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Historical decomposition of the Cyprus Residential Property Prices *

Chryso Aristidou† George Thucydides‡

October 2022

Abstract

The aim of this paper is to examine the main driving force(s) of residential property prices during various periods, via historical decomposition. This is achieved by establishing the contribution of different structural shocks to the historical dynamics of the residential property price index. For every quarter in the sample, the growth rate of the residential property price index is decomposed into its different components in order to assess the driving forces behind residential property prices fluctuations. In effect, an insight into possible disconnection of property prices and economic fundamentals could potentially also be gained, thus providing indications of possible vulnerabilities building up in the sector, which would in turn impose risks on financial stability. Furthermore, emphasis is given on the recent surge in construction costs which is shown to play a predominant role in the recent residential property price dynamics.

Keywords: Construction cost; Residential Property Price Index (RPPI); Historical Decomposition

JEL classification: C11, C32, R30

*The analysis benefited from comments from Maria Papageorghiou, Senior Officer at the Central Bank of Cyprus and from participants in an internal seminar at the Central Bank of Cyprus. The views expressed are solely our own and do not necessarily reflect those of the Central Bank of Cyprus or the Eurosystem. Please address correspondence to ChrysoAristidou@centralbank.cy and GeorgeThucydides@centralbank.cy.

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1 Introduction

In this paper, a historical analysis of the driving forces of residential property prices in Cyprus is carried out. Specifically, by using econometric decomposition techniques, the trend of the Central Bank of Cyprus (CBC) Residential Property Price Index (RPPI) is decomposed into its estimated constituents, revealing the magnitude of the impact of each driving force on residential property prices at each point in time. The main motivation of this analysis is to give an in-depth analysis on the underlying driving forces of the Cypriot real estate price developments. This paper adds to the literature of Cyprus real estate market by mainly shedding more light on the assessment of price volatility and its constituent driving forces at each point in time.

The assessment of historical dynamics of residential property prices has been a popular subject for research internationally. This assessment can assist policymakers and macroprudential authorities (as it is the case for Central Banks) to gain insight into one of the most important economic segments, the real estate sector, which is interconnected with the banking sector in various ways [1] (ECB (2015), Cerutti et al. (2015), ESRB (2016), Bengtsson et al. (2017)). As Hilbers et al. (2001) argue, unbalanced real estate developments often contribute to financial sector distress, thus monitoring real estate trends is important in preserving the soundness of the financial sector. A collapse in real estate prices (as the one experienced during the Lehman Brothers crisis) poses significant risks to the economy and particularly to the financial stability of the banking/financial system (see for example Cecchetti (2008), Hartmann (2015) and WEF (2015)). Thus, disentangling the impact of each driving force on residential property prices allows market participants and national authorities to better assess the cyclical and structural drivers of the sector.

Furthermore, the econometric estimations in this paper present evidence on what is the actual impact of the currently rising construction cost on residential property prices. Specifically, with significant supply chain interruptions due to, initially, COVID-19 and, subsequently, due to the war in Ukraine, overlapping supply shocks have led construction prices soaring around the world. Cyprus is not an exception, as construction cost rose significantly in the period 2021Q1-2022Q2. However, the magnitude of its impact on residential property prices was not clear and the pass-through of its impact was unknown. The analysis presented in this paper sheds light on these issues, showing that the pass-through rate seems to be varying across time.

The paper is organised as follows. In Section 2, literature review on the topic is presented. In Section 3, the methodology employed in order to estimate the historical decomposition of the residential property prices is outlined, while, in Section 4,

[1] Real estate is used as the main collateral in mortgage loans and frequently in corporate loans Praet (2019). It also constitutes the main form of wealth of households (ECB (2009) and Praet (2019)).

descriptive analysis of the data used is presented. In Section 5, estimation results are presented and Section 6 concludes the paper.

2 Literature Review

In this section, the literature on the driving forces of residential property prices is presented, as a way of expanding the scope of the historical decomposition exercise.

A wide range of residential property prices drivers has been examined in the literature, with some variables appearing consistently to be significant and to play an important role in affecting property prices across countries. For example, Tsatsaronis and Zhu (2004) have examined these factors by comparing the driving forces in 17 industrialised economies, concluding that, over longer horizons, demand for housing is driven mainly by growth in household disposable income, gradual shifts in demographics, permanent features of the tax system that might encourage home ownership, as opposed to other forms of wealth accumulation, and the average level of interest rates (possibly related to the long-run behaviour of inflation), while in the short term residential property prices are driven by debt financing as well. On the other hand, this study suggests that housing supply is driven by the availability and cost of land, the cost of construction and investments in the improvement of the quality of the existing housing stock. It is also worth noting that the study finds evidence that, in the short term, idiosyncratic national factors can lead to significant differences in the dynamics of prices across countries. In a cross-country analysis performed by Huynh-Olesen et al. (2013), using data from European Union (EU) countries, it is concluded that disposable income, population, interest rates and credit growth play a predominant role in driving residential property prices from the demand side, while construction cost is found to drive prices from the supply side. A study of 20 OECD countries Geng (2018) finds demand related factors that drive residential property prices to be household disposable income, household net wealth, interest rates and demographic. Supply side factors found to drive prices are supply shortage proxies, while structural factors include price elasticity of housing supply, tax incentives and rent control. Gattini and Hiebert (2010) in their European Central Bank (ECB) working paper estimate a Vector Error Correction Mechanism (VECM) model to obtain the historical decomposition of euro area residential property prices, using the time series of housing investment, real disposable income per capita and interest rates.

