than loans to the private sector and identifying two cointegration relationships. Their results are consistent with those reported by Fitzpatrick and McQuinn (2004) in that they find that the two variables are interdependent in the long run.

The remainder of this paper is organised as follows: as a precursor to the empirical analysis, Section 2 provides some stylised facts for the mortgage lending and housing markets in Greece. In Section 3 we identify the factors that will be relevant for our econometric investigation, drawing from the theoretical and empirical literature. Section 4 is the main part of the paper where the empirical methodology is presented and the results are reported, while Section 5 provides some concluding remarks.

2. The markets for housing loans and housing in Greece: stylised facts

This section sets the scene for the empirical analysis that follows by presenting some stylised facts for the markets for housing loans and housing in Greece. Overall, the evolution of real housing loans has gone hand-in-hand with that of real housing prices during the period from 1993 to 2005, for which housing price data is available (see Figure 1). The growth rate of real housing prices was more volatile during this period than that of real housing loans, becoming in fact negative in the first quarter of 2004. Nevertheless, the two series appear to be closely linked, as evidenced by their very high correlation (97.9%). In the remainder of this section we shall consider the two markets in turn, starting from the market for housing loans.

The market for housing loans in Greece has recorded impressive growth during the last ten years, with the annual growth rate of housing loans averaging 28% in the 1996 – 2005 period. Indeed, these growth rates are considerably higher than those witnessed in the euro area as a whole (see Figure 2), a development that can be attributed to a host of factors. Mortgage lending was deregulated in Greece relatively

recently (in 1994), while previously only specialised credit institutions[6] were permitted to engage in this activity. Following deregulation, commercial banks were also permitted to enter this market, which until then was relatively underdeveloped. As a result, households were, to a large extent, credit constrained. Housing purchases were made either in cash, accumulated through savings or obtained through transfers from other family members, or through financing provided by property developers.[7] That households were credit constrained implies that a significant pent-up demand for mortgage loans existed, which, following deregulation, was steadily met.

Another factor that contributed significantly to the impressive growth rates of housing loans was the considerable fall in mortgage interest rates, both in nominal and, more importantly, in real terms, witnessed during the period considered. The deregulation of the mortgage lending market meant that interest rates that were previously administratively set, became subject to competitive pressures. Moreover, in the run-up to Greece's EMU membership market interest rates dropped significantly, which exerted further downward pressures on mortgage interest rates. As a result, the floating[8] nominal interest rate on housing loans declined from 20% at the end of 1993, to 3.9% at the end of 2005 (see Figure 3).

Moreover, factors related to supply-side changes also contributed to the robust growth rates of housing loans. As a result of the deregulation process, housing loans gradually became an increasingly important part of bank portfolios, as the share of mortgage loans in total bank loans more than doubled between 1995 (14%) and 2005 (29%, see Figure 4). At the same time, other developments in the banking sector also fed the growth of the mortgage lending market. In particular, banks found themselves with increased liquidity as the Bank of Greece gradually reduced reserve requirements in accordance with Eurosystem rules. Furthermore, the abolition of the requirement for banks to hold government bonds and, subsequently, the very low yields on these securities induced banks to substantially reduce their holdings of government debt and shift their portfolios towards private sector debt, among which mortgage lending

[6] The specialised credit institutions engaged in mortgage lending at the time were the Deposits and Loans Fund, the National Mortgage Bank of Greece, the National Housing Bank of Greece, the Postal Savings Bank and Aspis Bank.

[7] To the extent that property developers in turn financed themselves through bank loans, this practice in effect amounted to indirect bank lending to housing purchasers.

[8] This relates to housing loans with a floating interest rate or a rate fixed for a period of less than 1 year. Such loans represent the majority of housing loans in Greece.

assumed an important role. These developments led to increased competition among banks in the mortgage lending market, which was, to some extent, manifested as increased financial innovation in terms of new products, designed to more accurately and flexibly address borrowers' requirements.[9] More recently, banks in Greece have also become more innovative in the methods used to finance their lending activities, tapping into international financial markets and securitising parts of their loan portfolios, starting from their housing loan portfolios.

Due to the large growth rates of housing loans, which far exceed the rate of nominal GDP growth, the mortgage debt to GDP ratio increased from 24% in 1997 to 36% in 2005. This notwithstanding, the ratio for Greece remains well below the euro area average (see Figure 5).

Turning to the housing market, home ownership has traditionally been important in Greece for cultural reasons. Moreover, the fact that property was the only investment available to households that could insulate their savings from inflation in a period when financial regulation was intense and capital controls were in place, added to the importance attached to home ownership. This is reflected in the remarkable home ownership rates recorded, which were already very high by international standards at the outset of the deregulation of the mortgage lending market and have since increased further. Indeed, among euro area countries, based on the most recent figures available, only Spain had a higher home ownership rate than Greece (see Figure 6).

During the decade from 1995 to 2005, housing prices have grown at double digit annual rates for most of the period, with the notable exception of 2002-2004 when weak housing market dynamics were observed. In any case, the average annual growth rate of housing prices throughout the decade was 11% and typically exceeded that of household disposable income (see Figure 7). This suggests that during this period housing became, almost continuously, less affordable for households. Moreover, rents did not keep up with the growth rates recorded by housing prices. This is evident in the upward trend of the P/E ratio for the housing market (the ratio of house prices to rents, see Figure 8), which has only recently levelled off.

[9] Examples of such innovative mortgage loan products include "accordion" loans (loans where the duration is adjusted so as to maintain a constant monthly repayment in the face of interest rate changes), grace period loans, loans with capped interest rates, etc.

Turning to the supply side of the housing market, residential investment was robust throughout the 1995-2005 period (see Figure 9).[10] This pattern is confirmed by the evolution of private construction activity, in terms of building permits issued, which, despite the soft patch observed in 1999,[11] has followed a clear upward trend. As regards construction costs, although they increased throughout the 1995-2005 period, they cannot account for the observed trend in real housing prices, as they moved very closely with the consumer price index. Indeed, for most of the period, the annual growth rates of the construction cost index were lower than inflation (see Figure 10).

Finally, developments in the housing market also reflect fiscal factors, since changes in the taxation framework relating to the acquisition and ownership of property directly affect the market, usually by inducing a transitory surge in demand, as in most cases these measures are announced well ahead of their proposed implementation date. Notably, such cases include the changes introduced to the income tax deductibility of mortgage interest payments in January 2003, the levying of Value Added Tax on new buildings from January 2006 and the increases in the "objective" property values determined by the authorities for tax purposes, in March 2001 and January 2006.

3. Factors affecting the market for housing loans

In this section we set out the variables that we will consider for our empirical analysis, which follows in Section 4.[12] This choice will be guided by three considerations: the relevance of the variables in question from a theoretical and empirical perspective, the availability of data and the need for a parsimonious

[10] With the exception of the year 2000, which was possibly related to the aftermath of the bust in the stock prices listed on the Athens Exchange, following the peak observed in 1999. On the interaction between stock price and housing price developments in Greece, see Georgakopoulos *et al.* (2005) and Kapopoulos and Siokis (2005).

