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Econometric Approaches for Housing Price Evaluation Approches économétriques pour l'évaluation des prix de l'immobilier

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Résumé

Dans la plupart des marchés immobiliers mondiaux, des variations rapides des prix des biens immobiliers, tant à la hausse qu'à la baisse, ont été observées. Ces fluctuations peuvent être attribuées à des changements dans les facteurs économiques, sociaux et financiers qui influencent le marché des prix de l'immobilier. L'objectif de cette étude était de déterminer comment les prix de l'immobilier évoluent sous l'influence des facteurs macroéconomiques et financiers.

Cette étude estime l'impact des changements dans les déterminants macroéconomiques et financiers sur le marché des prix de l'immobilier à long terme, ainsi que l'ajustement à court terme des prix réels de l'immobilier vers l'équilibre, à la lumière de six hypothèses de modèle. Afin d'évaluer empiriquement cette relation, un estimateur Pooled Mean Group développé par Pesaran et Smith (1995) et Pesaran et al. (1999), ainsi qu'un effet fixe dynamique (DFE) des données de panel hétérogènes dynamiques, ont été appliqués à six pays, à savoir les États-Unis, la Grèce, l'Espagne, les Émirats Arabes Unis, la Malaisie et le Maroc, sur la période de 2010 à 2023.

Notre hypothèse de modèle propose différents scénarios pour les principaux facteurs influençant les prix de l'immobilier à long terme et à court terme, en analysant la relation entre les prix réels des logements, les fondamentaux économiques et les déterminants spécifiques aux banques dans les six pays au cours de la période d'échantillonnage.

Mots-clés :

Prix de l'immobilier ; Estimateur de Moyenne Groupée Pooled ; Effet Fixe Dynamique.

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Abstract

In most worldwide real estate markets, rapid changes in property prices, both upward and downward, were observed. Those fluctuations can be attributed to changes in economic, social, and financial factors that affect the housing price market. The aim of this study was to determine how housing prices are changing under the influence of macroeconomic and financial factors.

This study estimates the impact of changes in the macroeconomic and financial determinants effect on the housing price market in the long-term as well as the short-run adjustment of real house prices back to the equilibrium in light of 6 model hypotheses. In order to assess this relationship empirically, a Pooled Mean Group estimator developed by Pesaran and Smith (1995) and Pesaran et al. (1999), and a dynamic fixed effect (DFE) of dynamic heterogeneous panel data are applied on six countries, namely USA, Greece, Spain, UAE, Malaysia, Morocco was used over the period of 2010-2023.

Our model hypothesis proposes different scenarios for the most housing price influencers in the long-run and short-run relationship over the sample period between real house prices, economic fundamentals, and bank specific determinants in the six countries.

Keywords:

House Price; Pooled Mean-Group Estimator; Dynamic Fixed Effect.

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Introduction

The fulfilment of housing needs is one of the fundamental human desires. According to Maslov's hierarchy of needs, housing satisfies the basic physical requirements for safety and survival. Housing fulfills a broad spectrum of needs, which implies that the property market, where housing resources are transferred, affects the behavior of individuals as well as the entire society.

The property market is connected to the financial institutions and macroeconomic environment by a system of communicating vessels. Stagnation in one of the segments and lack of communication between the sectors have a negative impact on the sustainability of the system Forys´, A. Li, S.(2009). As a recipient of signals generated in the financial institutions and macroeconomic factors, the property market also generates signals that affect the environment which leads to mutual feedback. Hence, the property price market, financial institutions and macroeconomic environment respond strongly to changes in those signals.

For Owusu, M.D. and Badu, E. (2009), the relationship between house prices, financial institutions, and key macroeconomic variables is of great concern to policymakers, banks, and researchers, especially after the meltdown of the U.S. housing market which started around 2006 and the subsequent global financial crisis. In this context, there are two main streams of literature. One stream argues that the subprime bubble affected the housing market and that changes in house prices reflect movements in financial institutions such as mortgage investment, non-performing loans, mortgage rate and macro fundamentals, such as real estate sector transparency, GDP, PD, etc. For instance, Leung,S. Mirosław,j. Radosław,C. (2014) builds a dynamic stochastic general equilibrium model to justify that house prices and mortgage are co-integrated. Bardahan, A. Edelstein, R. Leung, C.À(2004) found that house prices were closely aligned with macroeconomic fundamentals before 2008 when the mortgage markets crashed. Nneji, B.Meidani, A. Zabihi, M. Ashena, M (2011) investigated whether intrinsic bubbles and rational speculative bubbles resulted in deviations in U.S. house prices from economic fundamentals during 1960–2011.

Holly, C. Hevert, K. Mclaughlin, R. (2010) studied the determinants of real house prices in a panel of 49 U.S. states from 1976 to 2007 and concluded that the rising real house prices were in line with real income. Other influential studies included Frappa, S. Mesonnier, J. (2010), Murialdo, F.(2013), and (Smith, 2006). Empirical studies on the impact of macroeconomic variables on house prices with the use of international data are also rich Stepanyan, V. (2010) ; Huiran Pan, (2009) ; Engle, R. and Granger, C. (1987).

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For Mishkin, F. Schmidt-Hebbel, K.(2001) found no evidence of a long-run relationship between house prices and macro-fundamentals, which implies that house prices are not in line with fundamentals, and thus, housing bubbles may exist.

Baltagi,B. Badi,H. (1995) defines a house price bubble as a situation in which house price growth is not supported by changes in its fundamentals. For instance, Nickell, S. (1981) suggests a disequilibrium existed between house prices and per capita income during 2003–2007 in the U.S. Park, B.U.

Mammen, E.; Lee, Y.K.; Lee, E.R. (2015) found evidence of a U.S. housing bubble from 2000 to 2007 with a cointegration test. Ferguson, C.A. Bowman, A.W. Scott, E.M. Carvalho(2006) uses both U.S. national-level data and a panel of 95 U.S. cities and concludes that house prices and income are not cointegrated. Ferguson, C.A. Bowman, A.W. Scott, E.M. Carvalho, L. (2005) used aggregate U.S. data and found that changes in fundamentals do not explain the surge in U.S. house prices after 2000.

Our paper examines house price developments in a sample of six countries around the world (USA, Greece, Spain, Malaysia, UAE, Morocco) and estimates price determinants between 1998 to 2015. We estimate the deviation of house prices from their fundamentals. Our model employs other than macroeconomic factors, new explanatory variables related to financial institutions such us mortgage investment, non performing loans, mortgage rate ; which, in our opinion, has contributed to the house price booms in the majority of the countries included in our analysis. To validate the estimation, we use panel data analysis to estimate equilibrium prices of housing in our group of countries by using the long-run relationship between real house prices, financial institution, and macroeconomic fundamentals and the short-run adjustment of real house prices to the equilibrium in our sample.

What particularizes our work from previous empirical studies on the relationship between house prices, financial institutions, and macroeconomic fundamentals are the following : (1) our work use other than the previous researches, the financial institution factors especially the non performing loans which has rise dramatically in most of the sample countries after the subprime crisis. (2) our work applies the pooled mean-group (PMG) and dynamic fixed effect (DFE) estimation techniques to study both the long-run and the short- run behaviors of real house prices in different countries under 6 model hypothesis ; in particular, the deviations of real house prices from their fundamentals and the speed of adjustment of real house prices to financial institutions and macroeconomic disturbances. The PMG and DFE estimations are implemented in levels of data and allow for non-stationarity and cointegration across a panel of

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data well suited to capturing housing market characteristics, and (3) the study was to determine how housing prices are changing under the influence of macroeconomic factors banks specific determinants and measure the level of delays in these changes.

The paper is organized as follows : section II presents a literature overview on the subject ; section III describes data and methodology ; section IV presents estimation results ; and section V conclusion.