In the case of Cyprus, various studies identify a large number of house price dynamics. In the seminal work of Pashardes and Savva (2009), it was shown that there is positive correlation between house prices and the cost of construction materials, labour cost, credit, sterling/euro exchange rate and wealth effects. On the other

hand, stock market returns and foreign workers seem to have an inverse relationship with residential property prices. A European Commission study on Cyprus real estate market Coutinho et al. (2018) estimated various house prices models, using as explanatory variables the purchasing capacity, housing stocks, sales to foreigners, households' deposits and loans and the household non-performing loans ratio. Michail and Thucydides (2019) examine the impact of foreign demand on residential property prices in Cyprus in the period 2008 - 2017, showing evidence that foreign demand was a key factor in property prices dynamics. The study also provides evidence that residential property prices are also driven by growth income dynamics, credit, cost of construction, interest rates and inflation. Sivitanides (2015) examines various model specifications that capture the driving forces of residential property prices in Cyprus, explaining up to 70% of the price changes. The study shows that nominal GDP per capita has the largest impact on prices, followed by construction costs and demographic factors captured by the number of households, while interest rates were found to have the smallest effect. Interestingly, the study also finds evidence that the effect of GDP growth on property prices was stronger before the Lehman Brothers collapse. Finally, Andreou and Pashiourtidou (2019) show evidence of significant correlation between residential property prices in Cyprus and survey variables (in levels) capturing the sentiment in the market, as well as with the quarterly growth rates of GDP, investment in housing, and unemployment, although their contemporaneous relationship with residential property prices has not been tested in a regression framework. Of relevance is the Box included in the Central Bank of Cyprus (CBC) Economic Bulletin of June 2016 (CBC, 2016), which examines house price dynamics in Cyprus vis-a-vis their economic fundamentals. The CBC used a VECM model along with a Hondrick-Prescott filter in order to estimate the equilibrium at each point in time, and it is shown that residential property prices were overvalued from 2007 onwards, peaking in 2008, before coming closer to the fundamentals in 2009.

There is a plethora of research on the drivers of property price dynamics, albeit specific literature on the time varying properties of factors affecting residential property dynamics is limited. The current study, in essence, uses factors that have been found to be consistently important drivers of residential property prices both across countries and across time.

3 Methodology

3.1 Bayesian Vector Autoregression

The methodology employed is based on a general B-VAR model with n endogenous variables, p lags, and m exogenous variables, written as:

$$\begin{pmatrix} y_{1,t} \\ y_{2,t} \\ \vdots \\ y_{n,t} \end{pmatrix} = \begin{pmatrix} \alpha_{11}^1 & \alpha_{12}^1 & \dots & \alpha_{1n}^1 \\ \alpha_{21}^1 & \alpha_{22}^1 & \dots & \alpha_{2n}^1 \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{n1}^1 & \alpha_{n2}^1 & \dots & \alpha_{nn}^1 \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \\ \vdots \\ y_{n,t-1} \end{pmatrix} + \dots + \begin{pmatrix} \alpha_{11}^p & \alpha_{12}^p & \dots & \alpha_{1n}^p \\ \alpha_{21}^p & \alpha_{22}^p & \dots & \alpha_{2n}^p \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{n1}^p & \alpha_{n2}^p & \dots & \alpha_{nn}^p \end{pmatrix} \begin{pmatrix} y_{1,t-p} \\ y_{2,t-p} \\ \vdots \\ y_{n,t-p} \end{pmatrix}$$
$$+ \begin{pmatrix} c_{11} & c_{12} & \dots & c_{1m} \\ c_{21} & c_{22} & \dots & c_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ c_{n1} & c_{n2} & \dots & c_{nm} \end{pmatrix} \begin{pmatrix} x_{1,t} \\ x_{2,t} \\ \vdots \\ x_{m,t} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{nt} \end{pmatrix} \tag{1}$$

In compact form the model can be rewritten as:

$$y_t = \quad A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + C x_t + \varepsilon_t \tag{2}$$

where t=1,2,...,T, y_t=$(y_{1,t}, y_{2,t}, \dots, y_{n,t})$ is a n X 1 vector of endogenous data, $A_1, A_2, \dots, A_p$ are p matrices of dimension n X n, C is a n X m matrix, and x_t is a m X 1 vector of exogenous regressors which can be constant terms, time trends, or exogenous data series. ε_t=$(\varepsilon_{1t}, \varepsilon_{2t}, \dots, \varepsilon_{nt})$ is a vector of residuals following a multivariate normal distribution:

$$\varepsilon_t \sim N(0, \sum) \tag{3}$$

ε_t is assumed to be non-autocorrelated while $\sum$ is a n X n symmetric positive definite variance-covariance matrix. T is the size of the sample used for the regression. In what follows, y_t consists of the year-on-year growth rate of the construction cost index, interest rate on housing loans, housing loans, residential investment, Foreign Direct Investment (FDI) in the real estate and RPPI. All endogenous variables enter the model as annual percentage changes, except FDI in the real estate and interest rates on mortgage loans which enter the model in levels. x_t includes a constant term and some deterministic time dummies. To estimate the B-VAR model the independent normal-Wishart prior is employed.

3.2 Historical decomposition of BVAR

The aim of this paper is to establish the contribution of different structural shocks to the historical dynamics of the RPPI. For every quarter in the sample, the growth rate of the RPPI is decomposed into its different components. This identifies the historical contribution of each shock to the observed data sample of the RPPI. The

historical decomposition summarises the history of each endogenous variable in the light of the B-VAR. So the question to be answered is: "Given the estimated model, what is the sequence of shocks that is able to replicate the time series of RPPI?" In this paper the focus is to establish the contribution of each structural shock on the (i) construction cost index, (ii) interest rate on housing loans, (iii) housing loans, (iv) residential investment and (v) FDI in the real estate sector to the growth dynamics of RPPI.

In what follows, it is shown that each variable in the B-VAR can be written as in terms of present and past structural shocks, along with its exogenous component. First, note that an alternative specification of the reduced B-VAR model (2) is the structural B-VAR model, written as:

$$D_0 y_t = \quad D_1 y_{t-1} + D_2 y_{t-2} + \cdots + D_p y_{t-p} + F x_t + \eta_t \tag{4}$$

with $\eta_t \sim N(0, \Gamma)$, a vector of structural innovations with variance-covariance matrix Γ assumed to be diagonal so that impulse response function are not suffering from shock correlation and structural shocks are uncorrelated, arising independently. Defining

$$D = \quad D_0^{-1} \tag{5}$$

and premultiplying both side of (4) by D, it can be obtained that:

$$A_i = \quad DD_i \tag{6}$$

$$C = \quad DF \tag{7}$$

and

$$\varepsilon_t = \quad D\eta_t \tag{8}$$

Given that the model can also be written as an infinite order moving average process:

$$y_t = \quad A(L)^{-1} C x_t + \Psi_0 \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \Psi_2 \varepsilon_{t-2} + \ldots \tag{9}$$

it is noted that $\Psi_1, \Psi_2, \Psi_3, \ldots$ represent the impulse response functions of the reduced form B-VAR.