[11] The building permits series appears to lead residential investment significantly, since there is often a considerable lag between obtaining the building permit and actually incurring the building costs.

[12] In our empirical analysis we also considered variables that were thought to be relevant for the housing market (e.g. construction costs, measures of construction activity). However, we were not able to establish the existence of a second cointegration relationship, capturing the long-run equilibrium of the housing market. These variables were also considered in the short-run analysis, again without yielding significant results. Hence, these variables are not discussed in this section.

specification imposed by the relatively small size of the available sample, which will be discussed in the next section.

In principle, economic agents use credit in order to smooth their spending over their lifetime, based on the income they expect to earn throughout their life, or permanent income. Hence, under a frictionless setup, the amount of debt that agents assume should depend on their permanent income. However, as Gimeno and Martínez-Carrascal (2006) note, the existence of financial frictions suggests that in more realistic setups the determinant of credit is current rather than permanent income, as the latter is not observable and verifiable by the lender. Moreover, economic activity may also affect credit from the supply side. In the presence of informational asymmetries, Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) show that borrowing is constrained by the amount of collateral that borrowers can offer, which is determined by their net worth. Since net worth is procyclical, i.e. it is a positive function of real output, lenders' willingness to provide credit increases when activity is buoyant and is limited during economic downturns. Empirically, the relationship between credit and current economic activity is well founded. Hofmann (2001) documents that in 16 industrialised countries the annual rate of change in real credit is closely related to that of real GDP. Indeed, it is common practice in the empirical literature to use some measure of current aggregate economic activity as a determinant of credit, in general (see for example, Fase, 1995; Calza, Gartner and Sousa., 2003; Calza, Manrique and Sousa, 2003; Davis and Zhu, 2004; Hoffman, 2004; Gerlach and Peng, 2005) and mortgage credit in particular (see for example, Fitzpatrick and McQuinn, 2004; Gimeno and Martínez-Carrascal, 2006).

The cost of borrowing, i.e. the interest rate, is expected to have a negative relationship with credit, since when interest rates rise, credit becomes more costly and the demand for borrowing falls. The bank lending channel literature (see, for example, Bernanke and Blinder, 1988) suggests that interest rates, being the monetary policy instrument, can also affect the supply of credit, hence reinforcing the theoretical prediction for a negative relationship between credit and interest rates. Although this relationship is confirmed empirically, there is no consensus among researchers as to which is the appropriate interest rate to be used. While Calza, Gartner and Sousa (2003) use both a short and a long-term real rate, implying that the term structure is important, Davis and Zhu (2004) and Hofmann (2001) use a real short-term rate.

Gimeno and Martínez-Carrascal (2006) argue that, due to credit market imperfections, nominal rather than real rates should be used when modelling the borrowing of the household sector. Calza, Manrique and Sousa (2003) also use a nominal measure of the cost of loans, calculated as a weighted average of bank lending rates, when modelling loans to the private sector in the euro area. Since housing loan rates are predominately variable in Greece, we will follow the approach of Fitzpatrick and McQuinn (2004) who use a real variable mortgage interest rate.

Given the aim of our empirical analysis, an obvious variable to include is property prices. As outlined in Section 1, property prices can positively affect credit through wealth and financial accelerator effects, while the increased availability of credit can boost the demand for property and, since supply reacts in a more sluggish manner, can lead to increased property prices.

4. Empirical analysis

Based on the discussion presented in the previous section, we arrive at the following choice of variables for our econometric investigation: housing loans (*l*), GDP (*y*), variable mortgage interest rate (*r*) and residential property prices (*hp*).[13] All variables are included in real terms, having been deflated using the CPI except *y*, where the series' own deflator was used. Moreover, all variables, except *r*, have been seasonally adjusted and are expressed in logs. Our data are quarterly and cover the period from 1993:Q4 to 2005:Q2. The relatively small size of our sample is due to the limited availability of the *hp* series.[14]

Our econometric approach involves estimating a VECM. This model deals with the possible simultaneity problem between housing loans and housing prices, which is the crucial feature of our analysis. Moreover, it has the attractive property that it allows the modelling of the long-run and short-run relationships in a unified empirical framework.

As a preliminary step, we perform standard unit root tests (Augmented Dickey-Fuller tests, see Dickey and Fuller, 1981) to determine the order of integration of the series. The results suggest that all variables are integrated of order one. We then

[13] Further information regarding the series used, including their sources, is provided in the Appendix.
[14] For this series, data prior to 1993:Q4 and after 2005:Q2 are not presently available.

proceed to determine the existence of cointegration relationships, using the testing approach suggested by Johansen (1988, 1991, 1995). However, in view of the limited size of the sample at our disposal, we follow the modelling strategy suggested by Pesaran *et al.* (2000) and Greenslade *et al.* (2002) and use a theoretical prior in order to impose a weak exogeneity restriction prior to testing for cointegration, thereby increasing our degrees of freedom and the power of the tests. More specifically, we treat *y* as weakly exogenous, based on the plausible assumption that economic activity is not determined, in the long run, by the level of mortgage lending.[15] Hence, the VECM that we will be estimating is of the following form (see Johansen, 1992 and Urbain, 1992) :

$$\Delta Y_t = \alpha\beta' X_{t-1} + \sum \Gamma_j \Delta X_{t-j} + \Psi \Delta Z_t + \delta D_t + \varepsilon_t \qquad (1)$$

where X is the vector of cointegrating variables (l, y, hp, r), Y is the vector of variables included in X the dynamic properties of which interest us (l, hp, r), Z is the vector of weakly exogenous variables in X (y), D is the vector of deterministic variables affecting the short-run dynamics (we include four dummy variables to account for the effect of one-off changes in the tax framework affecting home ownership such as those discussed in Section 2) and α and β are the matrices[16] of loading factors and long-run coefficients, respectively. We also include in the cointegration vector a constant as well as a time trend, envisaged to capture the gradual effect of deregulation and innovation affecting the mortgage lending market in Greece.

To implement the Johansen testing procedure, we estimate the unrestricted VAR in levels that corresponds to (1). The lag length implied by standard information criteria (Akaike and Schwartz) is four. The estimated fourth-order VAR passes the standard diagnostic tests for normality, heteroscedasticity, third-order autoregressive conditional heteroscedasticity and third-order autocorrelation.[17] The results of the

[15] We revisit this assumption and test it statistically using the conditional model, i.e. the model where the existence of one cointegration vector is imposed. The assumption is clearly not rejected (*p*-value of 0.765).

[16] In the case of only one cointegration relationship, α and β are in fact a column and a row vector, respectively.