I. Literature Review

It is generally acknowledged that the price of real estate is highly complicated and is interrelated with a multitude of factors Li, W. and Shi, H. (2011). Various researchers have used a diverse set of factors for their analysis due to differing perceptions as to what should be emphasized most among the different factors affecting value. In the past researches, efforts have been made to identify variables affecting value of real property for specific case regions. Jin and Zeng (2003) developed a general equilibrium model that examines the relationship between the business cycle and residential investment and house prices. The study concludes that the monetary policy interest rate and the tax rate affects the price of real estate, but the price is strongly correlated with GDP. In their paper, Meidani, Zabihi and Ashena (2011) studies the relationship between existing housing prices, GDP, consumer price index (CPI) and exchange rate as the main variables in a model of endogenous. Test results have shown a significant correlation between the determinants. An international approach was used by Case, Goetzmann and Rouwenhorst (1999), considering that cycles of real estate markets are defined by major fluctuations of economic variables that are correlated across countries. Their study showed a relevant aspect, showing how GDP seems to be the factor that most affects the correlation between countries. The study also shows how the housing market is visibly affected by a mix of global and local economic factors. Relationship between the price of property and economic variables - notably GDP and CPI. It was also observed that the unexpected changes that occur in the price of property does not affect macroeconomic variables but the reverse situation can have a significant impact in real estate. Limsombunchai, Gan, C., Lee, M. (2004)

Another important characteristic of housing is that in many countries it is the most preferred form of collateral for bank loans. Rising house prices increase households' consumption power by making more goods and services available to them through the accelerator model. This implies potential risk for the quality of banks’ assets because house price declines can cause a significant increase in non performing loans (Bernanke et al,1996).

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While a substantive body of literature studies house prices, in particular in the current decade, no fixed set of price determinants has been identified. For example, Iossifov (2008) and Williams, B., Brown, T., Onsman, A. (2010) focuses on residential property prices in 20 advanced countries in Western Europe and Asia. As determinants of house prices, they employ real per capita GDP, interest rates, unemployment, financial deepening, population, primary fiscal balance, and current accounts, with data covering 1980−2007. The authors find that house prices are aligned with these fundamentals for their sample countries and that more than half of the price adjustment happens within one quarter. The most important variable in their estimation is the short-run real interest rate, with house price elasticity of −3.6. Farber S. (1998)

(Klyuev, 2008) studies development of house prices in the United States from 1970 to 2008 using two methods : the fundamentals model and the asset pricing approach. In the fundamentals model, he uses real construction cost, average household size, real disposable income, real mortgage rate, unemployment, and regional dummies as determinants of prices. Under the asset pricing approach, (Klyuev, 2008) links prices with real rents and interest rates. Both methods yield substantial overvaluation in the U.S. housing market, starting from 2001. He also finds that house prices can deviate from their equilibrium values for long periods of time.

(Hilbers et al, 2001) focus on the relationships between the real estate market and the financial sector. In the analysis expected growth in income, anticipated real interest rate, taxes, demographic situation, availability of credit resources are emphasized as main determinants of real estate prices. The analysis of the real estate market cycle and financial cycle reveal close relations between them. Analysis concludes that unbalanced real estate price developments often cause financial sector distress and that trends in the real estate market should be monitored closely in the context of the financial sector analysis. The other finding of the papers is that price changes in real estate markets may be used as indicators for the financial system.

Moreover, in 2011 this newly introduced tax rate was doubled. [9] It should be added that it all happens at a time when the average dwelling space per inhabitant is relatively low, compared to other EU countries, furthermore, the quality of these dwellings is quite low. In addition, the government as part of its budget consolidation has planned to re-evaluate the real estate tax applicability that will a ect the real estate market in a currently unknown way author wants to stress that the main focus of the tax should be regulation, control of the real estate market, and not maximising the return from the money of collected taxes.

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Higher real estate tax would have been much appreciated before the real estate crisis ; it would have stimulated more active real estate market development and slowed down the extremely fast growing demand. One of these factors is the volume of loans, which, as suggested by the research, has an impact on real estate values and speed of sales. It was also established that declining economic growth does have an impact on declining real estate transactions, resulting in ever-growing discounts.Krishnakumar, J., Nagar, A. L. (2008)

For Niu, S.; Ding, Y.; Niu, Y.; Li, Y.; Luo, G (2017) purchasing of real estate property represents a better financial investment in the long term than any other investment, thus also offering protection against inflation. A real estate property maintains, or gains, value. Interest rates also play an important role. Declining interest rates and growing inflation have an influence on rising real estate transactions, and vice versa. We identified a positive correlation among declining interest rates, higher prices and growing real estate transactions. The research conducted by (Wheaton and Nechayev, 2008) for 1998 – 2005 includes inflation and real estate prices during that period. To solve this case, by using benchmarking, they took into consideration the rise in demand, population and income growth and the reduction of interest rate.

In this study we set out to determine in six countries such us USA, Spain, Greece, Morocco, UAE, Malaysia between 2010 and 2023 ; if we can find a causal relationship between banks variables Real Estate Investment(REI), NonPerformingLoans(NPL), Rate(R), and macroeconomic factors such us Real Estate Price Index(REP), Growth Domestic Product(GDP), Consumer Price Index(CPI), Inflation(I), Taxation(T), Transparency Index(TIndex), Stability(S).

The reasons why are chosen as follows. The REP index is represented by a percentage changes that reflect real estate price fluctuations over the time (Murialdo., 2013), the REI represented in billions from the most powerful banks over six countries, the NPL represented in millions the inability of lenders to repay the banks, the GDP and CPI are also chosen because of their importance in the housing market, CPI is introduced because it is normally considered as an indicator of Inflation or deflation which can lead to rising costs of workers or construction materials, indirectly affecting housing costs (Mishkin and SchmidtHebbel, 2001), the population density (PD) is strongly correlated with the demands of housing purchasing. Besides, people usually purchase real estate through mortgage loans. Therefore, the rate englobe the interest rate from conventional banks and the rate of return from islamic banks(fix), inflation is measured by the percentage change from the previous period CPI, taxation is

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presented by a government real estate taxation in pourcentages, the TI is presented by pourcentages from the global real estate transparency index (JLL's ninth) that reveals which countries provide the most favourable operating environments for investors.

The « REI-NPL-R » dataset that has been used in our case study has been obtained from a public database that contains credit data of a (Morgan chase, USA (1) -Banco Santander, SPAIN(2)-Alpha bank, GREECE(3)-Central bank-Morocco(6), and from Islamic banks, we used data from Albaraka bank-UAE(4)- Mai bank- MALAYSIA (5), the six countries database were organized in a table in SPSS.

II. Econometric Model and Techniques

1. Testing for Panel Unit Root and cointegration

Before investigating the possible long-run relationship between real house prices, financial institutions and macroeconomic fundamental determinants, we begin with a panel unit root tests to verify the order of integration for each variable in level and first difference Epstein,J(1994). The null hypothesis for all three tests is that all panels contain unit roots. Specifically, the Im-Pesaran-Shin (IPS) unit root test is based on the individual augmented Dickey-Fuller (ADF) regression :

$$\Delta y_{it} = \alpha_i + \delta_i t + \lambda_i y_{it-1} + \sum_{j=0}^{pi} \emptyset_{ij} \Delta y_{it-j} + \mu_{it} \quad (1)$$

