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Credit, House Prices and the Macroeconomy in Cyprus

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Abstract

This paper examines the existence of a link between house prices, credit and macroeconomic conditions in Cyprus, using a vector error correction model (VECM) and quarterly data from 2005Q4 to 2016Q4. Overall, the results suggest that a link exists and that house prices have a bi-directional relationship with loans and the unemployment rate. Macroeconomic conditions matter for the Cyprus economy as an unexpected shock in unemployment is found to have a persistent impact on all the variables in the model. The interest rate is also found to have an effect on wages and house prices.

Keywords: credit, house prices, VECM, Cyprus

JEL Classification: E44, E50, R20

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Credit, House Prices and the Macroeconomy in Cyprus

1. Introduction

Following the turn of the century, most developed economies experienced strong rates of money and credit growth associated with house price increases. The link between the two became evident by 2008, when the global financial crisis was full blown. As the crisis evolved, the interaction between credit and house prices was already considered as the root cause (Duca et al, 2010).

In the case of Cyprus, a similar phenomenon was observed during the period preceding its entry into the European Union in 2004. Fuelled by real estate demand and strong domestic credit growth property prices and construction activity soared. During the period 2006-2008, credit growth in Cyprus surged further and intensified following the irrevocable fixing of the Cyprus pound against the euro in July 2007 at its ERM II central parity.¹ The main factors behind this increase were the perceived lower foreign exchange risk and the anticipated convergence of interest rates towards euro area rates. The two factors generated a climate of euphoria in the real estate sector both for Cypriot and foreign buyers, which boosted demand and led to an escalation in property prices. In addition, an influx of foreign deposits, attracted by higher interest rates compared to the rest of the euro area, further boosted credit growth which, in its turn, was aimed at housing projects. Indeed, the sharp rise in property prices observed in Cyprus from 2006 onwards was among the highest across euro area countries (Argiridou-Dimitriou et al., Ch.6, 2012).

¹ In text credit and loans are used interchangeably and refer to Monetary Financial Institutions (MFIs) lending to non-MFIs.

The above developments raise an important question: are the observed developments in house prices, loans, unemployment and other macroeconomic variables caused by a common driving force, such as the economic cycle, or are they due to direct linkages between the said variables? Furthermore, if a direct link exists, does it run from houses to loans and the other macroeconomic variables, does causality flow the other way or is there evidence of the connection moving in more than one directions?

Building on the findings of the literature (see also next section), this paper examines, for the first time the possible existence of such a link in Cyprus. In particular, by employing cointegration analysis and vector error correction models (VECM), we allow for the assessment of the dynamics of credit, house prices and macroeconomic developments in the island. Through the use of quarterly time series data from 2005Q4 to 2016Q4, the findings show evidence of a bi-directional relationship between loans and house prices and between unemployment and house prices. That is, changes in loan growth are foreseen to affect house prices, whilst changes in house prices will also have an impact on loan growth. Furthermore, wages affect unemployment and vice versa. Macroeconomic conditions are extremely important for the Cyprus economy, as an unexpected shock in unemployment has a persistent impact on all the variables employed in the model. Interest rates are also found to have an effect on wages and house prices but a smaller effect on the other variables.

The remainder of the paper is structured as follows: Section 2 provides a short overview of the related literature with Section 3 describing the set of data employed. Section 4 describes the empirical methodology used; Section 5 presents the empirical results, impulse responses and variance decomposition while Section 6 concludes.

2. An overview of the literature

The existing literature has presented evidence that higher house prices induce homeowners to spend and borrow more, via a wealth effect, hence providing a link between housing and credit growth (see, *inter alia*, Bostic et al, 2009; Dvornak and Kohler, 2007; Gimeno and Martinez-Carrascal, 2010; Gan, 2010). As recent literature has shown, increased spending promoted by rising house prices can have a significant effect on economic growth, even at the regional level (Miller et al, 2010; Davis and Palumbo, 2001). Further to this, as Iacoviello and Minetti (2008) point out, monetary policy transmission is also affected by the housing finance system, through the bank balance sheet channel.