[17] Although the individual equations easily pass the tests for autocorrelation, the VAR fails the vector autocorrelation test. This conflicting result may be due to the overparameterisation of the vector test,

trace and the maximum eigenvalue tests are reported in Table 1, using the small sample correction, which is called for given the size of our sample. The tests clearly indicate the existence of one cointegration vector. This conclusion still holds when we use the critical values suggested by Pesaran *et al.* (2000), which are appropriate given that we have treated *y*, an I(1) variable, as weakly exogenous. Recursive estimation of the system's eigenvalue indicates that the finding of one cointegration relationship is robust (see Figure 11).

Long-run analysis

Having established the existence of one cointegration relationship among the variables, we proceed in estimating the VECM (1), conditional on this. Identification of the cointegration relationship can be obtained simply by imposing a normalisation restriction. The signs of the long-run coefficients indicate that this is a mortgage loan demand equation, hence we normalise on the *l* variable. This is consistent with the approach usually followed in the empirical literature when modelling credit aggregates, where it is assumed that they are mainly demand driven (see, for example, Bernanke and Blinder, 1988; Hofmann, 2001; Calza, Gartner and Sousa, 2003). The estimation results for the exactly identified system are reported in Table 2. Panel A of the table shows the long-run coefficients while panel B reports the loading factors.

The long-run coefficients reported in Table 2 are all statistically significant (except for the coefficient corresponding to the constant term) and carry the expected signs. More specifically, housing prices are positively related to housing loans with an elasticity of 0.23, which is on the low side of the respective elasticities estimated by Fitzpatrick and McQuinn (2004) for Ireland (0.50 to 0.52) and Gimeno and Martínez-Carrascal (2006) for Spain (0.78).[18] This elasticity is also low compared to results from estimations focusing on total, rather than housing lending, which in principle should be less responsive to changes in property prices than mortgage lending. For example, the elasticity reported by Gerlach and Peng (2005) for Hong Kong is 0.36, while the elasticities estimated by Hofmann (2001) for most of the countries in his

which results in low power of the test, given the small size of our sample. Under small sample sizes Jacobson *et al.* (2001) show that the asymptotic reference values used for such specification tests are poor approximations to the actual small sample distributions that would be required to draw reliable conclusions.

[18] The estimated elasticities are not strictly comparable to the those reported in Gimeno and Martínez-Carrascal (2006), as the latter use the credit aggregate in per household terms.

sample are also larger.[19] The estimated interest rate semi-elasticity carries the expected negative sign, although again its size (0.039) is smaller than the semi-elasticity for Spain reported by Gimeno and Martínez-Carrascal (2006), who nevertheless use nominal interest rates. Conversely, Fitzpatrick and McQuinn (2004) who also use real interest rates come up with a lower coefficient on the interest rate for Ireland (0.007 to 0.009). The income elasticity we estimate is 0.997 which is in line with the findings of Fitzpatrick and McQuinn (2004), Gerlach and Peng (2005) and Gimeno and Martínez-Carrascal (2006). The restriction of a unitary elasticity of income is easily accepted (*p*-value of 0.992). Overall, the estimated coefficients appear to be stable, as evidenced by Figure 12, which presents the recursively estimated long-run coefficients.

The loading factor for housing loans (-0.315) is both statistically and economically significant, implying relatively fast adjustment of mortgage loans to disequilibria. The loading factor for housing prices, however, is insignificant, which suggests that housing prices are weakly exogenous. The implication of this result is that disequilibria in the market for housing loans do not appear to lead to adjustment in housing prices, suggesting that, in the long run, the direction of causality does not run from housing loans to housing prices. Finally, the loading factor for the interest rate variable is also not statistically significant, hence the interest rate is also weakly exogenous.

Short-run analysis

To complete the investigation of the interaction between housing loans and housing prices we turn to short-run analysis and estimate dynamic relationships for each of these variables. In both cases we start with a general specification and, following the general-to-specific approach, arrive at a parsimonious model. At each step of the process we gradually eliminate insignificant variables, starting with the most insignificant ones, while ensuring that the corresponding tests for model reduction are passed. An issue that needs to be addressed when estimating these dynamic relationships is the possibility of simultaneity bias since, from a theoretical perspective, housing prices could be endogenous in the housing loans equation and vice versa. In view of this and in order to examine the consistency of our OLS

[19] With the exception of Canada (0.23) and Spain (0.04 but not significant). Hofmann also reports a negative coefficient for property prices in the case of Germany.

estimates, we conduct Hausman tests. In both cases the residuals of the auxiliary equation are not significant, indicating that the null hypothesis of consistent OLS estimates cannot be rejected.

In the general specification of the dynamic equation for housing loans we include four lags of the dependent variable (Δl), current values and four lags of the first differences in housing prices (Δhp), GDP (Δy) and the interest rate (Δr) as well as an error correction term (CI) and a constant:

$$\Delta l_t = b_0 + \sum_{i=1}^{4} b_{l,i} \Delta l_{t-i} + \sum_{i=0}^{4} b_{hp,i} \Delta hp_{t-i} + \sum_{i=0}^{4} b_{y,i} \Delta y_{t-i} + \sum_{i=0}^{4} b_{r,i} \Delta r_{t-i} + b_{CI} CI_{t-1} + \varepsilon_{l,t} \qquad (2)$$

The parsimonious specification we arrive at includes, *inter alia*, the current difference in housing prices as well as the fourth-lag of the same variable, with oppositely signed and approximately equal coefficients.[20] The implied restriction that the coefficients add to zero is easily accepted, hence we impose it by replacing the two variables with their difference, which can be interpreted as the annual growth rate in housing prices, and re-estimate the dynamic equation, obtaining the results reported in Table 3. The parsimonious model passes the standard specification tests for autocorrelation, autoregressive conditional heteroscedasticity, normality, heteroscedasticity and stability. The results indicate that there is a contemporaneous effect of housing prices on housing loans but only to the extent that an acceleration or deceleration of the annual growth rate of housing prices is observed. In line with the results of the long-run analysis, we obtain a significant negative coefficient for the cointegration vector, which confirms that housing loans adjust to disequilibria in the mortgage lending market.

For the estimation of the dynamic relationship relating to housing prices, we start from a general specification that also includes four lags of the dependent variable (Δhp), current values and four lags of the first differences in housing loans (Δl), GDP (Δy) and the interest rate (Δr) as well as an error correction term (CI) and a constant:

[20] The estimation results at this stage are not reported for brevity.

$$\Delta hp_t = c_0 + \sum_{i=1}^{4} c_{hp,i} \Delta hp_{t-i} + \sum_{i=0}^{4} c_{l,i} \Delta l_{t-i} + \sum_{i=0}^{4} c_{y,i} \Delta y_{t-i} + \sum_{i=0}^{4} c_{r,i} \Delta r_{t-i} + c_{CI} CI_{t-1} + \varepsilon_{hp,t} \quad (3)$$

The estimation results for the parsimonious model are reported in Table 3, along with the results of the standard diagnostic tests. The results point to a significant positive contemporaneous effect of housing loans on housing prices. Consistently with the long-run analysis, the cointegration vector does not appear in the parsimonious specification for housing prices, confirming that property prices do not adjust to disequilibria in the mortgage lending market. Overall, the resulting specification is quite parsimonious, however our experiments with additional variables that are expected to affect housing price dynamics, such as construction costs and the level of construction activity, failed to improve the results.