Where i and t indicate state and time, respectively, and y denotes real house prices. The IPS statistic is the average of the t-statistics (denoted as t_i) for λ_i in the individual ADF regressions :

$$t_{IPS} = \frac{\sqrt{N}(\underline{t} - E[t_i \backslash \rho_i = 0])}{\sqrt{var[t_i \backslash \rho_i = 0]}} \quad (2)$$

$$\text{where } \underline{t} = \frac{1}{N} \sum_{i=1}^{N} t_i$$

The Maddala and wu test statistic is obtained by p=-2 $\sum_{i=1}^{N} ln\ ln\ p_i$, and combines the p-values from the individual ADF tests. Both the IPS and MW tests assume no cross-sectional dependence in the panel data. However, house prices, financial institutions factors, and macroeconomic fundamentals show strong cross-sectional dependence (Mikhed and Zemčík 2009a, 2009b; Holly et al., 2010), which should be taken into account in testing for unit roots and cointegration. (Pesaran, 1995) proposes a panel unit root test robust to cross-sectional dependence, known as the CIPS test. It is based on the cross-section augmented Dickey-Fuller (CADF) regression :

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$$\Delta y_{it} = \alpha_i + \delta_i t + \lambda_i y_{it-1} + \eta_i \underline{y}_{t-1} + \sum_{j=0}^{pi} \emptyset_{ij} \Delta y_{it-j} + \sum_{j=-qi}^{pi} y_{ij} \Delta \underline{y}_{t-j} + \mu_{it} \quad (3)$$

If the variables were found to be non-stationary based on the unit root tests, then we would have needed to further examine whether they were cointegrated. According to economic theory, if real house price developments are in line with economic fundamentals, non-stationary real house prices should be cointegrated with other non-stationary economic variables with the same order of integration. We apply the panel cointegration tests of Westerlund (2007) to investigate the existence of a long-run relationship between real house prices and other key economic fundamental variables. The tests allow for a large degree of heterogeneity, both in the long-run cointegrating relationship and the short-run dynamics, and dependence within as well as across the cross-sectional units. The null hypothesis is that of no cointegration in the panel. In particular, the data-generating process for the error-correction tests is :

$$\Delta y_{it} = \delta_i' d_t + \alpha_i (y_{it-1} - \beta_i^i X_{it-1}) + \sum_{j=0}^{pi} \emptyset_{ij} \Delta y_{it-j} + \sum_{j=-qi}^{pi} \emptyset_{ij} \Delta X_{it-j} + \varepsilon_{it} \quad (4)$$

Where d contains the deterministic components and x represents economic fundamental variables. Westerlund(2007) proposes four tests based on the least squares estimates of α_i in Eq.4 and its t-ratio.

The group-mean statistics are calculated as :

$$G_t = \frac{1}{N} \sum_{i=1}^{N} \frac{\widehat{a_i}}{SE(\widehat{a_i})} \; and \; G_\alpha = \frac{1}{N} \sum_{i=1}^{N} \frac{T\widehat{a_i}}{\widehat{a_i}(1)} T \quad (5)$$

Where $SE(\widehat{a_i})$ is a conventional standard error of $\widehat{a_i}$. The panel statistics are computed as

$$P_t = \frac{\hat{a}}{SE(\hat{a})} \text{ and } \qquad P_\alpha = T\hat{\alpha} \quad (6)$$

Our methodological approach is based on panel data analysis. Such analysis for house price determinants can be performed using several alternative approaches. One approach is to pool the data and apply a panel data estimation technique that allows for group-specific intercepts

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(e.g., fixed-effect panel data estimator). This approach was used by Almeida and others (2006), Annett (2005), Iossifov and others (2008), Égert and Mihaljek (2007), and Terrones and Otrok (2004) for an international sample of housing markets. The main problem with this approach is that it relies on the assumption of homogenous slope coefficients and produces inconsistent estimates in the presence of slope heterogeneity Attanasio O(2009).

Another approach is to employ the dynamic fixed effect (DFE) estimator, which pools the time series of all cross-sections and allows only intercepts to differ across groups ; Finally, panel data analysis of house prices can be performed using the pooled mean group (PMG) estimator of Pesaran et al. (1999), which imposes homogeneity restriction on the long-run relationship between house prices and their fundamentals across groups.

In our study we use the PMG and DFE estimation approach.

2. PMG and DFE Estimations

To further study the long-run equilibrium between real house prices, financial institutions, and macroeconomic fundamentals in the six countries, as well as the short-run adjustment of real house prices, we apply the PMG and DFE estimators to a panel of the six countries over the period 2010–2023. The PMG and DFE estimators have been proposed to estimate non-stationary dynamic panels in which the parameters are heterogeneous across groups. For Dogbegah, R., Owusu, Manu D., Omoteso, K., (2011), the main difference between the two estimators is that the PMG estimator imposes a homogeneity restriction on the long-run relationship between variables while the DFE estimator pools the time series of all cross-sections and allows only intercepts to differ across groups (Nickell, 1981). Such homogeneity restrictions imposed by the theory can be tested empirically by using the Hausman test.

For Pagourtzi, E., Assimakopoulos, V., Hatzichristos, T., French, N. (2003), the house price determinants frequently studied in the housing literature proved the cointegration effect between bank specific variables and macroeconomic fundamentals on the housing price market Field, A. (2005). Compatible with the long-run theory and the cointegrating relationship among the variables of interest, we describe the long-run relationship between real house prices and their fundamentals in the following log-linear form :

$$REP_{it}=\alpha_i + \beta_{1i}\ln REI_{it} + \beta_{2i}NPLs_{it} + \beta_{3i}R_{it} + \beta_{4i}T\ Index_{it} + \beta_{5i}GDP_{it} + \beta_{6i}CPI_{it} \quad (7)$$

$$+\beta_{7i}PD_{it} + \beta_{8i}S_{it} + \beta_{9i}I_{it} + \mu_i + \eta D + \varepsilon_{it}$$

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Where the dependant variables represent respectively the real estate price in country i in year t ; the REI_{it} represents the real estate mortgage investment in country i in year t ; the NPLs represent the non-performing loans ; the R represent the mortgage rate ; the $Tindex_{it}$ represents the real estate transparency index in country i and year t ; the GDP_{it} represents the real growth rate in country i and year t ; the CPI_{it} represents the consumer price index in country i in year t; the PD_{it} represents the population density in country i in time t ; the S_{it} is the sector stability in country i in time t ; the $I_{it}$is inflation growth rate in country i in time t ; β_{1i}, β_{2i}, β_{3i}, β_{4i}, β_{5i}, β_{6i}, β_{7i} are estimated coefficients ; $\mu_i$is the state-specific fixed effect and D represents the vector of dummy variables that capture the impact of financial crisis ; and $\varepsilon_{it}$is a random disturbance. One feature of the model in which we are interested is the extent to which real house prices are driven by fundamentals such as mortgage investment, non-performing loans, mortgage rate, transparency index, population growth, GDP, CPI, inflation, countries stability. If the variables are integrated of order one (i.e.I(1)) and cointegrated, then the error term ε_{it} is stationary(i.e.I(0)) for all i.

For Rossini, P. (2000) and Rossini, P. (1998), the autoregressive distributed lags (ADRL), dynamic panel representation of the long-run Eq.7 :

$$REP_{it}=\alpha_i + \sum_{j=1}^{p} \lambda_{ij}\, REI_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{1}\, REI_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{2}\, NPLs_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{3}\, R_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{4}\, Tindex_{it-j} \quad (8)$$
$$+ \sum_{j=0}^{q} \delta_{ij}^{5}\, GDP_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{6}\, CPI_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{7}\, PD_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{8}\, S_{it-j} + \sum_{j=0}^{q} \delta_{ij}^{9}\, I_{it-j} + +\mu_i + \eta D + \varepsilon_{it}$$