Using (8), (9) can be reformulated as

$$y_t = \quad A(L)^{-1}Cx_t + \sum_{i=0}^{\infty} \tilde{\Psi}_i \eta_{t-i} \tag{10}$$

where

$$\tilde{\Psi}_0 \equiv D \quad and \quad \tilde{\Psi}_i \equiv \Psi_i D \quad for \quad i = 1, 2, 3, \ldots. \tag{11}$$

The series D,$\tilde{\Psi}_1$,$\tilde{\Psi}_2$, ... represent the impulse response functions of the structural B-VAR, that is, the response of the B-VAR variables to structural innovations.

The equations above are used to show how the model (2) can be decomposed into the historical contribution of deterministic variables and the historical contribution of structural shocks. Using backward substitution, model (2) can be rewritten as:

$$y_t = \quad \sum_{j=1}^{p} A_j^{(t)} y_{1-j} + \sum_{j=0}^{t-1} C_j x_{t-j} + \sum_{j=0}^{t-1} B_j \varepsilon_{t-j} \tag{12}$$

where the matrix series $A_j^{(t)}$, C_j and B_j are (potentially complicated) functions of A_1, A_2, ..., A_p. Note also that the matrices B_1, B_2, ..., B_{t-1} provide the response of y_t to shocks occurring at periods t,t-1,...,2,1. Therefore, by definition, these are the series of impulse response function matrices, Ψ^j:

$$B_j = \quad \Psi^j \tag{13}$$

Using (8), (11) and (13), the impulse response function can be written in terms of the structural shocks:

$$\Psi_j \varepsilon_{t-j} = \quad \Psi_j D D^{-1} = \tilde{\Psi}_j \eta_{t-j} \tag{14}$$

So that (12) can then be rewritten as:

$$y_t = \quad \sum_{j=1}^{p} A_j^{(t)} y_{1-j} + \sum_{j=0}^{t-1} C_j x_{t-j} + \sum_{j=0}^{t-1} \tilde{\Psi}_j \eta_{t-j} \tag{15}$$

Equation (12) makes it clear that y_t can be separated into two parts: one due initial conditions and deterministic exogenous variables (first and second term in the right hand side of (12), respectively) and one due to the contribution of unpredictable structural disturbances affecting the dynamics of the model (third term in the right hand side of (12)). Because it is only the latter part which is of interest in this exercise, one may simply rewrite (15) as:

$$y_t = \quad d^{(t)} + \sum_{j=0}^{t-1} \tilde{\Psi}_j \eta_{t-j} \tag{16}$$

where $d^{(t)}$ is a n x 1 vector of contributions from deterministic variables and initial conditions. Therefore, for each variable in the model, the historical decomposition can

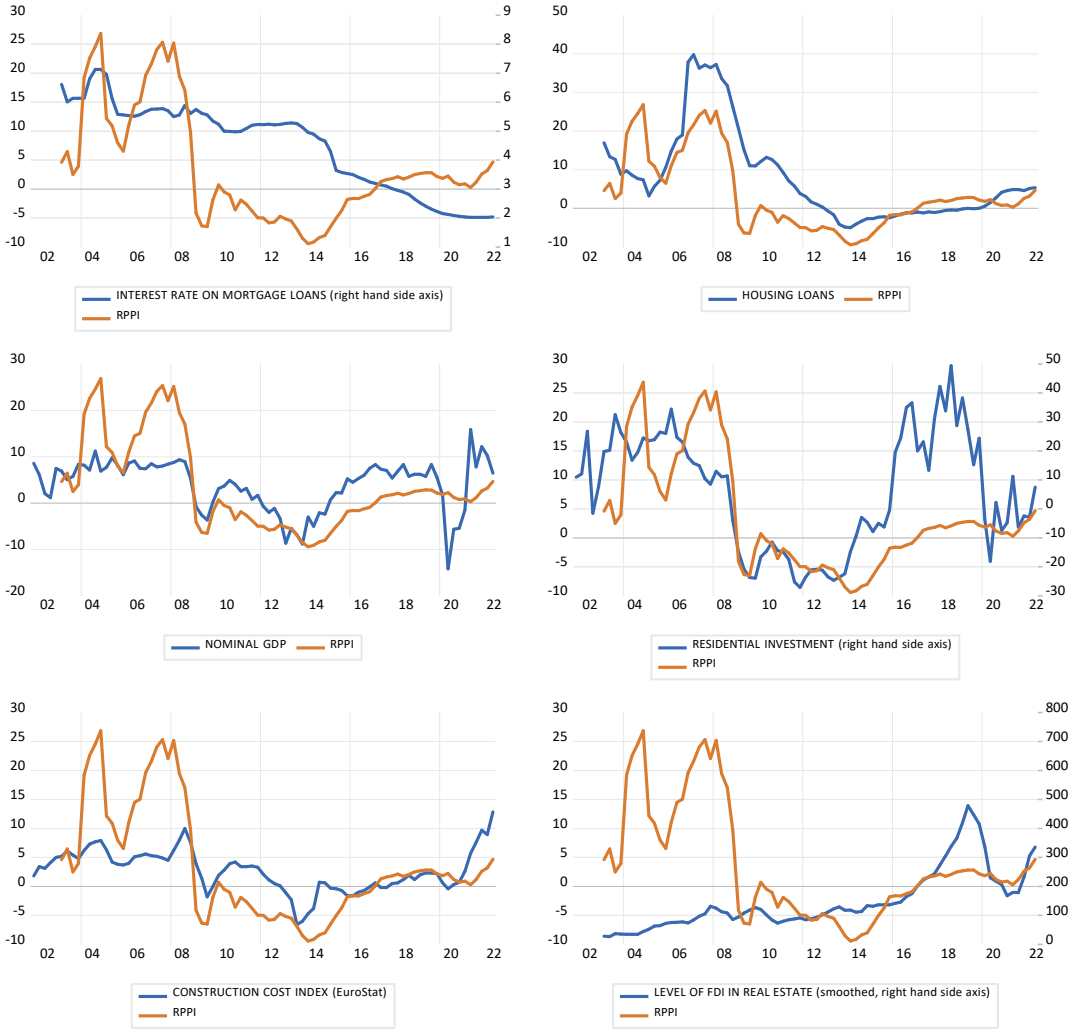
be expressed in terms of present and past structural shocks, along with its exogenous component.