In general, other researchers have taken up the task of exploring the linkage between house prices, credit and the macroeconomy for a number of countries, with most studies using macro-level data. In the study most closely related to this, Goodhart and Hofmann (2008) examine the linkages between money, credit, house prices and economic activity in 17 industrialised countries. Using quarterly data from 1970-2006 and a fixed-effects panel VAR, they find that shocks to house prices, credit and money have a significant impact on economic activity and aggregate price inflation. Shocks to GDP, CPI and the interest rate also have an effect on house, money and credit. The effects are stronger when prices are booming. Overall, the authors find evidence of a significant multidirectional link between house prices, monetary aggregates and the macroeconomy.

The importance of the relationship is further confirmed by Arestis et al (2014) who endogenise the development of bank credit by paying special attention to those variables that are related to the real estate market. In particular, they assume that the

main source of demand for credit emerges from households' desire to acquire housing and they confirm this relationship using cointegration techniques in nine OECD countries. Building on these results, Anundsen et al (2016) use the link of credit and housing to explore how developments in the two affect the likelihood of a financial crisis. Using quarterly panel data for 16 OECD countries which experienced financial crises they show that private sector credit and housing market exuberance have a positive and significant impact on the probability of a crisis.

The link between credit, housing and the macroeconomy has also attracted the interest of country-specific studies. For example, Muellbauer and Murphy (2008) explore the multiple interactions of housing markets with the rest of the economy in the UK. They find that income, housing stock, demography, credit availability, interest rates and lagged appreciation drive house prices. Housing collateral and down payment constraints are also found to have a significant role in house price variations. With regard to the US and the euro area, Musso et al (2010) estimate a structural VAR and find that monetary policy shocks are more significant in the US whereas credit supply has a substantial impact in the euro area.

In Singapore, Ng and Chow (2004) study the impact of public policy decisions restraining bank credit using an error correction model (ECM) specification. The results show that both private and public sector residential properties are affected by the same mortgage rate dynamics. Turk (2015) examines the interactions between house prices and household debt over the long run and the short run using an ECM specification for Sweden. The results suggest that household borrowing affects house prices in the short run and house prices impacts household debt over the long run.

Of the few studies which have used micro-level data to investigate the housing-credit nexus, Kelly et al (2015) use micro loan-level data on Irish mortgages from 2003 to 2010 to provide estimates of the relationship between credit, house prices and macro-prudential policy. In addition, the authors find that the link between credit availability and house prices allows them to evaluate the impact of the macro-prudential limits in the mortgage market. Their findings show that macro-prudential policies have an important role in preventing a housing boom. Their results echo those of Favara and Imbs (2015) who, also using micro-level data, present evidence of the impact of credit on house prices.

In line with the literature overviewed, the remainder of this paper presents evidence of the link between house prices, credit and the macro-economy in Cyprus. Whilst no one can doubt the existence of correlation between credit, house prices and the macroeconomy in Cyprus, one cannot easily detect the direction of causality if any. To this end, we first begin by providing an overview of the data and the macroeconomic developments in Cyprus over the past decade.

3. Data

This section provides an overview of the data used in our estimations, based on existing literature and data availability. Specifically, our analysis focuses on the following five variables: loans to households for house purchase, Residential Property Price Index (RPPI), the unemployment rate, wages and interest rates charged on loans for house purchase.

Based on theory, house prices and housing loans have a positive economic relationship. An increase in house prices will lead to an increase in loans for house purchase as the ratio of the loan to the value of collateral will be greater (Adams and Fus, 2010).

Similarly, an increase demand for housing loans supported by more favourable loan supply factors (i.e. more favourable credit terms and conditions) should cause an increase in demand for houses/real estate, eventually leading to an increase in house prices (Hempell and Kok, 2010).