5. Conclusion

The aim of this paper has been to analyse the interaction between housing loans and housing prices in Greece. In order to address this question empirically, we employed multivariate cointegration techniques. The results of our long-run analysis indicate that housing prices are weakly exogenous, hence they do not react to disequilibria in the mortgage lending market. This suggests that in the long run a line of causality running from housing loans to housing prices is not confirmed. Our short-run analysis, however, provides clear indications of a contemporaneous bi-directional dependence among housing loans and housing prices.

The absence of long-run causation running from housing loans to housing prices implies that other factors need to be examined in order to account for the developments in residential property valuations during the recent period in Greece. Among these factors, the improvement in household expectations regarding their future income, related to some extent to the fact that Greece was admitted into the euro area, is a very plausible one. Moreover, the reduction in interest rates, also partly related to the process of joining EMU, led to higher present values of future income flows stemming from real estate assets, thereby increasing housing prices. Demographic factors are also likely to have been important in this respect, particularly as regards the influx and gradual integration of immigrants during this period as well

as the reduction in the size of households, as single-person households have become more common. Finally, the low or negative real returns offered by most financial assets during this period indicate that the acquisition of residential property may have also served increasingly as an outlet for household savings.

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Table 1: Tests for cointegration

rank	*Trace test*		*λ Max test*		*Trace test - small sample correction*		*λ Max test - small sample correction*	
0	78.06	(0.000)**	50.89	(0.000)**	56.28	(0.001)**	36.69	(0.001)**
1	**27.17**	**(0.032)***	**17.04**	**(0.106)**	**19.59**	**(0.252)**	**12.29**	**(0.401)**
2	10.13	(0.123)	10.13	(0.123)	7.3	(0.323)	7.3	(0.324)

Notes: *p*-values are provided in parentheses, ** denotes rejection of the null (rank=0, 1, 2 respectively) at the 1% level, * denotes rejection of the null at the 5% level.

Table 2: Estimation results for the exactly identified system

Panel A: Long-run coefficients

	l	*hp*	*r*	*y*	constant	trend
β	1	**-0.230**	**0.039**	**-0.997**	2.321	**-0.034**
s.e.		0.104	0.005	0.399	3.847	0.004

Panel B: Loading factors

	l	*hp*	*r*
α	**-0.315**	0.044	-6.645
s.e.	0.063	0.093	4.028

Table 3: Estimation results for the short-run dynamics

Panel A: Estimated coefficients

	Δl_t		Δhp_t	
constant	0.019 **	(0.003)	-	-
$\Delta hp_t - \Delta hp_{t-4}$	0.156 *	(0.060)	-	-
EC_{t-1}	0.196 **	(0.018)	-	-
Δl_t	-	-	0.316 **	(0.045)
R^2	75.4%		53.7%	

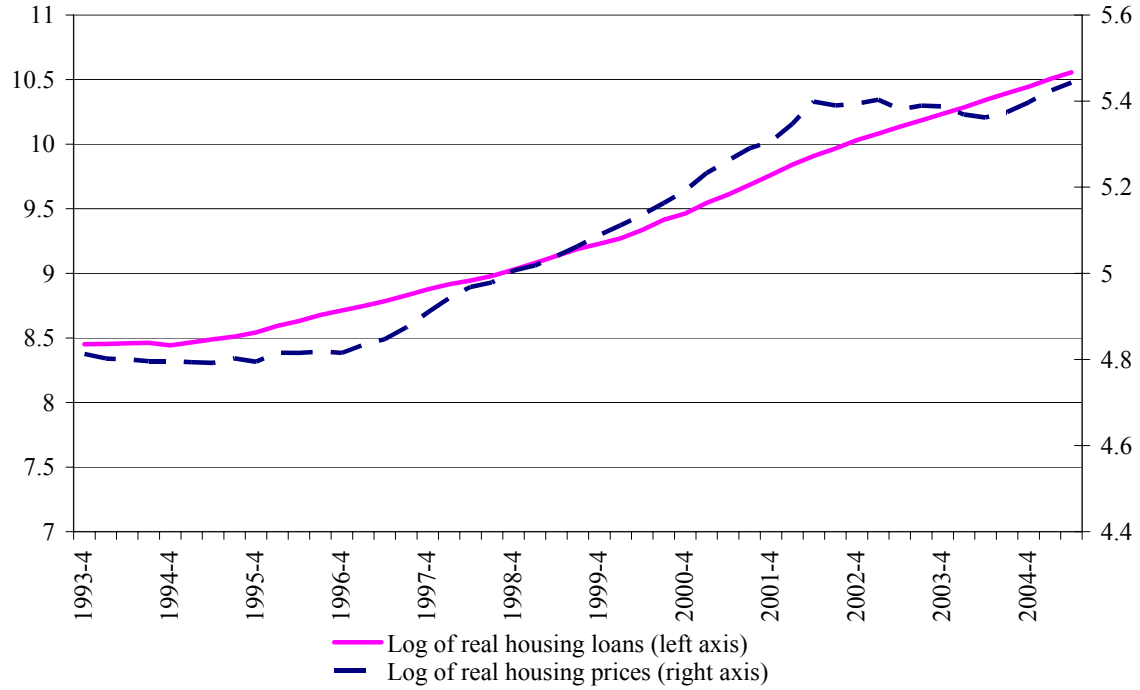
Notes: heteroscedasticity robust standard errors are provided in parentheses, ** denotes significance at the 1% level, * denotes significance at the 5% level.

Panel B: Diagnostic tests

	Δl_t		Δhp_t	
Autocorrelation 1-3 test	0.50613	(0.6805)	3.7705	(0.0183) *
ARCH 1-3 test	0.34468	(0.7932)	1.7520	(0.1744)
Normality test	2.8953	(0.2351)	2.3946	(0.3020)
Heteroscedasticity test	0.84426	(0.5070)	0.84413	(0.4378)

Notes: *p*-values are provided in parentheses, ** denotes rejection of the null (Normality, absence of autocorrelation, ARCH and heteroscedasticity) at the 1% level, * denotes rejection of the null at the 5% level.