4 Data

The data series used in the econometric analysis are the following: (i) residential property prices, (ii) the interest rate on mortgage loans, (iii) housing loans, (iv) construction cost, (v) residential investment and (vi) FDI in the real estate sector. The Residential Property Price Index (RPPI) has been obtained from the CBC website. The interest rate on housing loans corresponds to the interest rate on loans to households for house purchase (outstanding amounts) collected from the ECB Statistical Data Warehouse (SDW). Housing loans correspond to the outstanding amount of loans to households for house purchase, as obtained from CBC's Monetary and Financial Statistics. The construction cost index was collected from EuroStat while residential investment has been taken from the National Accounts, published by Cyprus Statistic Service (CyStat). Publicly available data for the FDI in the real estate has been collected from the European Commission. Data cover the period 2003Q1-2022Q2. The model was estimated using ECB's Bayesian Estimation, Analysis and Regression toolbox (BEAR) of Dieppe et al. (2016), using four lags.

Figure (1) depicts the evolution of RPPI growth rate along important indicators in the real estate market. The Figure demonstrates that the RPPI attains strong cross correlation with a number of other variables in certain time periods. For instance, it is shown that growth in the housing loans closely follows RPPI growth rates throughout the sample. Similarly, growth in residential investment exhibits high correlation with RPPI growth rates. Other variables become correlated with RPPI to a greater or lesser extent, depending on the underlying economic environment. For instance, the interest rate on housing loans seems to have a strong negative correlation with RPPI growth rates over the last 10 quarters of the sample, over which lending to households for house purchased has been encouraged by the low interest rate environment. It is clear from Figure 1 that the relative contribution of each variable to the RPPI volatility is likely to vary across time, depending on the prevailing economic conditions.

Figure 1: Real estate indicators and RPPI fluctuations, year-on-year growth rates, %



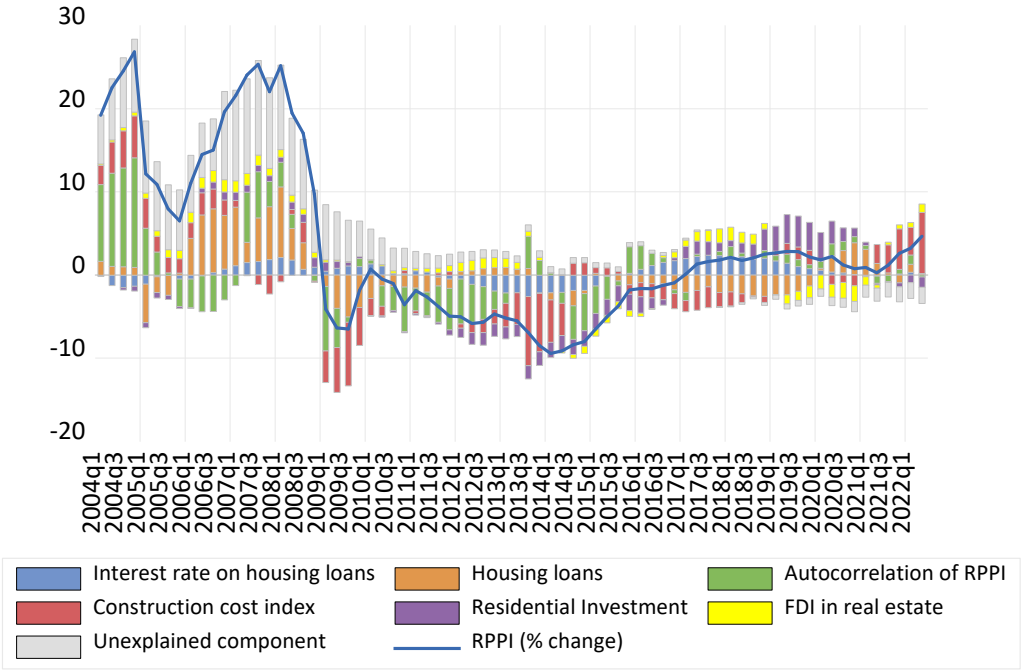
Note: FDI is shown in € million and interest rate in percentages.

5 Results

The historical decomposition of RPPI fluctuations has revealed that the chronicle of real estate market can be broadly grouped into seven regimes. Over each regime, the prevailing idiosyncratic economic conditions determined to a large extent the important forces that governed the evolution of RPPI growth rates. Figure 2 shows the contribution of each variable to RPPI growth rates over the sample considered. The broad picture provided by the decomposition verifies the fact that different factors become the dominant drivers of RPPI over different time periods. Over the whole period, housing loans seem to play a prominent role in explaining RPPI fluctuations, with FDI in the real estate and interest rates on housing loans having the least explanatory power across time.