Andrews (2010) argues that the relationship between interest rates on housing loans and house prices is negative and depends on the level of competition among banks. When the interest rate is rising, the cost of borrowing increases and potential buyers are discouraged. As a result, housing demand and hence demand for housing loans decreases. When on the other hand, interest rates go down, the cost of housing decreases and demand for housing loans increases (Apergis and Rezitis, 2003; Igan et al, 2011). According to Frederic (2007), interest rates can affect house prices both in a direct and indirect way. The direct approach refers to the impact on the cost of capital, the expectations of future house price movements and credit supply. The indirect impact is seen through changes in housing wealth and the effect of credit channel on consumption and on demand. From a reverse point of view, Jud and Winkler and Painter (2002) and Redfearn (2002) argue that the impact of house prices on the level of interest rate is insignificant, in contrast to Zan and Wang (2012), Goodhart and Hoffman (2008) and others in the literature that consider it as one of the most important macroeconomic determinants of housing decision making.

The unemployment rate is another factor that is considered important. Smith and Tesarek (1991) found that a decrease in the housing activity leads to an increase in unemployment growth rate. Schnure (2005) estimated that a unit increase in the unemployment rate leads to a decrease in house prices by 1%.

Finally, another potential candidate for the housing-credit nexus is the level of wages in the economy, which is also expected to have a positive impact on the two variables (Davidoff, 2006). Based on existing literature, wages are used as a proxy for income expectations and are considered to have a positive and significant correlation with loans to households for house purchase as well as house prices (Valverde and Rodriguez Fernandez (2010). This makes intuitive sense as an increase in affordability driven by an increase in wages, could encourage borrowing and, given a temporary fixed supply due to the time it takes to construct new housing units, would result in a, *ceteris paribus*, increase in house prices. This increase in demand will then feed into higher residential property prices (Goodhart and Hofmann, 2008).

The inclusion of both the unemployment rate and wages is made in order to fully capture changes in the macroeconomic environment. As explained further below, developments in both variables were important in Cyprus during the past decade. In essence, the inclusion of these two variables allows us to capture both the change in the macroeconomic environment through the unemployment rate (which is directly linked to output via Okun's law) and the change in the income expectations of those who remained employed.²

Data on credit using real housing loans as a proxy, the mortgage rate and the residential property price index (RPPI) were obtained from the Central Bank of Cyprus website, while data for real wages and unemployment were obtained from the Cyprus Statistical Service. In particular loans refers to the notional stock of housing loans, RPPI refers to the Central Bank of Cyprus residential property price index, the unemployment rate

² No case of multicollinearity exists as regards wages and the unemployment rate as the respective correlation coefficient stands at -0.22. This result can be attributed to the relative wage stickiness in the Cyprus economy prior to the crisis, an outcome attributed to the fact that wage growth was mainly determined by contractual agreements and cost of living adjustments which were largely unrelated to changes in unemployment.

refers to the Labour Force Survey rate, wages refer to total wages and salaries (employees) and the mortgage rate refers to the MFI interest rate for house purchase with an initial rate of fixation up to 1 year.³ House prices, wages and loans were deflated using the harmonised index of consumer prices, also obtained by the Cyprus Statistical Service. The sample period is limited to 2005Q4 - 2016Q4, as data prior to this date are not available for loans, mortgage rates and the RPPI.

Table 1- Descriptive Statistics: Full Sample 2005Q4-2016Q4

	Loans (%)	Wages (%)	RPPI (%)	Unemployment Rate	Interest Rate
Mean	8.34	1.55	0.57	9.87	4.94
Median	4.42	2.26	-3.66	10.01	5.16
Max	33.20	11.92	25.34	17.61	6.79
Min	-5.19	-13.82	-9.45	3.14	2.98
Std. Dev.	11.92	6.98	10.64	4.87	1.01
Obs	40	40	40	40	40

The results for the full sample (Table 1) appear to mask the business cycle phase in Cyprus. The year-on-year growth of the RPPI remained flat, on average, during each quarter of the sample, as the increase in the RPPI during the boom period was offset by the decrease observed during the downturn.⁴ This is supported by the large standard deviation of the time series. In contrast, despite the decreases in lending during the downturn, housing loans are found to have increased by an average of 8% per quarter during this 10-year period with a maximum rate of 33% and a minimum of -5%. Wages also appear to have increased over the period, despite the large ups and downs observed. As for the interest rate on new housing loans, it averaged close to 5% during the whole

³ The notional stock of housing loans is constructed by imposing housing loan net transactions (obtained from the European Central Bank's Statistical Data Warehouse) on the initial stock of housing loans. Notional stocks are adjusted for amounts that do not arise from "actual" transactions. Such amounts are reclassifications/other adjustments, revaluation adjustments and exchange rate adjustments.