The model specification in the error-correction form of Eq.8 is as follow :

$$\Delta REP_{it}=\alpha_i(REP_{it-1} - \beta_{0i} - \beta_{1i} REI_{i1} - \beta_{2i} NPLs_{it} - \beta_{3i} R_{it} + \beta_{4i}\, Tindex_{it} \quad (9$$
$$-\beta_{5i}\, GDP_{it} - \beta_{6i}\, CPI_{it} - \beta_{7i}\, PD_{it} - \beta_{8i}\, S_{it}) + \sum_{j=1}^{p-1} y_{ij}\, \Delta REP_{it-j} + \sum_{j=0}^{q-1} \theta_{ij}^{1} \Delta\, \Delta REI_{it-j} + \sum_{j=0}^{q-1} \theta_{ij}^{2} \Delta\, NPLs_{it-j}$$
$$+ \sum_{j=0}^{q-1} \theta_{ij}^{3}\, R_{it-j} + \sum_{j=0}^{q-1} \theta_{ij}^{4}\, Tindex_{it-j} + \sum_{j=0}^{q-1} \theta_{ij}^{5}\, GDP_{it-j} + \sum_{j=0}^{q-1} \theta_{ij}^{6}\, CPI_{it-j}$$
$$+ \sum_{j=0}^{q-1} \theta_{ij}^{7}\, PD_{t-j} + \sum_{j=0}^{q-1} \theta_{ij}^{8}\, S_{it-j} + \sum_{j=0}^{q} \theta_{ij}^{9}\, I_{it-j}$$
$$+\varepsilon_{it}$$

Where $\alpha_i = -(1 - \sum_{j=1}^{p} \lambda_{ij})$, $\beta_{0i} = \frac{\mu_i}{-\alpha_i}$, $\beta_{1i} = \frac{\sum_{j=0}^{q} \delta_{ij}^{1}}{-\alpha_i}$, $\beta_{2i} = \frac{\sum_{j=0}^{q} \delta_{ij}^{2}}{-\alpha_i}$, $\beta_{3i} = \frac{\sum_{j=0}^{q} \delta_{ij}^{3}}{-\alpha_i}$, $\beta_{4i} = = \frac{\sum_{j=0}^{q} \delta_{ij}^{4}}{-\alpha_i}$,

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$\beta_{5i} = = \frac{\sum_{j=0}^{q} \delta_{ij}^{5}}{-\alpha_i}$, $\beta_{6i} = = \frac{\sum_{j=0}^{q} \delta_{ij}^{6}}{-\alpha_i}$, $\beta_{7i} = = \frac{\sum_{j=0}^{q} \delta_{ij}^{7}}{-\alpha_i}$, $\beta_{8i} = = \frac{\sum_{j=0}^{q} \delta_{ij}^{8}}{-\alpha_i}$, $\beta_{9i} = = \frac{\sum_{j=0}^{q} \delta_{ij}^{9}}{-\alpha_i}$.

The error-correction term ($REP_{it-1} - \hat{\beta}_{0i} - \hat{\beta}_{1i} REI_{i1} - \hat{\beta}_{2i} NPLs_{it}$ - $\hat{\beta}_{3i} R_{it}$+$\hat{\beta}_{4i}$ $Tindex_{it}$-$\hat{\beta}_{5i}$ GDP_{it} -$\hat{\beta}_{6i}$ CPI_{it} -$\hat{\beta}_{7i}$ PD_{it} $-\hat{\beta}_{8i}$ $S_{it} - \hat{\beta}_{9i} I_{it}$) represents the temporary deviations of real house prices from their fundamental values at the state level. The homogeneity restriction imposed by the PMG estimator is on the coefficients of long-run real house price determinants β_1, β_2, β_3, β_4, β_5, β_6, β_7, β_8, and β_9, restricting all the long-run parameters to be the same across states. This restriction can be relaxed to restricting only the subset of the long-run parameters to be the same across countries. The intercept β_{0i}, speed of the adjustment parameter α_i and short-run adjustment coefficients $\theta_{ij}^1, \theta_{ij}^2, \theta_{ij}^3, \theta_{ij}^4, \theta_{ij}^5, \theta_{ij}^6, \theta_{ij}^7, \theta_{ij}^8, and\ \theta_{ij}^9$ vary across countries. We expect a negative speed of adjustment parameter α_i, which suggests that real house prices react to disequilibrium in the real estate market : real estate prices decrease following positive deviations from the long-run equilibrium in the real estate market, while they increase following negative deviations from the long-run equilibrium.Bell, R. MAI (1998).

3. Data

Data collection for our analysis turned out to be a challenging task. In most countries of our sample, official statistics do not publish house price data, and we had to search various publications and private sector sources to obtain the necessary data. To our knowledge, the database we have put together for this paper is the first attempt at gathering house price data for the six countries. The data covers the following countries : USA, Greece, Spain, UAE, Malaysia, Morocco. Data frequency and data spans vary widely from country to country (Table 1). The earliest data comes from 2010, and the latest observations in most cases are for 2023. The house price data either covers the capital cities or represents country averages.

In the study, annual house prices changes are explained by real estate mortgage investment-Non Performing mortgage loans-Mortgage interest rate, the real (GDP) growth rate, the consumer price index(CPI), the inflation (I) growth rate, the stability(S), the population density(PD), the real estate transparency index(TINDEX). All the data were collected as precise in the table 1

[Insert table 1]

Table 1 reports the summary statistics (variable, notation, unit and sources) for all variables used in the econometric study.

Our data series are constructed in the form of indices, pourcentages (%), and units based on variable particularities. Use of actual house pricing is related to sample countries' currency.

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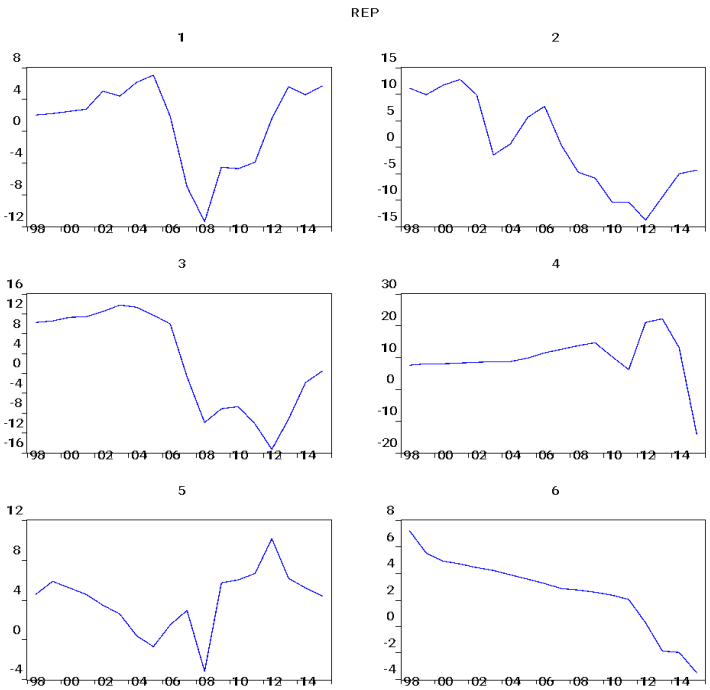
As data shows (Figure 1), house prices have been growing at an accelerating pace until the second half of 2008, from which point a plunge in house prices is observed in all countries of our sample.

Figure1 : House price indices in respectively USA, Greece, Spain, UAE, Malaysia, Morocco.



source: Authors calculations

The observed decline in house prices was not unique to our sample of countries. Many advanced and emerging economies also experienced sharp price declines in 2019 and 2022. Indeed, the world economic and finance institutions claim that the house price crisis was spreaded in almost all countries.

All variables are regarded as I (1), for the purpose of modeling, which is also supported by the individual augmented Dickey-Fuller tests (Dickey and Fuller (1979) and Dickey and Fuller (1981)). The average order of integration of all variables except population density is found to be one, while in several cases the housing stock is found to be trend stationary, which seems implausible. Also, the tests indicate that population density may be I (2), we conduct our analysis under the modeling assumption that all variables are at most integrated of order one.