Figure 1: The evolution of real housing loans and real housing prices in Greece

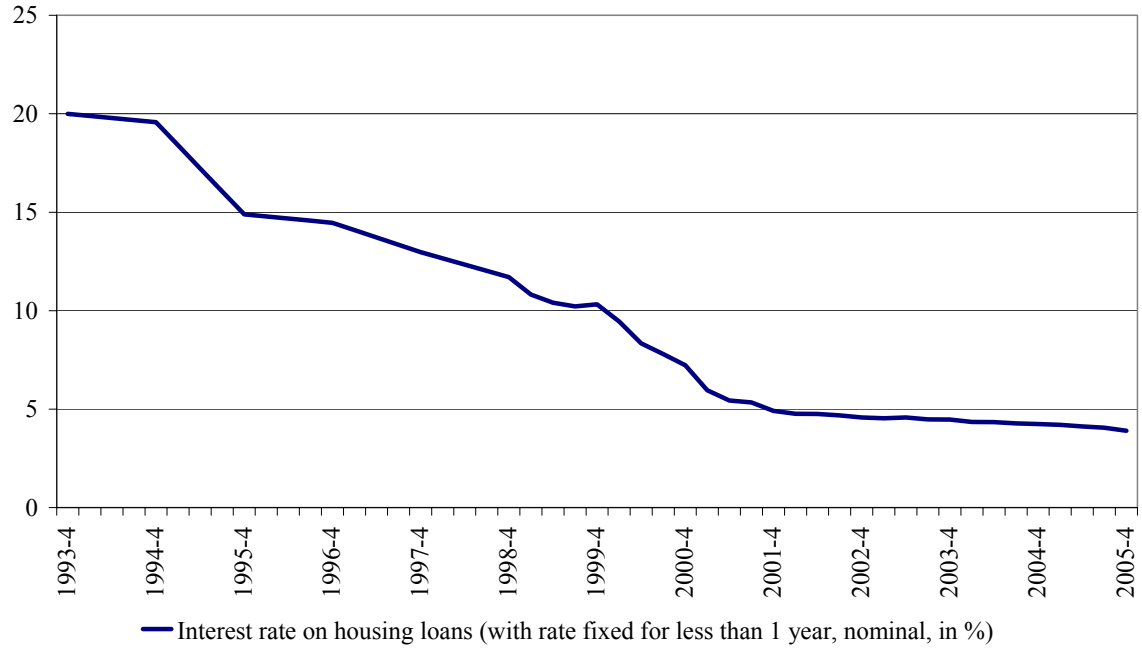


Source: Bank of Greece.

Figure 2: Annual growth rates of housing loans (in nominal terms)

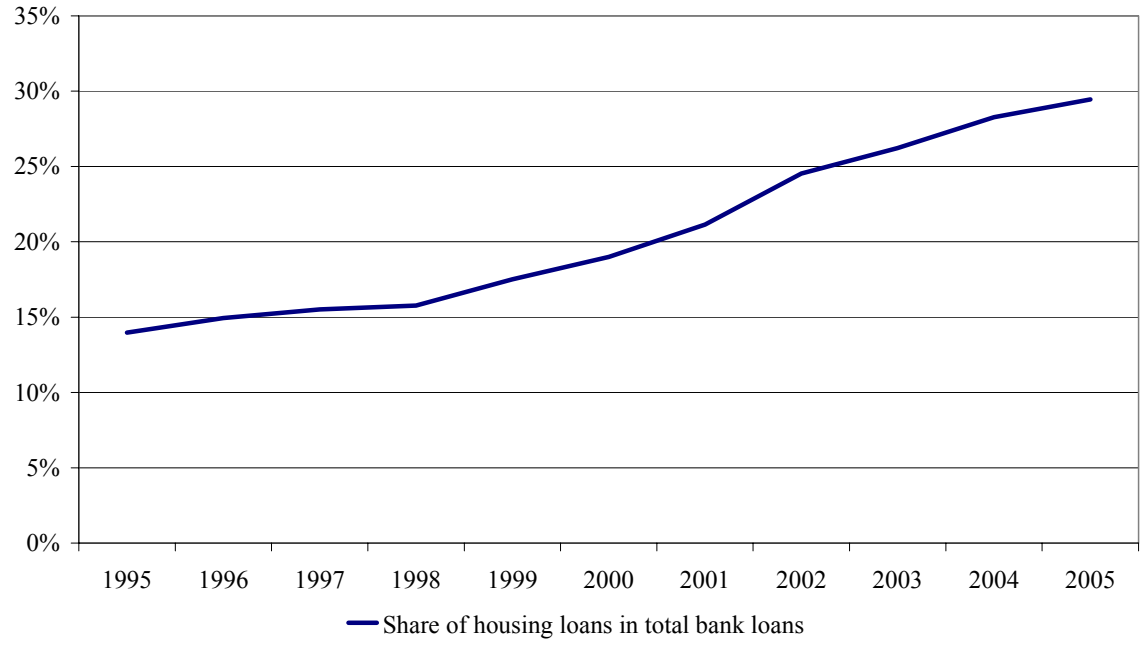
Sources: Bank of Greece and ECB.

Figure 3: Interest rate on housing loans in Greece



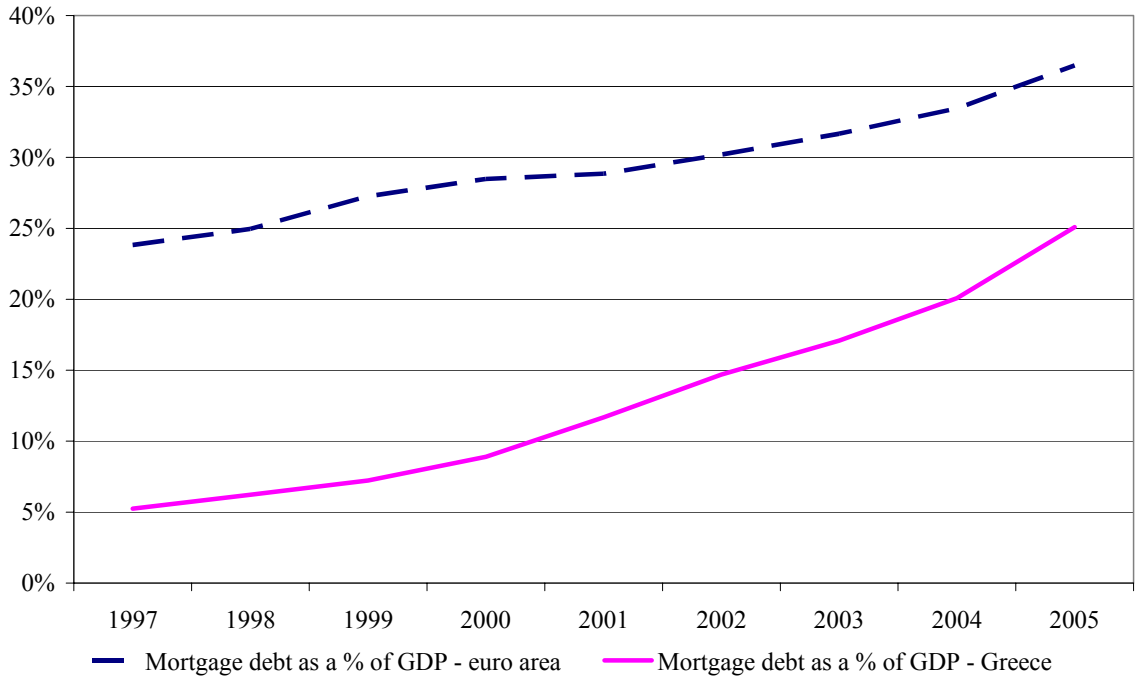
Sources: Bank of Greece and Georgakopoulos *et al.* (2005).