⁴ Additional studies on the behaviour of house prices in Cyprus can be found in Pashardes and Savva (2009), Sivitanides (2015) and Savva and Michail (2017).

sample period, despite the significant declines observed since 2013. The unemployment rate stood, on average, at 9.7% during the period, albeit again with very large fluctuations, judging from the standard deviation values.

As already suggested, the overall descriptive statistics are not very helpful in understanding the changes which took place in the economic environment of the Cypriot economy during the past decade. As such, Tables 2 and 3 present descriptive statistics for two sub-periods, the first being 2005Q4--2011Q4 (Table 2) and the second 2012Q1- 2016Q4 (Table 3). The results from the sub-periods are indicative of the boom and bust periods in the Cyprus economy.

Table 2- Descriptive Statistics: Sub- Sample 2005Q4-2011Q4

	Loans (%)	Wages (%)	RPPI (%)	Unemployment Rate	Interest Rate
Mean	18.29	6.53	6.39	5.41	5.60
Median	14.78	5.98	-0.77	5.34	5.60
Max	33.20	11.92	25.34	8.94	6.78
Min	4.76	0.60	-6.50	3.14	4.45
Std. Dev.	8.80	3.66	12.40	1.70	0.63
Obs	20	20	20	20	20

Table 3-Descriptive Statistics: Sub- Sample 2012Q1-2016Q4

	Loans (%)	Wages (%)	RPPI (%)	Unemployment Rate	Interest Rate
Mean	-1.61	-3.42	-5.25	14.33	4.28
Median	-1.73	-1.36	-5.34	14.62	4.44
Max	4.09	3.21	-0.94	17.61	5.41
Min	-5.19	-13.82	-9.45	11.09	2.98
Std. Dev.	2.42	5.88	2.72	1.96	0.90
Obs	20	20	20	20	20

As Table 2 indicates, the period 2005-2011 was marked by rapid credit growth, with a mean increase of 18.3%, along with the associated wage and house price increases. As the economy boomed, wages and the RPPI recorded exceptional growth rates despite a higher interest rate. Unemployment was low during this period, standing on average at

5.4%. After the bust, the above variables registered negative growth rates, with house price experiencing the largest average drop, at -5.25% (Table 3). During the same period, average unemployment nearly tripled to 14.33%.

In general, the data overview underlines the fact that Cyprus underwent significant changes in its economy during the past decade. The boom in real estate fuelled by strong credit growth, which was in its turn motivated by an influx of foreign funds, was followed by a path characterised by a contraction in income as well as an adjustment in house prices and a subsequent surge in the unemployment rate. The results in the following section aim to shed some light on the structural relationships behind these developments.

4. Methodology

In order to investigate the presence and direction of causality among the economic variables analysed in the previous section, we employ the vector error correction model (VECM) developed by Johansen and Juselius (1990). We define the model such that:

$$\Delta y_t = C + Ay_{t-1} + \sum_{i=1}^n B_i \Delta y_{t-i} + Dx_t + \varepsilon_t$$

where y_t is a vector of the (log) endogenous variables, C is the vector of estimated constants, matrix A contains the long-run coefficient estimates, matrix B contains the short-run coefficient estimates, x_t includes any exogenous variables and D is the matrix of coefficient estimates for these exogenous variables. In the case of Cyprus, y_t contains housing loans (notional stocks), wages, the RPPI Index, the LFS unemployment rate and the mortgage rate. x_t contains a period dummy variable in order to capture the effect of the strong credit expansion in Cyprus, similar to the approach of Goodhart and

Hofmann (2008) and Anundsen et al (2016). The period dummy variable is used as an exogenous variable and takes the value of one from 2005Q4 to 2011Q4 and zero thereafter. All variables employed, excluding the unemployment and the mortgage rate, were transformed into natural logarithms.