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III. Empirical Results

1. Panel unit root and cointegration test results

Table 2 summarizes the panel unit root results based on the full sample from 2010 to 2022. To conduct the testing, we include time trends for the real house price index, since it exhibits a clear upward trend over time in the sample. The number of lags for each variable in each state is chosen automatically by using the Bayesian information criterion (BIC) with a maximum of four lags. Boldface values denote sampling evidence in favor of unit roots. For the full sample, all three panel unit root tests suggest that REP, REI, NPLs, Rate, Tindex, S, I are integrated of order one, or I (1), and that the remaining GDP, CPI are stationary on order level, or I(0), at the 5% significance level, and that PD are stationary on order 2eme difference, or I(2)

[Insert table 2]

Given the panel unit root test results for the full sample, we proceed to conduct the panel cointegration tests of Westerlund (2007) on the variables. Table 3 reports the results. Six of the eleven statistics and the corresponding *p*-values suggest rejecting the null of no panel cointegration. Therefore, our results confirm the existence of a long-run relationship between real house prices and their fundamental values over the period of 1998 to 2015, which satisfies the assumptions in the following PMG and MG estimations.

2. Long-run Equilibrium between real house price and macroeconomic fundamentals

Table 4.a ; 4.b presents the results of the baseline model of personal consumption specified by equation (9). Furthermore, the Hausman test of long-run homogeneity of coefficients is employed in order to determine which estimator is more appropriate (DFE or PMG). According to Pesaran et al. (1999), the slope coefficients are indeed homogeneous, then the PMG and DFE estimators are consistent and efficient. According to results, homogeneity restriction is not rejected by the data, implying that the PMG and DFE estimators are efficient under the null hypothesis. However, the PMG estimator is preferred over the DFE estimator because it allows for short-run coefficient heterogeneity.

The upper panel reports the average long-run coefficient estimates in Eq.9 for the log of the real house price index. As a benchmark, Model I includes the log of mortgage investment, non-performing loans, mortgage rate, real estate transparency index, GDP, CPI, population density, inflation, countries stability as the financial institutions, and macroeconomic fundamentals for the log of the real house price index. Notably, the Hausman tests with *p*-values greater than 0.05 suggest that the PMG estimator is preferable, since we fail to reject the null hypothesis

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that the difference between the PMG and DFE models is not systematic. This suggests a common long-run relationship among real house prices, financial institutions factors, and macroeconomic determinants across the six countries. In the PMG estimations that restrict common long-run coefficients across countries, and from six real house price determinants, we find a statistically significant negative long-run relationship between the log of the real house price index and the log of real estate transparency index, which mean the increase in real estate transparency index with 1 unit conduct to a decrease in house price with 6,54 ; The impact of GDP and population density on real house prices is significantly positive; Also countries stability have a positive significance on house prices. Overall, our results confirm that the long-run equilibrium real house prices increase with rising demand due to higher GDP population density, and countries stability, but lower transparency index. Our results fit perfectly with the literature. (Klyuev, 2008) ; (Egert and Mihaljek, 2007) ; (Leicester, 2009).

[Insert table 4a]

Therefore, in Model II, we rely long-run and short-run relationship between financial institutions determinants (mortgage investment, non-performing loans, mortgage rate) and house price ; the PMG estimator results proved a long run relation between bank specific determinants and house price, the mortgage investment have a significant positive long-run equilibrium with house price, the increase in REI with 1 unit include an increase in house price with 0.15 ; On the other hand, it's found that the NPLs and R have a significant negatif long-run equilibrium with REP ; In other way of speaking, the increase in NPLs and R with 1 unit, include respectively a decrease in REP with 2.42-5.32. From model II we can observe the robustness of relation in the long term between bank specific variables (REI, NPLs, R), which explain the extent that talked banks over time for financing the real estate market (households mortgage-investors mortgage). But the meltdown of the U.S. housing market around 2006 triggered the subsequent global financial crisis. That is why we introduced in Model III, a time dummy variable (Dummy) to control for the impact on the country's housing markets during the recent 2007–2008 financial crisis. The time dummy is negatively significant on real house prices, which expressed that any increase in dummy variable includes a decrease in house price with 1.96.

[Insert table 4b]

Our model IV, is a combination between model I and model II, which represent financial institutions, determinants, and macroeconomic factors. To study the impact of inauguration of macroeconomic and bank specific variables for the equilibrium of the housing price which was

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constructed by Rice and Strahan (2010). It is shown that bank specific variables plays a significant role in the adjustment of real house prices, the mortgage investment have a statistically positive long-run relationship with house price (when mortgage investment increase in 1 unit, house price increase with 0.15) ; for the non-performing loans, we find a positive significant long run relationship with the house price ; otherwise, the mortgage rate has a negative significant long-run equilibrium with the house price which mean that if mortgage rate increase by 1 unit, house price decrease with 0,54. With the introduction of bank specific determinants, we notice a change in macroeconomic variables significance, such as a positive significance with inflation, a negative significance with consumer price index (CPI), and insignificance with population density (PD).

Since economic fundamentals could have varying impacts on real house prices in the long run versus the short run, we examine alternative model specifications in Table 4b, which allow for different economic fundamentals in the long-run equilibrium versus the short-run adjustment of real house prices. More than bank determinants, Model V consider Tindex-GDP-CPI ; and Model VI incorporates PD-S-I in the long run. As expected in model V, with the existence of bank determinants, just tindex have a significant positive long run equilibrium with house price. On the other hand, between all the variables in model VI, mortgage investment is insignificant to real house price. The lags of real house prices, bank determinants, and all six economic fundamentals in Eq.10 are considered in the short run. Consistent with the results in Table 4a, the Hausman tests suggest that the PMG estimator is preferred in all model specifications. All long-run coefficients are statistically significant with the expected signs.

3. Short-Run Adjustments of real house prices to the long-run Equilibrium

[Insert table 4a ; 4b]

The speed of the adjustment of real house prices to the long-run equilibrium is measured by the coefficient α_i in Eq.9. All model specifications of the PMG estimations show a significantly negative speed of adjustment, which ranges from –0.14 to –0.64. This finding indicates that real house prices adjust to the long-run equilibrium in response to a shock : following positive deviations from the long-run equilibrium in the real estate market, real house prices decrease, and vice versa. Following the literature, the half-life of the adjustment is approximated by –ln (2) / ln (1+α_i), which indicates that the time necessary for a deviation from the long-run equilibrium is halved. For the benchmark Model I, the coefficient α_i of –0.51 suggests that 50% of the real house price deviations in the previous quarter from the equilibrium are adjusted this quarter.

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Related to all proposed models, we observe in general the existence of short run equilibrium between determinants and our dependent variable (real house price). Indeed, in modelI there is evidence of the consumer price index and sector stability effect in analyzed countries with a statistically significant coefficient respectively (0.55, 3.04). The elasticity of house price to changes in inflation is also negatively significant in the short run with the coefficient of -0.45. For the model II, only the mortgage rate has a short-run impact on house price changes. For model III, we observe a short-run impact with four (4) variables ; a positive short-run equilibrium with Index-CPI-PD for a coefficients respectively (5.69, 0.32, 2.54) ; otherwise, a negative short-run equilibrium with inflation and dummy (crisis period) with a coefficients represent respectively (-0.048, -1.90). On the other hand, model IV presents a high possibility for a short-run relationship, represented by a statistically positive equilibrium with Tindex, GDP, and REI with respective coefficients 4.15, 0.31, 0.60. And a negative statistically significant short-run relationship with CPI, NPLs, R with respective coefficients -0.05, -1.44, -0.35.

Since the PMG procedure allows for short-run heterogeneity, it is possible to estimate separate short-run coefficients for each country in the panel. We take model IV as a benchmark due to a combination of bank specific determinants and macroeconomic variables.