5.1 Historical Decomposition

Figure 2: Historical decomposition of Residential Property Price Index fluctuations



2004Q1 - 2005Q4 - EU accession

In the first regime, ranging from 2004Q1 to 2005Q4, the bulk of RPPI fluctuations can be attributed to autocorrelation. The strong upward trend of RPPI growth rates during the first year of the sample has been supported by the strong tendency of RPPI to maintain momentum. The strong impact from the autocorrelation terms may be stemming from the fact that, following the stock market crash in Cyprus around 2000, large amounts of investment moved to the real estate sector, leading to residential property price increases. At the same time, the EU accession of Cyprus in 2004, which was accompanied by a catching up in economic activity (Figure 1) (also evidenced in the high growth rates of residential investment). During the same period, construction costs escalated, reaching annual growth rates of 7,8% (Figure 1) and reaching their highest value over a period of eight years. This is reflected in Figure 2, which shows that construction costs contributions were important over this regime. Although the negative contribution of interest rates on housing prices is modest in 2004, it is coupled with the negative contribution of housing loans in the subsequent quarters, reflecting the large deceleration of housing loans over the aforementioned period (Figure 1). The introduction of mortgage loan plans with long-term repayment schedules and low installments by local banks in the period 2002-2003 has led to large acceleration in housing loans according to Loizou (2007). The impact of this introduction was estimated to have increased local demand by four times (Loizou (2007)). At the same

time, banks have offered long-term mortgage financing to foreigners for the first time, while demand from abroad increased, as a possible solution to the Cyprus problem and the EU accession seemed to be approaching at the time. The aforementioned deceleration in housing loans in the period 2004-2005 can be attributed to both the decrease in the Loan-to-Value (LTV) ratio by the CBC from 85%-90% to 75%-80% and the increase of 100 basis points in the basic interest rate from the CBC (Loizou (2007)). FDI in the real estate and residential investment seem to have played a minor role in RPPI dynamics during this period. It is worth noting that foreign demand was subdued as other countries such as Bulgaria, Turkey, Croatia have started to become competitive property investment destinations. Moreover, the unfavorable GBP/CYP exchange rate for British buyers, who constituted the largest source of FDI in Cyprus at the time, also contributed to the limited foreign demand.

2006Q1 - 2008Q3 - Credit overheating

This regime is characterised by important developments in the real estate market. Among other things, Cyprus accession in the EU resulted to increased foreign investors' interest relative to the past, while domestic investors started searching for alternative types of investments, mainly in the real estate. This, coupled with the relative decrease in interest rates right after the Cyprus accession in the EU, led to substantial credit expansion for house purchase (possibly also supported by loose credit standards[2] and by the entrance of Cyprus to the Exchange Rate Mechanism II, which led to excess liquidity[3]), generating a new impetus in the real estate market, as reflected by the accelerating RPPI growth. Having said that, a possible explanatory factor for the relatively large unexplained component, which exists in this period, could have been the banking liquidity. It is also worth noting that a published CBC study has estimated residential property prices in Cyprus to be overvalued during the period examined in this regime CBC (2016). The rapid expansion in housing loans and residential investment, as well as the large increases in residential property prices are evident in Figure 1. The historical decomposition confirms the increasing importance of housing loans which dominate the dynamics of RPPI. To a lesser extent, the interest rates, FDI in the real estate and residential investment also contribute positively, although the positive impact of residential investment might also be driven by the credit expansion.

2008Q4 - 2010Q4 - Financial crisis

Contrary to the developments in the previous regime, this regime is marked by the domino effects of negative consequences in the global economy after the collapse of the Lehman Brothers, with residential property prices, as a result, recording signifi-

[2]The Bank Lending Survey of CBC provides data on credit standards since 2008, so the assertion of loose credit standards cannot be confirmed quantitatively.

[3]Excess liquidity is attributed to the fact that Euro was the domestic currency which was liable to less strict supervisory rules.

cant downward correction. The historical decomposition (Figure 2) reveals that the significant negative contribution in RPPI evolution stems from housing loans, the autocorrelation terms of RPPI and the construction cost index. Indeed, in 2009, a considerable deceleration was recorded in the construction cost index, attaining negative growth in 2009Q3. Housing loans have also substantially decelerated, following the rapid expansion in the previous years. In effect, the reduction in the strictness of credit conditions and credit demand resulted to decreases in residential property prices. The role of unexplained component, residential investment and interest rates, that positively contribute to RPPI growth, is small. It is worth noting that towards the end of this regime the negative year-on-year changes in RPPI were decelerating and stabilised in mid-2010, possibly a sign that the market believed at the time that economic problems would be temporary.

2011Q1 - 2014Q4 - Sovereign and banking crisis

This was a period of unprecedented economic turmoil for the Cyprus' economy, marked by a dual crisis: On one hand, the restructuring of Greek public debt under the Private Sector Involvement (PSI) had an immediate impact on Cyprus banking sector and on the other hand, the unsustainable fiscal path has led to significant vulnerabilities. The exposure of Cypriot banks to overleveraged local property companies, the downgrading of the Cypriot government's bond credit rating to junk status by international credit rating agencies and the consequential inability to refund its state expenses from the international markets led to depositors losing their savings in the government's efforts to bail in local banks. The troubled economic environment was immediately reflected in the real estate market, with RPPI recording historically large decreases and Cypriot economy entering a double-dip recession. Initially, and up until 2012Q4, RPPI dynamics were mainly affected by the autocorrelation terms that weighed RPPI downwards (Figure 2), reflecting the deterioration in the economy, while FDI in the real estate sector generated a modest positive contribution. From 2013Q1 until 2014Q4, the most important determinant of RPPI dynamics was the construction cost index which at the time experienced prolonged decreases (Figure 1). The interest rates on housing loans and residential investment also played a non negligible role, driving RPPI further down. As it can be seen from Figure 1, under this regime, residential investment was severely affected, recording the highest drop in the sample considered. It should be noted that the exogenous shocks do not appear in the contribution over this regime, suggesting that the endogenous variables in the model capture to a great extent the drivers of RPPI.

2015Q1 - 2016Q4 - Decelerating RPPI

Decreases in year-on-year growth rates of RPPI are still sustained in this regime, albeit to a lesser extent, reflecting the gradual reversal in market sentiment. Resi-

dential investment still drives RPPI down while construction costs and housing loans only generate a modest contribution to negative RPPI growth. Signs of the imminent recovery have started to show up with positive contribution coming from the autocorrelation terms and interest rates in 2016 (Figure 2).