Table 4: Unit Roots and Stationary Tests

Variables	Phillips-Perron		Augmented Dickey-Fuller	
	Levels	Difference	Levels	Difference
Loans	-3.04*	-3.33*	-2.42	-0.63
Wages	-2.27	-3.74*	-2.32	-2.16
RPPI	-1.72	-2.98	-1.37	-3.10*
Unemployment	-0.86	-8.55*	-1.41	-2.19
Mortgage rate	-0.18	-4.82*	-0.56	-4.82*

Note: Phillips-Perron test and Augmented Dickey-Fuller, * rejects the null hypothesis 5% level respectively (critical value: -3.02).

Table 5: Cointegration Tests

Variables	Johansen Cointegration Tests		Johansen et al. (2000) test
	Trace	Max Eigenvalue	Test statistic
None	0.64* (0.01)	0.64* (0.01)	126.9*
At most 1	0.48* (0.01)	0.48 (0.08)	74.9
At most 2	0.35 (0.07)	0.35 (0.17)	34.5

* rejects the null hypothesis of no cointegration at 5% level. Critical values for the Johansen et al. (2000) test are 113.5, 84.4 and 59.1 respectively.

To examine whether the variables are suitable for inclusion in a VEC model, we first examine them for stationarity. The results, which can be found in Table 4, are supportive of the view that all variables exhibit I(1) behaviour.⁵ The Johansen cointegration tests (Table 5) suggest that two cointegrating relationships exist on the basis of the Trace tests and one cointegrating relationship exists on the basis of the Maximum Eigenvalue tests. To settle on the number of cointegrating relationships, we examine them for economic significance and suitability prior to the estimation, as elaborated in Hendry and Juselius (2000, 2001). During this procedure, the second

⁵ The unit root process was also tested via the Kwiatkowski et al. (1992) and Elliot et al. (1996) unit root tests, which reached similar conclusions. Results are available upon request.

cointegrating relationship was found to be economically insignificant and was thus removed from the estimation. Supporting the choice of one cointegrating relationship, the Johansen et al. (2000) cointegration test which allows for a break in the series (as per the specified dummy), also found in Table 5, showed that only one cointegrating relationship exists.⁶ To be concrete, robustness checks were also conducted in which two cointegrating equations were included in the VECM estimation, with no qualitative changes recorded. Hence, we proceed to estimate the VECM using quarterly data from 2005Q4 to 2016Q4 with two lags based on the information criteria (AIC and SIC) and one cointegrating equation.

Table 6: Cointegrating equation

Variables	Cointegrating Relationship Estimates
Loans	1.00
Wages	-1.95*** (0.14)
House Prices	-0.53*** (0.10)
Unemployment	-0.06*** (0.00)
Mortgage Rate	0.05*** (0.01)
Constant	8.04

*** denotes significance at the 1% level

The order specifies notional stock of loans first followed by wages, residential property price index, the unemployment rate and, finally, the mortgage rate. In essence, the order implies that banks and consumers base their lending decisions on past performance of the remaining variables, with bank lending affecting all other variables contemporaneously. The cointegrating equation estimates can be found in Table 6 below and show that the relationship between loans and the remaining variables is significant in the long-run. Despite the use of orthogonalised impulse responses, the

⁶ We would like to thank an anonymous reviewer for pointing this out.

model is robust to changes in order. This is also confirmed through the use of the Generalised Impulse Response approach of Pesaran and Shin (1998) which, although not reported here, produces almost identical results. These are available on request.

5. Results

5.1. Granger causality

The existence of cointegrating relationships between loans, RPPI and macro conditions suggests that there ought to be Granger causality in at least one direction, on the basis of the Granger representation theorem. Following the estimation of the VECM model, the model's causal relationship is validated using the VECM Granger causality/block exogeneity Wald test. In Table 7, we provide joint χ^2 Wald statistics for the aforementioned variables.