[Insert Table 5]

The estimates of the short-run, country-specific error-correction models also provide evidence of the bank specific determinants and macroeconomic variables. For the USA, we observe an important short-run relationship between house price elasticity and bank specific variables. Indeed, the increase in mortgage investment with 1 unit cause the increase of house price with 0.15 ; otherwise we remark a statistically negative relationship between non-performing loans and mortgage rate with a respective coefficients -15.06, -0.46. The two coefficients show a severe impact on house price, the estimation results reveal that an increase in non performing loans and mortgage rate with 1 unit cause a decrease in housing price with 15.06 and a decrease in mortgage rate with 0.46. The result can be explained by the subprime crisis (mortgage insolvency) which led to a real estate crush (house price fall).

For greece and spain, it seems that all the variables (macroeconomic variables and bank specific determinants) have an impact on house price elasticity ; the estimation results show a severe negative short-run relationship between house price and mortgage rate with a respective coefficients -16.34, -12.43. The results explain that the increase in mortgage rate makes

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customers unable to take mortgages which led to an imbalance between supply and demand which eventually led to housing price meltdown.

The estimation results in UAE, show less short-run equilibrium between variables and housing price. The UAE housing price market seems to have a significant short-run relationship with population density with a coefficients of 3.92 ; on the other hand, UAE housing market have a significant negative equilibrium with mortgage investment and mortgage rate, which can be understandable by demand decrease.

Malaysian housing price market, seems have a short-run equilibrium with several determinants ; The REP have a statistically negative significance with GDP, CPI, Inflation, REI with a respective coefficients -0.11, -0.44, -1.31. In the Malaysian situation macroeconomic variables have more short-run relationship with housing price elasticity than bank specific determinants.

Finally, the Moroccan real estate sector appears to have a positive significant short-run equilibrium with GDP, and negative significant short-run relationship with PD, but it shows no short-run relationship with the financial determinants and the other macroeconomic variables. The study shows that the increase in GDP with 1 unit attended an increase in housing price with 0.07%, as for the rise of PD with 1 unit led to the decrease in housing price with 0.74%.

The study proved diversity in housing price determinants influence around the six countries, which were explained in one hand by the economic and financial particularity of each state ; and on the other hand it’s explained by the heterogeneity in countries influence degree on the financial crisis which led the real estate crisis.

Related to countries real estate crisis influence, we observe that USA housing price were influenced more by

Bank specific determinants than macroeconomic variables which explained by the financial crush.

For Greece and Spain, the housing prices were influenced in the first part by the financial determinants (mortgages), and in the second part by macroeconomic variables.

The Malaysian and Moroccan housing price were more influenced by macroeconomic variables than financial determinants ; on the other hand UAE housing price were influenced more by financial variables.

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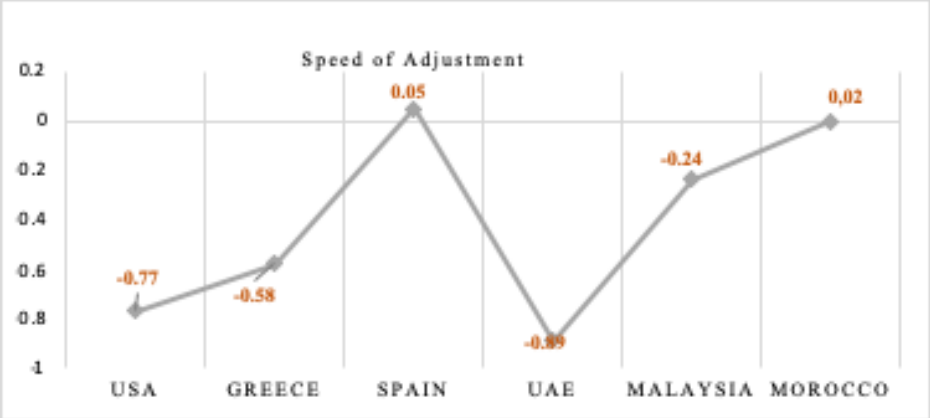
4. Real House Price Deviations from the Long-run Equilibrium

Based on the benchmark Model IV, we investigate the magnitude of real house price deviations from their fundamental values in the six countries, calculated by the error correction term in Eq.9. Figure 2 presents the speed of adjustment of real house prices coefficients from their fundamental values across the states over the sample period 2010-2023.

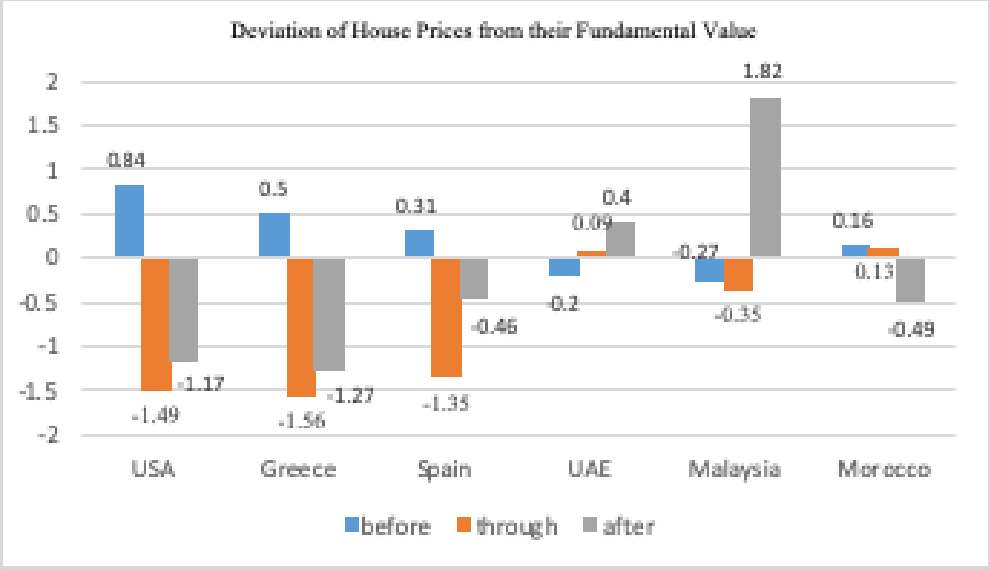
Figure 2 : Speed of adjustment coefficients from PGM Estimation



source: average of speed of adjustment coefficients over the sample period 2010-2023

To further compare the deviations of real house prices from economic and financial fundamentals before (2010-2018), through (2019-2021), and after the crisis (2021-2023).

Figure 3 : Real House price deviations from the financial and macroeconomic fundamentals long-run Equilibrium



source: means of the variables across the six countries states for the three periods

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Following the insight of Stepanyan et al. (2010), Figure 3 presents the means of the variables across the six countries states for the three periods (before-through-after). We observe a UAE and Malaysia positive house price deviation respectively (0.4%- 1.82%), a negative real house price deviations after crisis period for USA, Greece, Spain, Morocco (1.17%-1.27%-0.46%-0.49%). A severe decrease in Real house prices continued during economy crush for the six countries specially USA, Greece, Spain respectively with 1.49%-1.56%-1.35% ; on the other hand, UAE and Morocco were not influenced during the crisis but they show a major recession in housing price with respectively 0.09%- 0.13%. As for Malaysia, housing prices decreased by 0.35%.

One common observation is that the real house price deviations after the crisis period are larger than those during the peak. The large positive real house price deviations in the post-crisis period imply that, despite the relatively low current levels, real house prices still have some room for downward adjustment. This finding is consistent with the results of Stepanyan et al. (2010), who analyze the house price determinants in 11 selected former Soviet Union countries.

Mortgage investment decrease by 0.89%, Non-performing loans increased to (2.37%), decrease in mortgage rate on unprecedented levels by 8.34, decrease in transparency index by 1.4%, decrease in GDP by 0.5%, decrease in consumer price index by 0.07%, increase in inflation by 0.09%, decrease in sector stability by 0.11%, across countries after-crisis period. Thus, the economic fundamentals deteriorated even more rapidly than the decline in real house prices.