2017Q1 - 2020Q4 - Investments in the real estate

Since September 2016[4], investors could have benefited from an amended Cyprus Investment Programme which provided Cypriot passport in a short processing time, had they invested a predefined amount in the Cyprus economy, including the real estate sector[5]. To this end, in 2018-2019, FDI in the real estate is shown to play an important role in determining RPPI dynamics. Similarly, the contribution of residential investment picked up, becoming the dominant force in 2018-2020. The rising contribution of residential investment is confirmed by the surge in residential investment up until the end of 2019, as depicted in Figure 1. The co-existence of positive contribution of residential investment in 2020, and the negative growth rates in residential investment can be attributed to the time-lag required for a shock to show in the endogenous variables. This can be confirmed by the impulse response function of a shock in residential investment on RPPI, which requires some time to peak, as depicted in Figure 4. The declining interest rates on housing loans are also shown to positively contribute to RPPI developments, albeit to a lesser extent. On the other hand, growth in the housing loans has remained subdued, fluctuating around zero over this period, and contributing negatively to RPPI. Contrary to other European economies where the ultra-loose monetary policy implemented has encouraged over-borrowing and generated credit-linked bubbles in the real estate, the recovery of the real estate market in Cyprus cannot be attributed to credit overheating. The strict lending criteria, evidenced in the CBC Bank Lending Survey, as well as the change in Debt-Service-to-Income (DSTI) calculation[6] should have also played an important role in preventing over-borrowing. Construction costs also contribute negatively to RPPI, with the relevant construction cost index either stabilising or recording trivial increases.

2021Q1 - 2022Q2 - Surge in construction costs

This regime is marked by surging construction costs as evidenced in Figure 1, caused initially by the supply chain disruptions during the covid-19 pandemic and subsequently deteriorated due to the war in the Ukraine. The historical decomposition clearly confirms that construction costs drive RPPI up, representing the majority of contributions and highlighting that in the absence of rising construction costs, RPPI

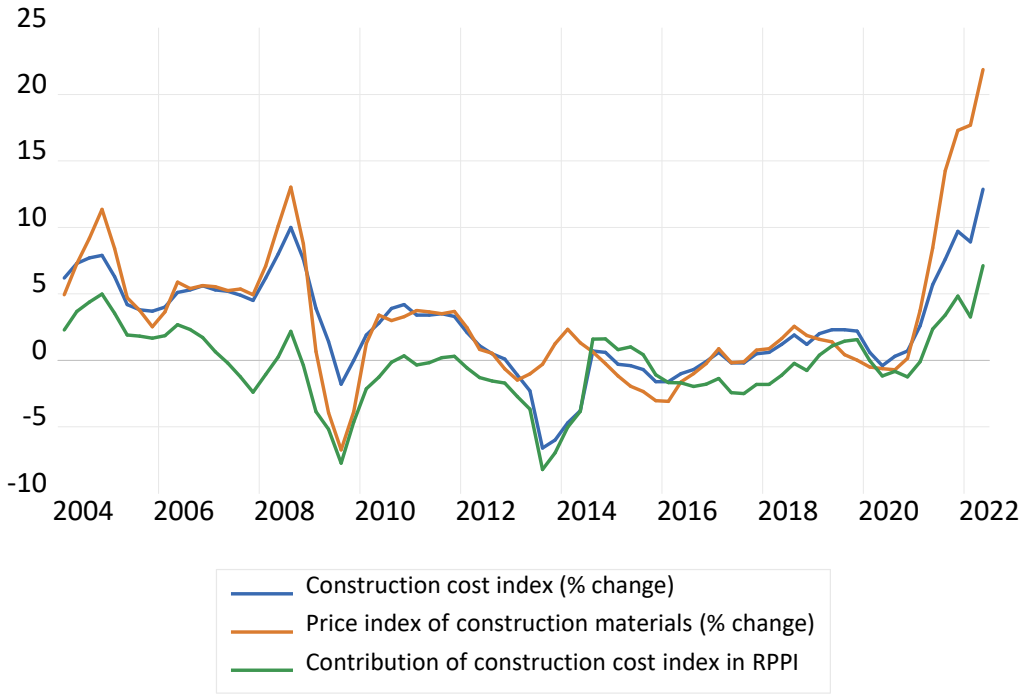
[4]The Council of Ministers Decisions dated 13.09.2016 but there was also a subsequent decision on 21.05.2018.

[5]In 2018, the requirement to obtain the citizenship was for the applicant to make a minimum investment of €2 million (including investment in immovable property) and purchase a residential property in Cyprus with minimum value of €500,000.

[6]The change in DSTI calculation concerns the use of net income instead of gross income.

would either have stabilised around zero or have recorded small decreases. Figure 2 also demonstrates the (small) positive contribution of housing loans which has been rising, possibly due to the state aid scheme of interest rate subsidy concerning mortgage loans. The modest positive contribution of FDI in the real estate might reflect the positive impact of new tax reliefs promoted by the state in the context of international headquartering, which aim at attracting foreign talented professionals and high-tech companies in Cyprus. While the full impact of international headquartering on the real estate market has not been shown yet, there is evidence that it has contributed to the increase of rents, especially in the districts of Limassol and Paphos. It is worth mentioning that a possible contributing factor to the RPPI increases is the significant immigration over the last quarters, for which, however, no detailed, timely and lengthly time series exists in order to be analysed.

Figure 3: Contribution of construction cost index in RPPI fluctuations and year-on-year changes in the construction cost index and price index of construction materials