Figure 4: The importance of housing loans in bank portfolios in Greece



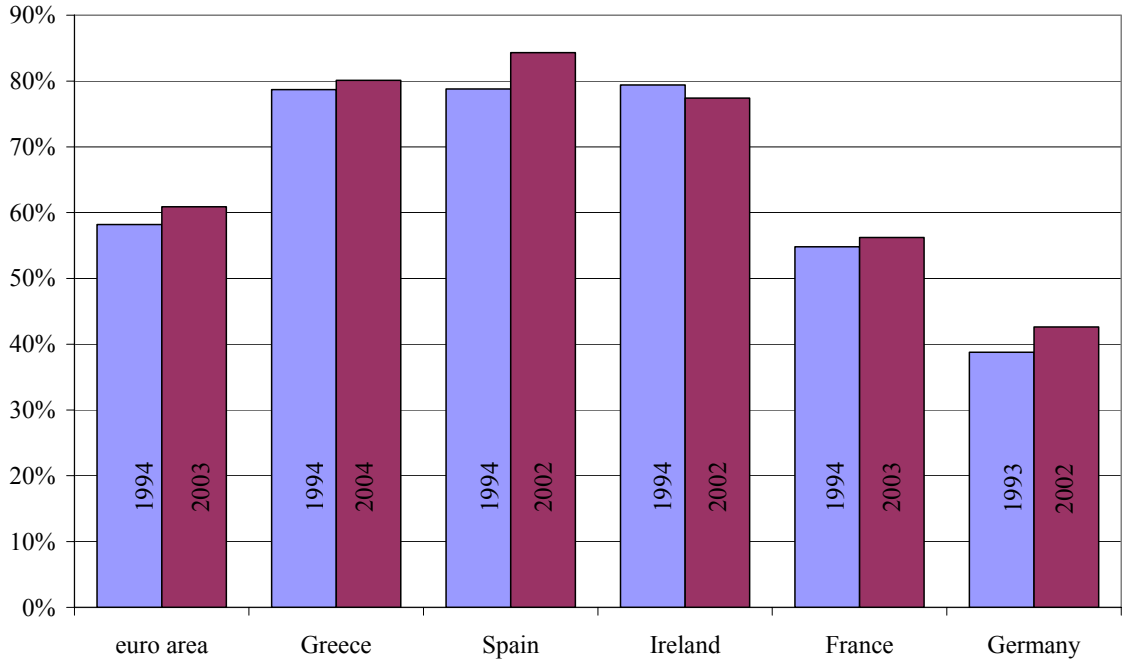
Source: Bank of Greece.

Figure 5: Mortgage indebtedness



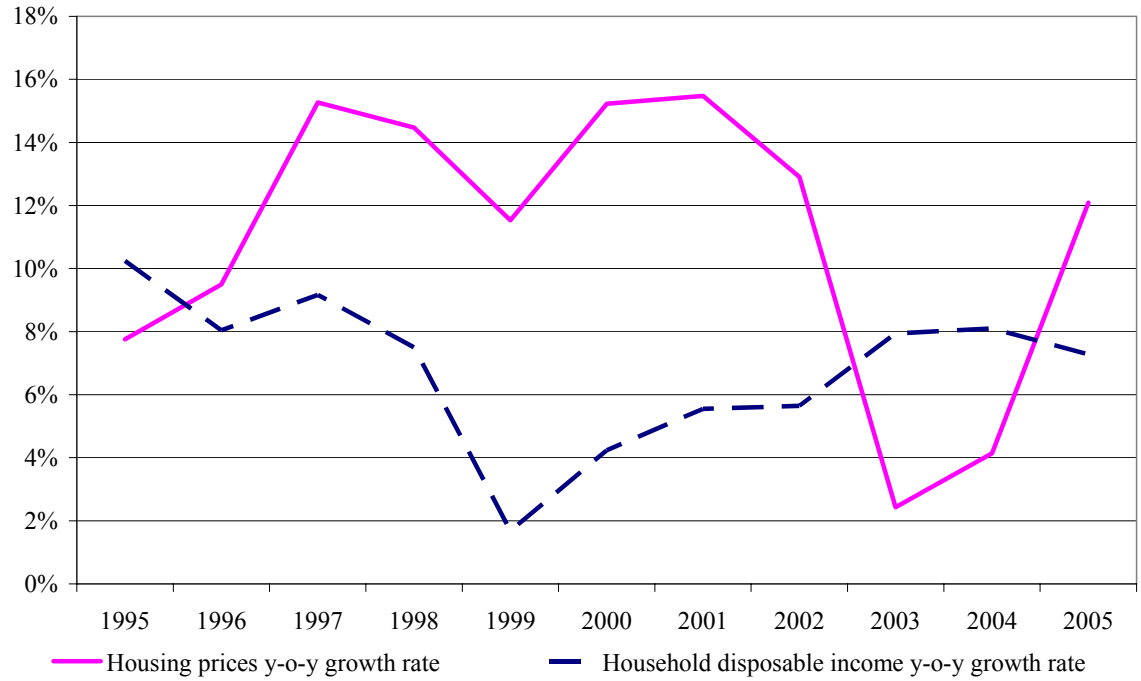
Sources: Bank of Greece, ECB and Eurostat.