Despite the fact of countries' differences, we can tell that all the countries had common results in the long-run relationship between housing price and their fundamentals (financial and macroeconomic variables) ; but we observe differences in the short-run equilibrium, especially in the crisis period.

From the six countries, it seems that morocco were less exposed to the real estate crisis effect because of the moroccan financial system policy ; However, he was affected by the macroeconomic worldwide changement expressed by the raw material price increase in the market, also the decrease in transfers from Moroccans living abroad. On the other hand, the US housing price market was the most crushed, the reason was due to financial market collapse which negatively affected consumer solvency. We can tell that the USA real estate market was crushed due to the banking sector more than macroeconomic determinants.

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IV. Conclusion

This paper applies the PMG and DFE estimators to examine real house price determinants in the 6 countries from 2010 to 2023. The empirical results show that bank specific determinants and macroeconomic variables jointly contribute to real house price developments in the full sample. Our results confirm that the equilibrium real house prices increase with rising demand due to transparency index, GDP, inflation, mortgage investment and non-performing loans, lower consumer price index, house stability and mortgage rate, thus providing evidence of a house price adjustment to the long-run equilibrium. The short-run adjustment estimates that about 64% on average of the real house price deviations in the previous period from the long-run equilibrium are adjusted during this period.

House price linkages to real and financial sectors highlight the importance of the subject for policymakers. Moreover, the deviations of real house prices from economic fundamentals in the post-crisis period are greater than those during the pre-crisis and peak periods, thus implying that economic fundamentals have deteriorated even more rapidly than real house prices after-crisis period which could lead to a further decline in real house prices.

To summarize, our study provides new evidence of the relationship between real house prices and their economic and financial determinants from the perspectives of both long-run equilibrium and short-run adjustment, and showed some light on policy implications for the sample countries between Housing markets, financial and macroeconomic sector. First, we confirm the existence of a common long-run relationship among real house prices, mortgage investment, non-performing loans, mortgage rate, GDP, CPI, PD, Transparency index, sector stability, inflation across 6 countries. When housing markets are undesirable, policies that promote bank specific determinants and macroeconomic variables should help long-run housing market recovery. Second, we show that the heterogeneity across countries in terms of deviations of real house prices from their fundamentals and the speed of adjustment should be taken into account when making policy decisions. Third, we believe these results to be relevant for the theoretical debate between competing approaches to modeling house price dynamics. Finally, our results, which are based on six countries' level data for the period of 2010-2023, suggest that a long time series is required to better capture the correction of real house prices after the recent housing market collapse. Therefore, the use of a longer time series to fully capture the effects of the financial crisis on house price dynamics would be of great interest in future research.

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Appendix

Table .1 Selected variables

Variable	Notation	Unit	Source
Real Estate Price Index	REP	%	Global property guide
Real Estate Investment	REI	currency /billions	Banks annual reports
Mortgage		currency/millions	Banks annual reports
Non Performing Loans	NPL	%	Office of national statistics
Growth Domestic Product	GDP	%	Officer if national statistics
Consumer Price Index	CPI	per km^2	Greater authority
Population per square km	PD	%	Banks annual reports
Rate	R	%	Office of national statistics
Inflation	I	%	Global property guide
Taxation	T	%	Global Real Estate
Transparency Index	T Index	millions	Transparency Index report
Stability	S		Office of national statistics

source: Author effort

Table2 : Results of panel unit root test : calculations performed in EViews

Unit Root Fisher	variable	IPS	ADF-Fisher	PP-Fisher
	REI	0.8789	0.9699	0.9799
	NPL	0.3309	0.4031	0.5154
	R	0.1160	0.1422	0.4892
Levels	REP	0.551	0.2489	0.8656
	Tindex	0.1174	0.0627	0.2564
	GDP	0.0032	0.0003	0.0000
	CPI	0.0256	0.0366	0.0000
	PD	1.0000	0.451	0.9899
	S	1.0000	0.9985	0.9291
	I	0.1460	0.1726	0.0002

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1st difference	REI		0.000**	0.000** 0.0000**
	NPL		0.001**	0.006** 0.0000**
	R		0.000**	0.000** 0.0000**
	REP		0.0012**	0.0027** 0.0003**
	GDP		0.0000*	0.0000* 0.0000**
	CPI		0.0000*	0.0000* 0.0000**
	Tindex		0.0000**	0.0001** 0.0000**
	PD	0.8468	0.5847	0.9766
	S		0.0209**	0.0314** 0.0000**
	I		0.000**	0.000** 0.0000**
2nd difference	REI		0.000**	0.000** 0.000**
	NPL		0.001**	0.006** 0.000**
	R		0.000**	0.000** 0.000**
	REP		0.000**	0.000** 0.000**
	GDP	0.000*	0.000*	0.003**
	CPI	0.000*	0.000*	0.000**
	Tindex		0.000**	0.000** 0.000**

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	PD	0.0483**	0.0760** 0.0002**
	S	0.000**	0.000** 0.000**
	I	0.000**	0.000** 0.000**

Source: Author effort

Table 3 : Results of cointegration test for full test (1998 - 2005)

Panel Statistics				
	Statistic	Prob	Statistic	Prob
Panel v-statistic	0.094832	0.4622	-2.133016	0.4471
Panel ρ-statistic	2.334130	0.6309	1.716053	0.9569
Panel t-statistic (PP)	-8.040902	0.0000	-5.301583	0.0005
Panel t-statistic (ADF)	-3.223319	0.0011	-4.977929	0.0000

Group Statistics	Statistic	Prob
Group ρ-statistic	3.497098	0.9937
Group t-statistic (PP)	-8.717495	0.0001
Group tj-statistic (ADF)	-2.795098	0.0214

Notes : *, ** and *** indicate stationary at 1%, 5%, and 10% significance levels, respectively.

The Pedroni test is an Engle-Granger type test where the residuals are tested for the presence of unit root. The null hypothesis is that of no cointegration and the decision is based on seven statistics. The main difference between the panel and group statistics is that the latter allows for potential heterogeneity in the individual units through its less restrictive alternative hypothesis. The p -values for the corresponding statistics are shown in brackets.

Source: Author effort

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Table 4a : PMG and DFE Estimation Results for real house prices

Dependant variable : Real House Prices	Model 1		Model 2		Model 3	
	PGM	DFE	PGM	DFE	PGM	DFE
Long-run coefficient						
Tindex	-6.5459	12.5865			0.1313	13.1681
	(0.0299)	(0.0000)			(0.8650)	(0.0000)
GDP	0.4522	0.7205			0.4859	0.4128
	(0.0000)	(0.0001)			(0.0513)	(0.0180)
CPI	-0.4267	0.4344			-3.5385	0.4687
	(0.2717)	(0.1991)			(0.0000)	(0.1306)
PD	-0.1020	0.4209			0.180235	0.4388
	(0.043)	(0.0000)			(0.0008)	(0.0001)
S	0.2370	-0.5209			-0.7437	-0.4817
	(0.0046)	(0.0147)			(0.0454)	(0.0276)
I	0.6881	0.4754			-0.0777	-0.4993
	(0.2161)	(0.1530)			(0.8810)	(0.1153)
REI			0.1595	0.0215	0.4953	0.010450
			(0.0112)	(0.6297)	(0.0000)	(0.8866)
NPL			-2.4216	-2.0706	-0.5124	-1.6167
			(0.0796)	(0.0006)	(0.0004)	(0.0373)
R			-5.3214	-0.7103	-0.5503	-0.6915
			(0.0003)	(0.0054)	(0.0010)	(0.0015)
Short Run Equation						
Speed of adjustment	-0.5130	-0.0593	-0.1436	-0.6548	-0.3578	-0.0686
	(0.0227)	(0.010)	(0.1392)	(0.1678)	(0.0179)	(0.0111)
	0.3562	0.1423			5.6992	-0.1623
Change in transparency	(0.9547)	(0.4523)			(0.0925)	(0.0356)
index	-0.0440	-0.0754			-0.3710	0.1981
	(0.6395)	(0.3454)			(0.2192)	(0.077)
	0.5549	0.3452			0.3221	-0.0073