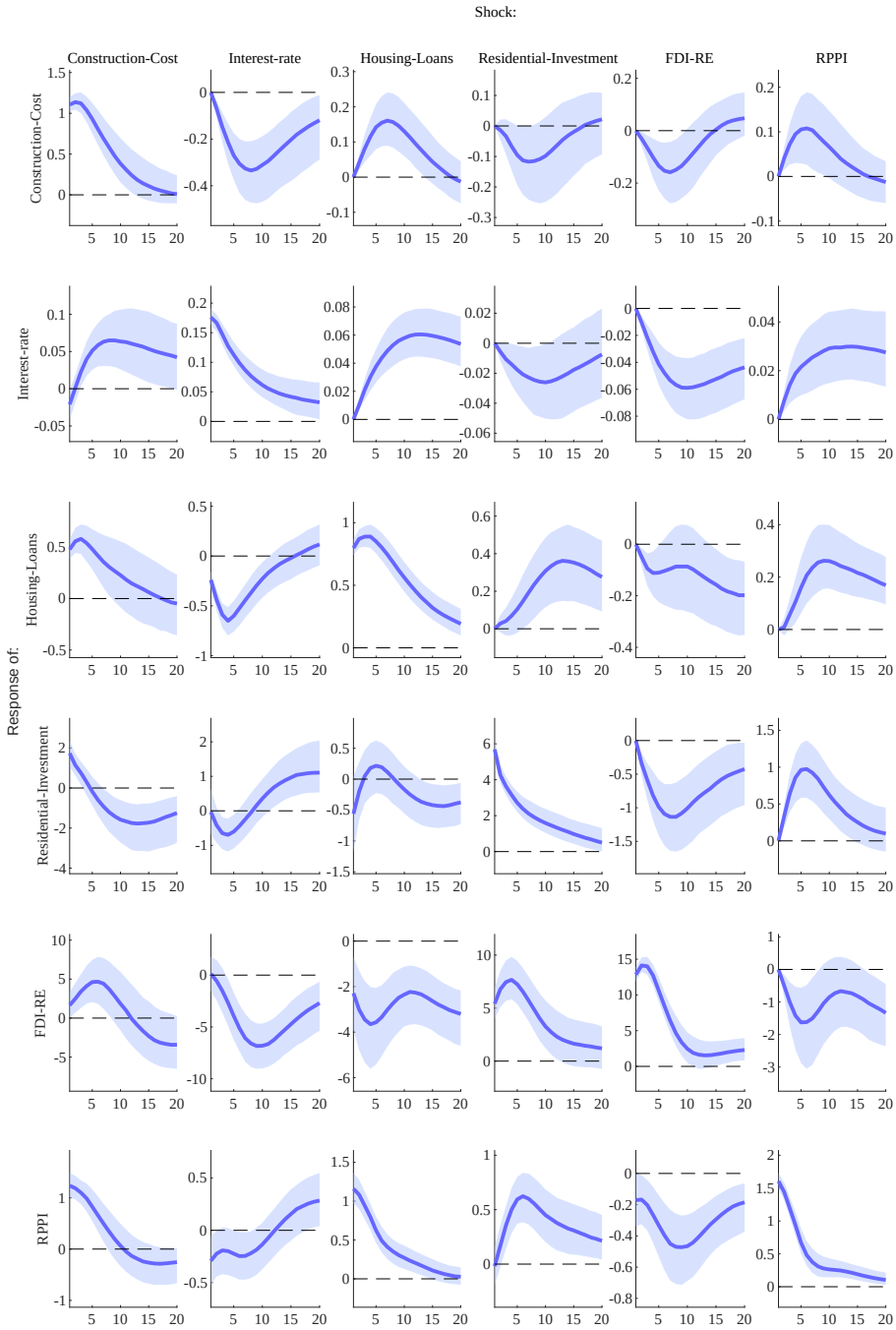
The analysis based on Figure 2 emphasises the predominant role of construction costs in RPPI dynamics, in certain periods. It is clear that, depending on the evolution of the construction costs, their importance becomes discreet to a varying degree. Figure 3 also confirms that, historically, the relationship between changes in the price of construction materials and the contribution of construction costs in RPPI changes is not linear or constant through time. Generally, significant drops in the price of construction materials, such as those observed in 2009Q3, are associated with strong response of contribution of construction costs in RPPI changes. In these cases the

pass-through of the price of construction materials in residential property prices seems to be strong. Instead, significant increases in the price of construction materials, like those observed in 2008Q3 and over the recent quarters, do not induce the corresponding immediate response of the contribution of construction costs in residential property prices, which seem to remain relatively subdued compared to the immense increases in the price of construction materials. This, inter alia, might be associated with the fact that part of the price increases are absorbed by the developers, squeezing their profit margins (pricing to market behaviour). In addition, the rising cost of construction materials concerns only newly built dwellings, which only constitute a small part of residential properties included in RPPI. Hence, any spill-over effects in the prices of second-hand residential properties are likely to take some time to become evident.

5.2 Impulse response functions

The dynamics of the different shocks are also depicted in Figure 4, which presents the impulse response functions (IRFs) estimated by the model. The main focus here is the response of RPPI in one standard deviation shock of the rest of the endogenous variables of the BVAR model (last row of Figure 4). A 1 standard deviation shock (corresponding to a 1,3% increase) in the construction cost has a positive impact of 1,1% on residential property prices in the first year, which decays with time. A shock on interest rate has a negative impact on RPPI, which is in agreement with economic theory. Specifically, a 0,22% increase in interest rates results to around 0,23% decrease in RRPI in the first year, also decaying with time. It is worth noting that according to the IRFs produced by the model, an increase in interest rates has a negative impact on housing loans, which provides further evidence of the plausibility of the results. Specifically, an increase of 0,22% in mortgage interest rates results to a decrease in housing loans by around 0,5% in the first year. As regards the impact of housing loans on the RPPI, the IRFs show a positive relationship, as expected by economic theory. A 1,2% increase in housing loans results to a 1% increase in RPPI in the first year. A shock in residential investment also contributes positively to RPPI, although the largest blow of the impact is felt in the second year. While the negative relationship of FDI in the real estate sector and the RPPI seems odd, evidence from the BVAR coefficients reveals a weak link between the two series (coefficients of all four lags in the model are close to zero). Finally, the importance of the autocorrelation terms of RPPI is shown by the positive contribution of an RPPI shock.

Figure 4: Impulse response functions



5.3 Robustness check

It should be noted that model results remain robust to a number of changes. Specifically:

- An alternative construction cost index has been employed, which is constructed by Cystat, delivering very similar results. The difference with the Eurostat index is that it contains only the cost of construction materials, while the Eurostat one, which has been used in this paper, captures labour cost as well. As such, the Cystat index has shown even stronger contribution of construction cost to the recent RPPI increases.
- The order of the variables in a B-VAR affects the impulse response functions. Usually, the most exogenous variables enter first. In this set up, the order in which the endogenous models entered the model was: Construction cost index, interest rate on housing loans, housing loans, residential investment, FDI in real estate and RPPI. Altering the order of the variables does not significantly affect the results.
- Results are not sensitive to the choice of the lags either (2 lags vs 4 lags have been tested).
- Similar results are obtained if the B-VAR model is estimated using different priors (e.g. independent Normal-Wishart, Minnesota, etc).
- An alternative set of endogenous variables has also been examined (for instance, using the nominal GDP instead of residential investment to capture economic activity or including sentiment indicators like the building activity indicator from the European Commission surveys) without substantially altering the results.