Table 7: Granger causality results

Dependent Variable:	Loans	Wages	RPPI	Unemployment Rate	Mortgage Rate
Loans	-	6.75 (0.03)	21.00 (0.00)	13.40 (0.00)	0.87 (0.65)
Wages	0.41 (0.82)	-	3.30 (0.19)	0.79 (0.67)	3.08 (0.21)
RPPI	3.09 (0.21)	8.54 (0.01)	-	2.36 (0.31)	0.21 (0.90)
Unemployment Rate	4.53 (0.10)	2.19 (0.33)	2.72 (0.26)	-	3.21 (0.20)
Mortgage Rate	0.02 (0.99)	9.14 (0.01)	8.92 (0.01)	0.45 (0.80)	-
All	21.79 (0.00)	20.83 (0.01)	28.56 (0.00)	16.83 (0.03)	8.48 (0.36)

From the results, it is noticeable that a direct Granger causality between the five variables may not always exist. In particular, the mortgage rate is found to be an exception as no causal relationship can be detected, neither for the interaction of mortgage rate with the other variables independently, nor for the system as a whole. This could be attributed to the fact that, historically, changes in mortgage rates in

Cyprus were mostly driven by supply rather than demand factors, and perhaps also attributed to persistence due to a long history of a maximum lending ceiling.

Nonetheless, a direct causal relationship exists from wages, the RPPI and the unemployment rate to loans, as these reject the hypothesis of non-causality. Similarly, wages are found to cause the RPPI, while loans are found to weakly affect unemployment. However, long-run causality, evidenced in the last row of Table 7, is present (i.e. statistically significant) in all equations, with the exception of the mortgage rate. However, even in cases when a direct causal relationship between the variables cannot be verified, a causal relationship may exist for a joint interaction of the variables examined, i.e. via indirect effects on the variables at hand. This is further analysed in the following section using impulse responses.

5.2. Impulse responses

Figure 1 shows the results from a standard deviation shock on housing loans on the other variables included in the VEC model using an Impulse Response horizon of 20 periods. As the figure illustrates, the response of wages to the shock is initially large but gradually stabilises in the 20-period horizon.

Similarly, the unemployment rate and the lending interest rate on housing loans do not yield substantial responses to the shock and appear to be insignificant throughout the shock horizon. More specifically, the shock on loans has a long-run impact of approximately -0.2% on the unemployment rate, with the mortgage rate response also maximising at about -0.2% and dying out in the long run. On the other hand, the increase in loans has a positive impact on the RPPI. This impact is persistent recording a constant increase throughout the horizon, stabilising at about 5% in the long run. This

is in line with the literature pointing to a link between loans and house prices (e.g. Favara and Imbs, 2015).