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Change in gross domestic product	(0.0556)	(0.3180)			(0.000)	(0.0021)
	11.1355	12.6547			2.5422	0.1345
	(0.2178)	(0.1127)			(0.0701)	(0.0681)
Change in consumer price index	3.0473	4.7632			2.3130	1.7643
	(0.0504)	(0.0754)			(0.2441)	(0.1231)
	-0.4546	-0.3256			-0.0480	0.0022
Change in population density	(0.0055)	(0.0854)			(0.0044)	(0.0010)
			0.3615	-0.6543	-0.1939	-0.2315
			(0.2142)	(0.1234)	(0.6310)	(0.5471)
Change in sector stability			-2.1846	-3,4571	2.3153	2.3521
			(0.3478)	(0.3867)	(0.6135)	(0.5543)
Change in inflation			-0.58732	0.3451	-1.3250	-1.3424
			(0.0976)	(0.05623)	(0.2466)	(0.245)
Real estate mortgage investment					-1.9060	-1.0419
					(0.0436)	(0.4592)
Non-performing mortgage	-1.0282	-59.6584		10.6573	-14.7528	-55.2420
	(0.9202)	(0.0000)		(0.0000)	(0.5737)	(0.0000)
Mortgage rate						
Dummy						
Intercept						
Statistics						
Hausman test for poolability of countries	0.103		0.231		0.134	
Number of observation	108		108		108	

Note: The sample contains the six countries over the period 1998–2015. The number of observations is 108 since two lags are used in the estimations. PMG represents pooled mean-group estimation and DFE denotes dynamic fixed effect. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
Source : Authors' estimations.

Source: Author effort

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Table 4b : PMG and DFE Estimation Results for real house prices

Dependant variable : Real House Prices	Model IV		Model V		Model VI	
	PGM	DFE	PGM	DFE	PGM	DFE
Long-run coefficient						
Tindex	3.9772	13.3659	6.4096	12.4575		
	(0.0010)	(0.0000)	(0.0282)	(0.0000)		
GDP	0.8725	0.4447	-0.7666	0.3983		
	(0.0002)	(0.0085)	(0.1113)	(0.0199)		
CPI	-2.8030	0.4724	-0.7139	0.2146		
	(0.0000)	(0.1267)	(0.3767)	(0.4403)		
PD	0.0568	0.4407			-1.2850	-0.0111
	(0.3834)	(0.0000)			(0.0000)	(0.9096)
S	-0.2502	-0.5150			2.0639	-0.4715
	(0.0125)	(0.0160)			(0.0000)	(0.0698)
I	1.3320	-0.5647			-0.5207	0.2058
	(0.0025)	(0.0636)			(0.0346)	(0.5129)
REI	0.1558	0.0160	0.2815	-0.0454	-0.0970	0.1266
	(0.0000)	(0.8255)	(0.0001)	(0.5071)	(0.3822)	(0.1533)
NPL	1.3405	-1.5838	-11.0936	-2.1931	-3.7799	-1.0629
	(0.0017)	(0.0404)	(0.0000)	(0.0031)	(0.0141)	(0.2487)
R	-0.5417	-0.6614	-0.3241	-0.5676	-0.6543	-0.8006
	(0.0009)	(0.0019)	(0.0000)	(0.0083)	(0.0000)	(0.0021)
Short Run Equation						
Speed of adjustment	-0.64386	-0.049	-0.2345		-0.3022	-0.3265
	(0.0001)	(0.0084)	(0.1233)		(0.0230)	(0.0451)
Change in transparency index	4.1542	4.1542	-2.3246			
	(0.0390)	(0.0376)	(0.6297)			
Change in gross domestic product	0.3182	0.2082	0.3318			
	(0.0479)	(0.0706)	(0.1182)			
Change in consumer price index	-0.0563	-0.0073	0.4787			
	(0.0203)	(0.0000)	(0.0022)			
	7.2437	8.5432			7.9967	8.4532

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Change in population density	(0.1513)	(0.17654)			(0.1759)	(0.2135)
Change in sector stability	2.7091	3.4321			1.1396	3.4351
	(0.3044)	(0.3457)			(0.5137)	(0.4570)
Change in inflation	-0.2711	-0.3245			-0.2992	-1.2154
	(0.4725)	(0.3452)			(0.3742)	(0.1789)
Real estate mortgage investment	0.6083	-0.4532	-0.1043	-0.7653	0.5826	1.5412
	(0.0136)	(0.1564)	(0.5206)	(0.6578)	(0.1890)	(0.2133)
Non-performing mortgage	-1.4443	-1.5437	1.3031	2.1571	-0.4710	-0.5681
	(0.0149)	(0.4321)	(0.5290)	(0.5194)	(0.8411)	(0.8341)
Mortgage rate	-0.3572	-0.3567	-0.3456	-0.2137	1.2317	2.1768
	(0.023)	(0.7234)	(0.2134)	(0.1287)	(0.3215)	(0.2134)
Intercept	-18.0785	-56.1097	0.9914	-51.5036	19.9164	11.8802
	(0.0046)	(0.0000)	(0.5439)	(0.0000)	(0.1802)	(0.0219)
Statistics						
Hausman	0.134		0.231		0.234	
Number of observation	108		108		108	

Note: The sample contains six countries over the period 1998–2015. The number of observations is 108 since two lags are used in the estimations. PMG represents pooled mean-group estimation and DFE denotes dynamic fixed effect. Robust standard errors are in parentheses. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Source: Author effort

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Table 5 : Short-Run, Country-Specific Estimates of house price Model

Country	α_i	Tindex	GDP	CPI	PD	S	I	REI	NPLs	R
USA	-0.778 (0.007)	3.985 (0.992)	-0.970 (0.019)	0.596 (0.021)	-12.363 (0.863)	-2.355 (0.349)	1.564 (0.178)	0.1572 (0.000)	-15.063 (0.059)	-0.467 (0.002)
Greece	-0.599 (0.000)	22.058 (0.090)	0.788 (0.000)	0.353 (0.000)	10.667 (0.007)	14.028 (0.001)	0.196 (0.008)	1.161 (0.002)	-6.040 (0.003)	-16.342 (0.0004)
Spain	-0.0536 (0.0078)	-14.1951 (0.7817)	-0.5858 (0.1214)	0.3879 (0.0881)	-3.9622 (0.3307)	1.2966 (0.0737)	0.7951 (0.0573)	0.2413 (0.0506)	-8.9960 (0.0345)	-12.4356 (0.0734)
UAE	-0.8949 (0.0007)	1.3294 (0.9849)	-0.4282 (0.1010)	-0.5333 (0.2431)	3.9294 (0.0345)	13.8881 (0.6036)	0.9852 (0.1546)	-4.3350 (0.0731)	25.0438 (0.8382)	-0.0662 (0.0864)
Malaysia	-0.2452 (0.0012)	29.4117 (0.8333)	-0.1194 (0.0010)	-0.4487 (0.0237)	-1.0530 (0.1700)	0.0420 (0.5801)	-1.3157 0.0003	0.4010 (0.0148)	1.7966 (0.6923)	-0.0954 (0.0832)
Morocco	0.0171 (0.0003)	-3.6192 (0.2775)	0.0798 (0.0001)	3.6657 (0.1305)	-0.7409 (0.0009)	-0.3401 (0.2227)	-3.5472 (0.1099)	-0.3191 0.7194	-9.1139 (0.9270)	0.0145 0.3246

Notes : *,**,*** indicates significance at 10%, 5% and 1% significance level, respectively; numbers in the brackets are standard errors for full PMG. Source : Author's calculations.

Source: Author effort