6 Conclusion

Residential real estate in Cyprus has been through various vicissitudes through the course of history, having experienced significant volatility in residential property prices at times, impacted by various irregular economic developments (such as the bail in of local banks, the pandemic and the war in Ukraine). The historical analysis of the driving forces of residential property prices examined in this paper sheds light regarding the evolution of the RPPI in various time regimes. Notably, each period had its own main driving force(s), confirming, in many cases, a-priori market beliefs about the causes of RPPI drivers. The historical decomposition has the additional benefit of quantifying these drivers, thus giving good indication of the magnitude of the impact of each variable on RPPI at each point in time.

Another important insight provided by the historical decomposition analysis relates to financial stability. Particularly, distinction between changes in macroeconomic and other fundamental drivers of the real estate market and non-fundamental drivers that can potentially lead to overvaluation in residential property prices is of high importance when assessing the health status of the sector.

Furthermore, this paper provides solid evidence on the significant impact of the high construction cost on residential property prices in recent quarters (2021Q2-2022Q2), revealing that in the absent of such increases in the construction cost, the growth rate of residential property prices in Cyprus would hover around zero (i.e. recording stabilisation instead of accelerating increases). Knowing the main driver and its magnitude of its impact is important, since, on one hand, it indicates that any actions to limit credit availability to the market would have weak results in tackling the accelerating increases in the RPPI, and, on the other hand, it would suggest that future normalisation in the construction cost (i.e. declining back to its pre-pandemic levels) could result to decreases in residential property prices. In all, considering that this paper sheds light on a topic for which literature in Cyprus is limited, future investigations could include using various transformations of the foreign direct investment in the real estate sector, or even using different proxies for foreign demand to better capture this driver of RPPI. Also, investigating the addition of more supply side variables could potentially enhance the robustness of the model. Using different econometric models (such as OLS regressions, regime switching models and time-varying parameters models) could provide further evidence on the main drivers of residential property prices.

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Appendices

A B-VAR residual diagnostics

Figure 5: Actual against fitted values in the B-VAR

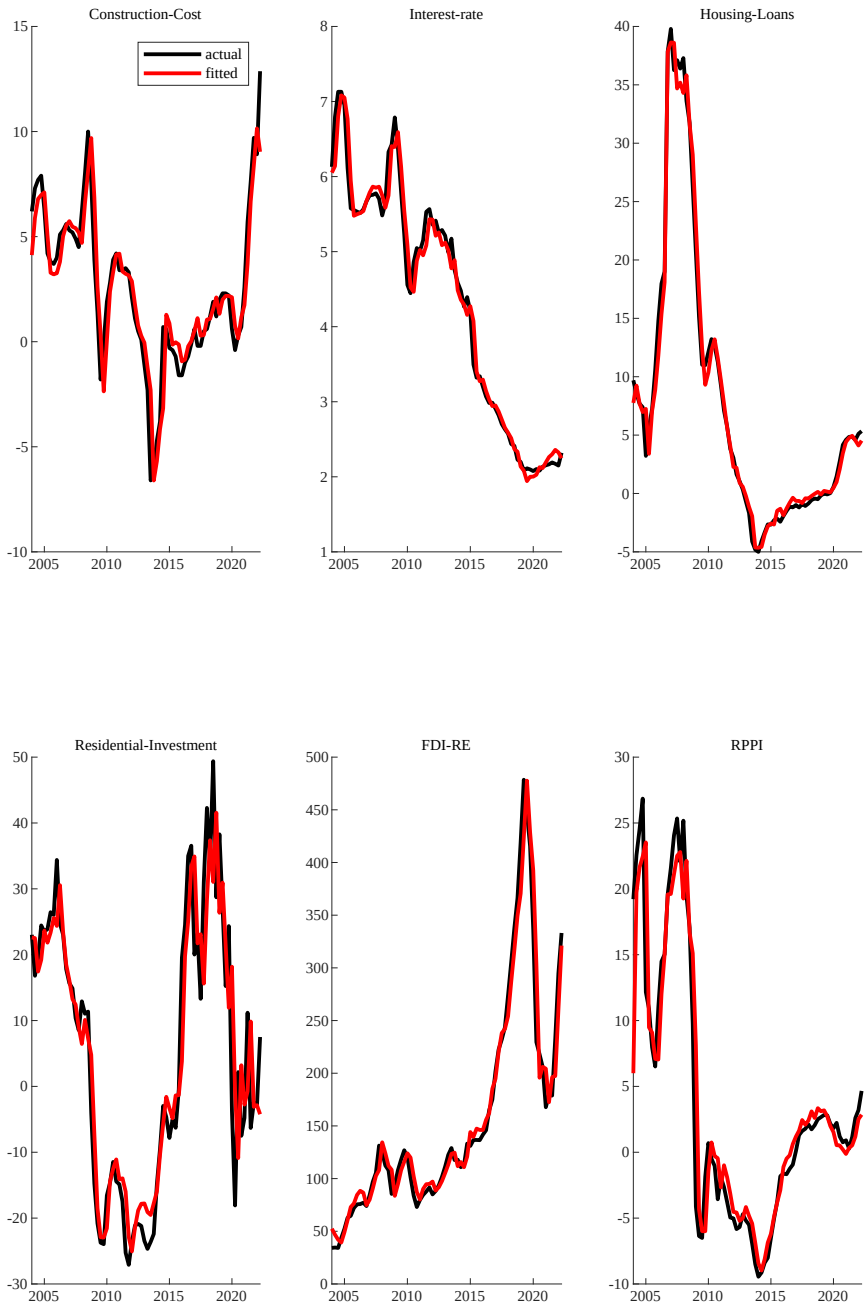

Figure 6: Residuals in the B-VAR