Figure 1: Variable responses to a standard deviation shock on loans

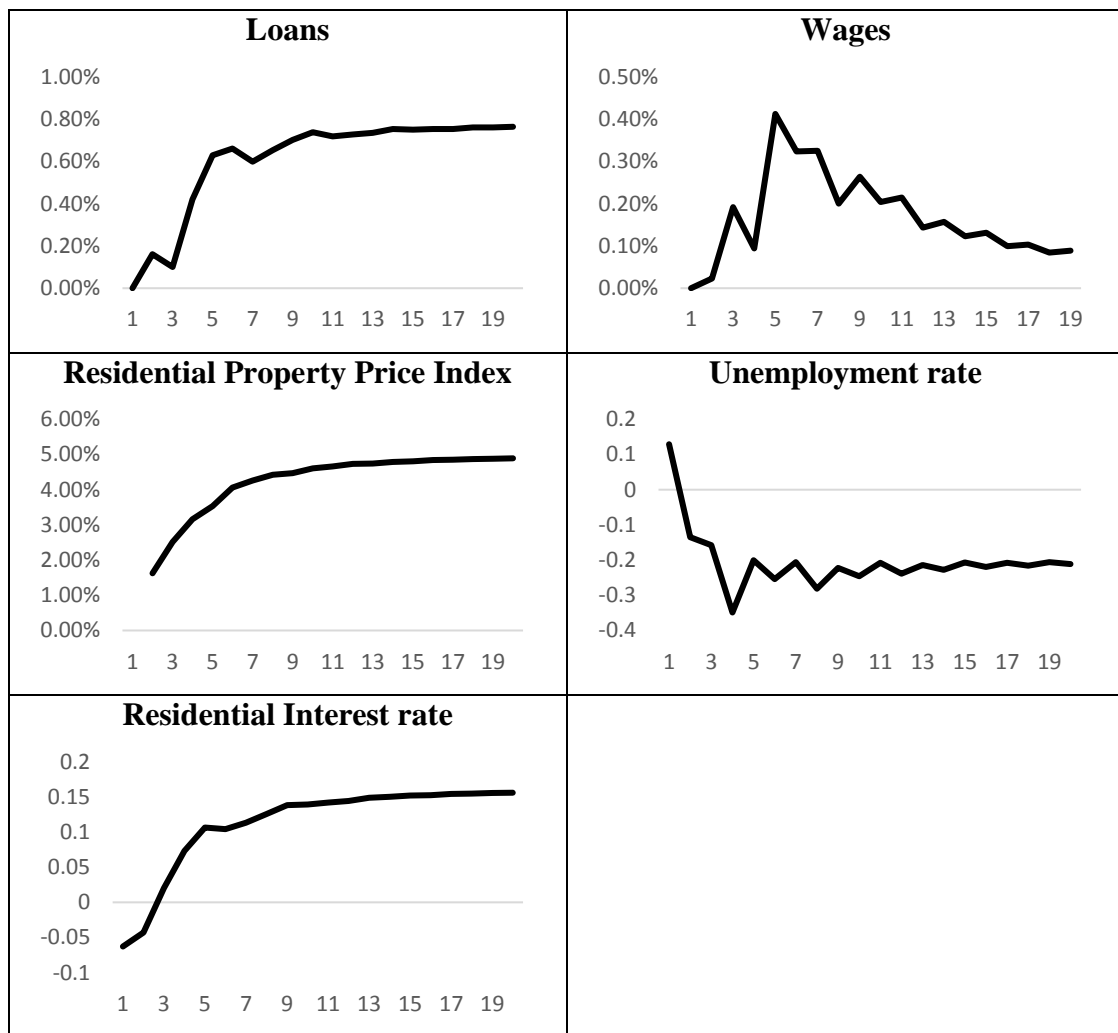


Figure 2: Variable responses to a standard deviation shock on wages



The results from a standard deviation shock on wages on the other variables in the model can be found in Figure 2. This shock has a positive impact on loans and the RPPI (after the initial period), as all shocks are persistent in the long run. In contrast, the response of the mortgage rate is very small, at less than 0.05%. An increase in wages yields a persistent decrease in the unemployment rate, reaching approximately 1.1% percentage point in the long run.

Figure 3: Variable responses to a standard deviation shock on the RPPI



In Figure 3 we examine the impact of a standard deviation shock on the RPPI. The increase in residential property prices has a strong positive and permanent impact on housing loans, reaching approximately 0.8% in the long run. The response increases relatively fast, with the slope stabilising after approximately nine periods. At the same time, the shock in property prices leads to an expected increase in the residential interest rate, perhaps in an effort for banks to increase their margins in view of higher demand for loans. A permanent decline in the unemployment rate is also observed although to a smaller extent, reaching its long-run level fast. Wages also increase sharply in the short run, with the effect slowly waning off in the long run.