Figure 6: Share of owner-occupied accommodation in selected euro area countries



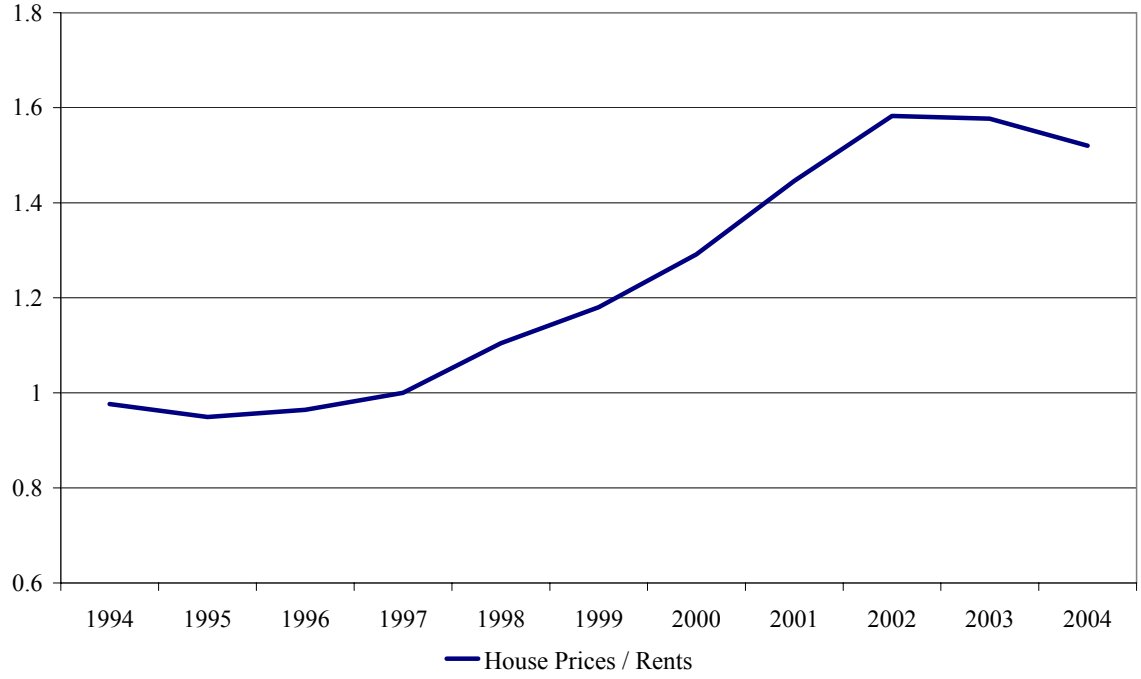
Sources: ECB and National Central Banks of the respective countries.

Figure 7: Annual growth rates of housing prices and household disposable income in Greece (in nominal terms)



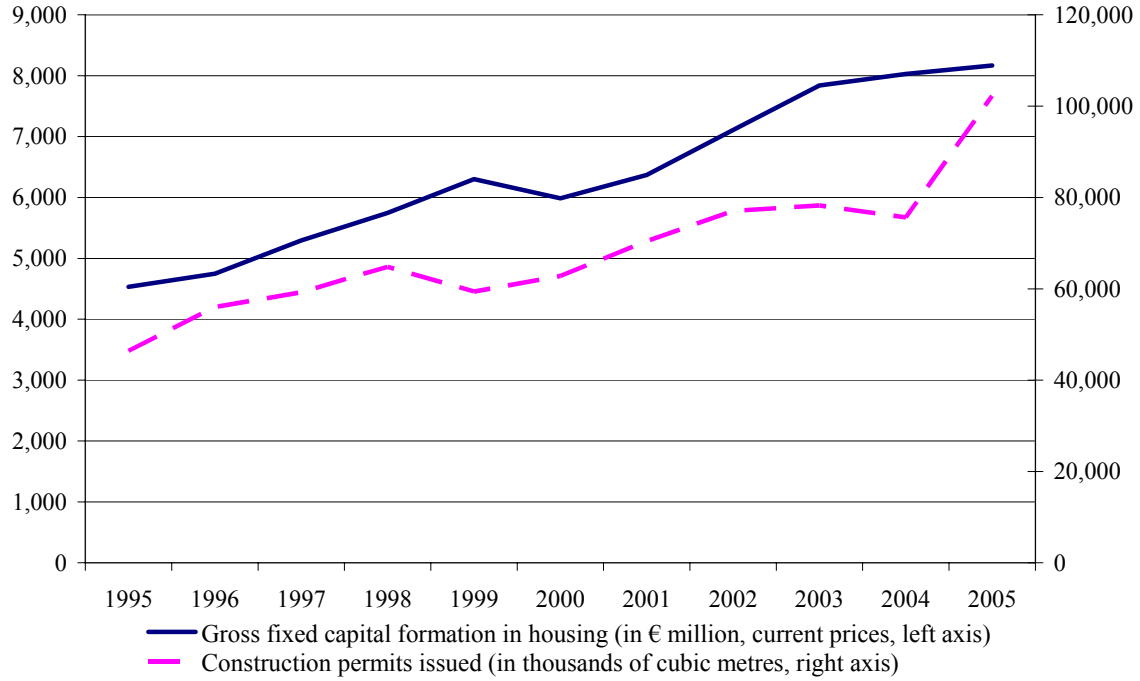
Sources: Bank of Greece and National Statistical Service of Greece.

Figure 8: Housing market P/E ratio in Greece



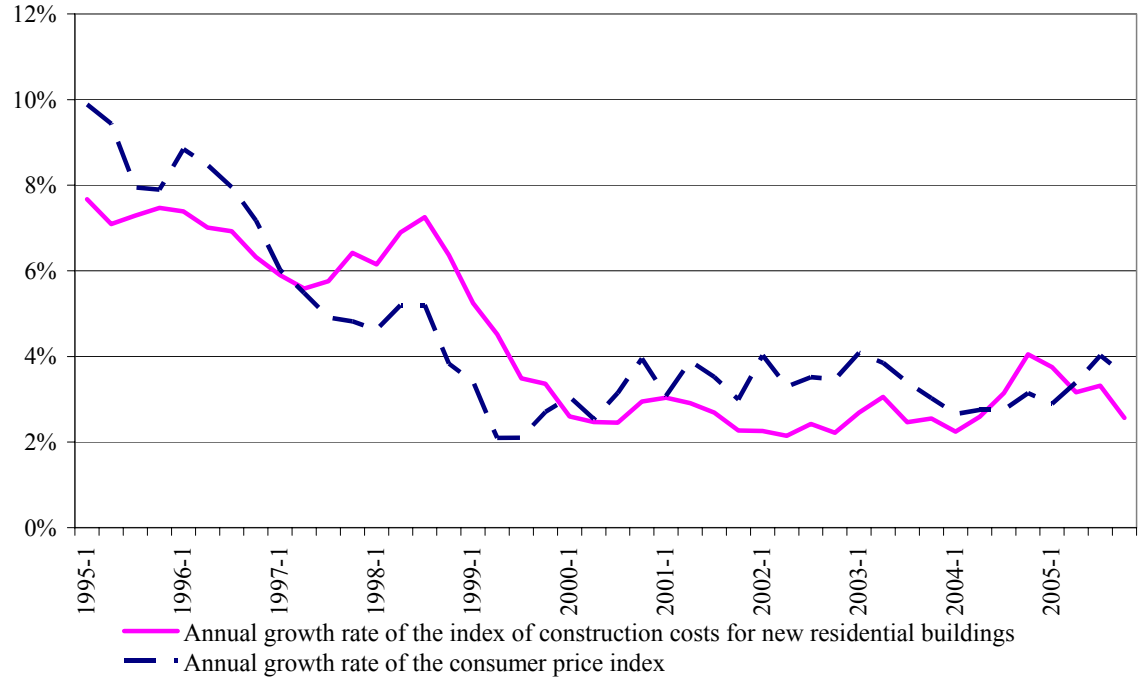
Sources: Bank of Greece, National Statistical Service of Greece and authors' calculations.

Figure 9: Residential investment and private construction activity in Greece



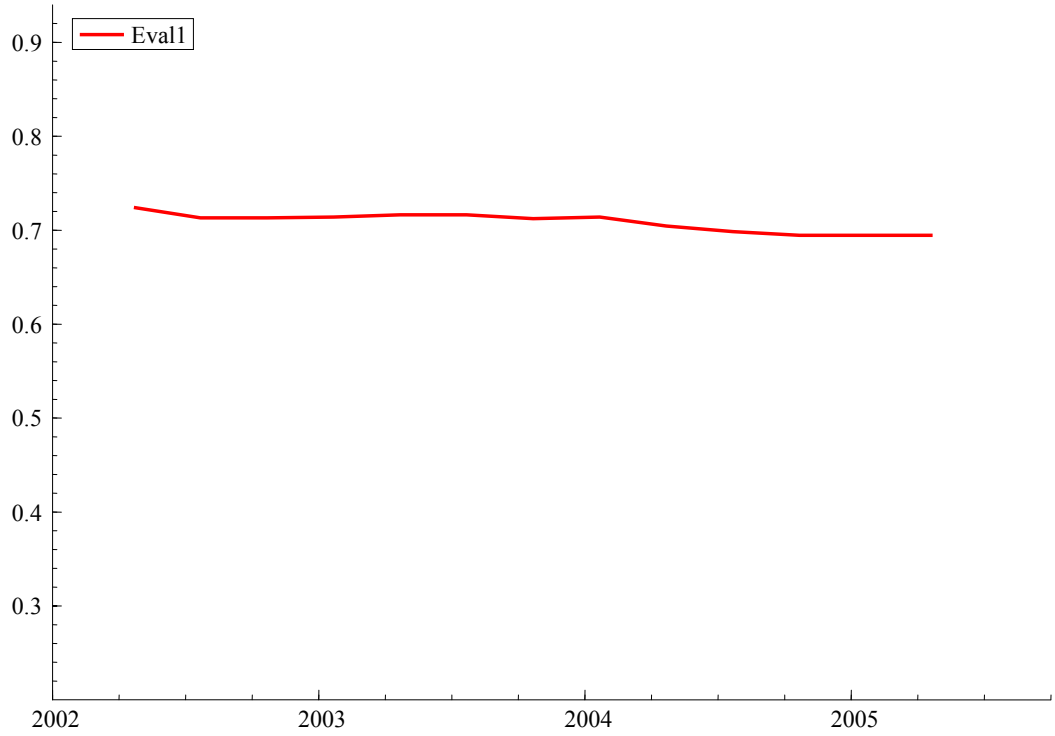
Sources: Eurostat and National Statistical Service of Greece.

Figure 10: Construction costs in Greece



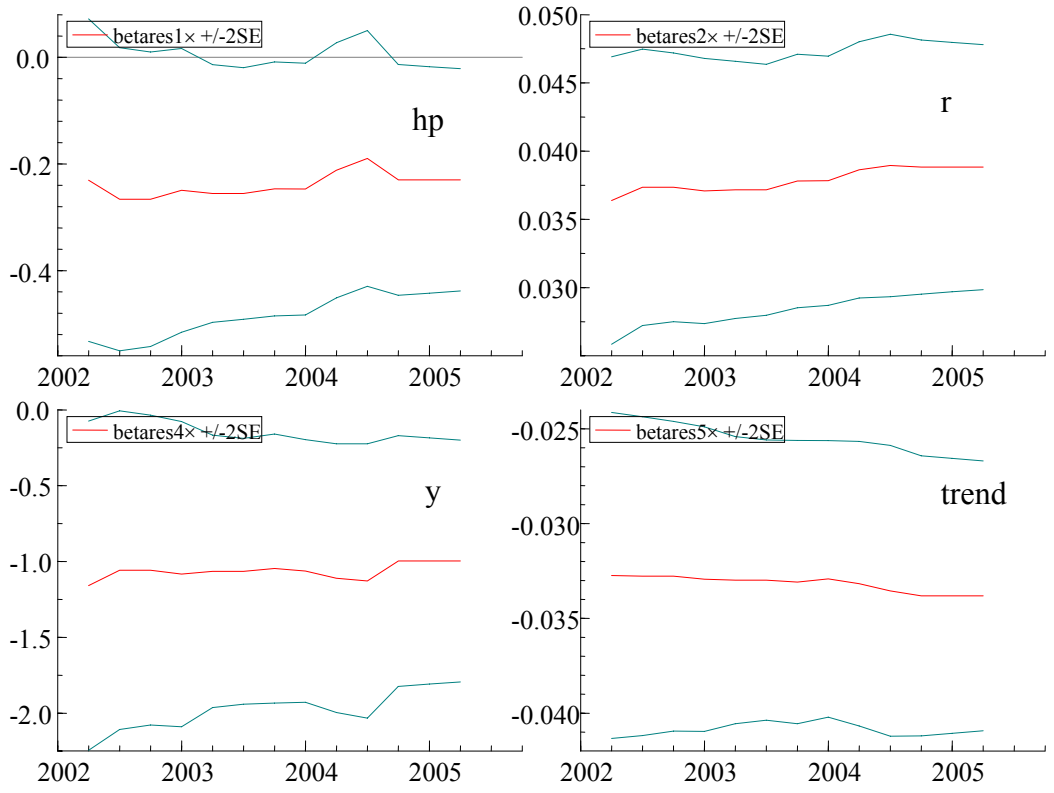
Source: National Statistical Service of Greece.

Figure 11: Recursive estimation of the maximum eigenvalue



Source: Authors' calculations.

Figure 12: Recursive estimation of the long-run coefficients



Source: Authors' calculations.

***Appendix*: Data used for the empirical analysis**

***l*:** *Housing loans*, including securitised loans. Seasonally adjusted using the X12 ARIMA module of the OxMetrics econometrics suite. Deflated using the CPI and expressed in logs. Source: Bank of Greece.

***hp*:** *Housing prices*. Weighted index of housing prices in Greek urban areas, defined as cities with population over 500,000 (Athens and Salonika). Seasonally adjusted using the X12 ARIMA module of the OxMetrics econometrics suite. Deflated using the CPI and expressed in logs. Source: Bank of Greece.

***y*:** *real GDP*. Seasonally adjusted using the X12 ARIMA module of the OxMetrics econometrics suite. Expressed in logs. Source: National Statistical Service of Greece.

***r*:** *interest rate on housing loans with variable rate or rate fixed for a period of less than one year*. Expressed in real terms by subtracting from the nominal rate the annual growth rate of the CPI. Source: Georgakopoulos *et al.*, 2005 (1993:Q4 – 1998:Q4) and Bank of Greece (1999:Q1 – 2005:Q2).

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