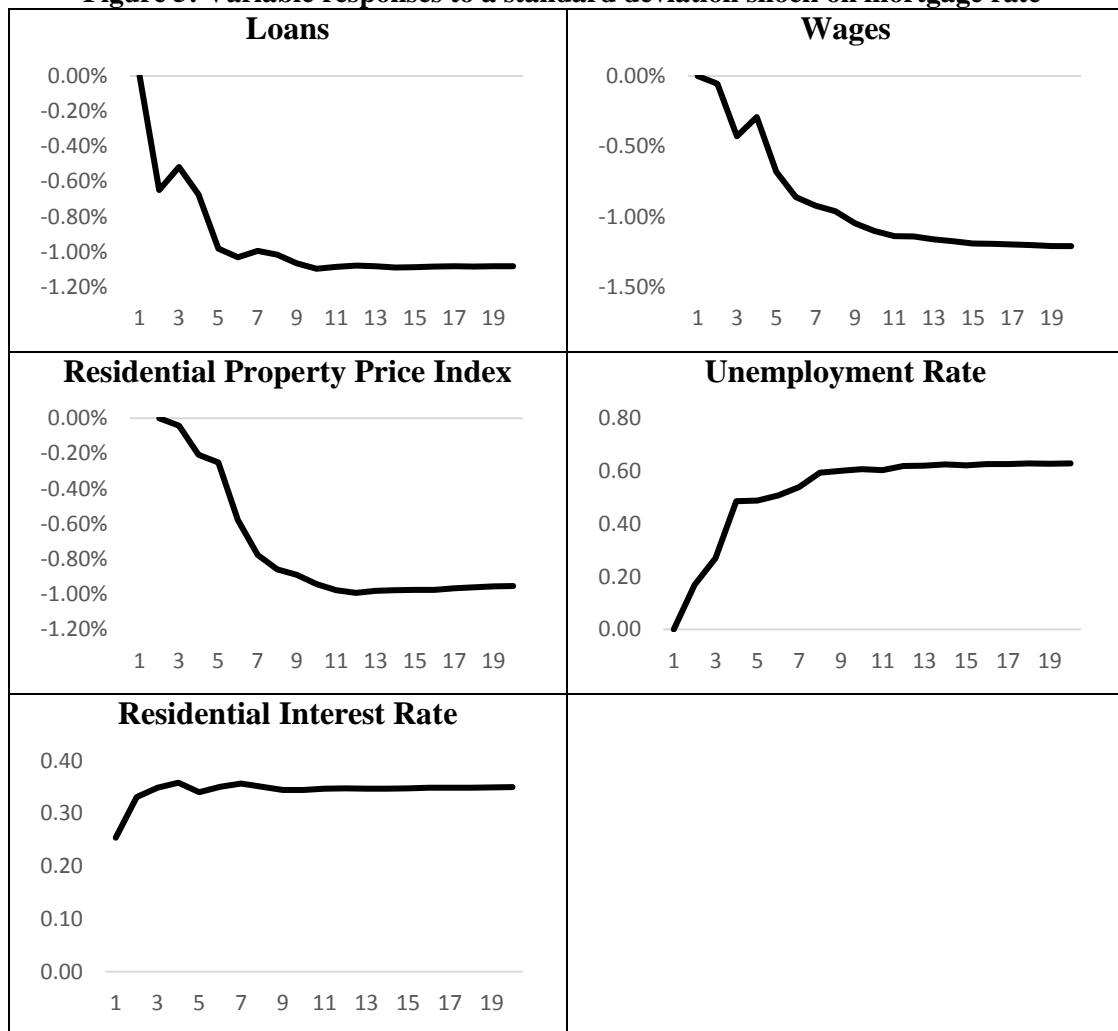
Figure 4: Variable responses to a standard deviation shock on unemployment



Figure 4 shows the responses after a shock on the unemployment rate. The impulse responses suggest that a shock on the unemployment rate has a strong impact on all variables, excluding the mortgage rate which registers a minimal response. Wages record the largest short run response, stabilising at about -3% in the long run. This is in line with economic theory whereby an increase in unemployment generates downward pressure on wages given greater labour market slack. The RPPI reacts much less in the short run reaching a maximum of -1%, with the effect dying out in the long-run. Loans also register a small, albeit persistent, decrease.

Lastly, the results from a standard deviation shock on the mortgage rate are shown in Figure 5. As expected, loans are strongly affected, registering a reduction close to 1.2% in the long run. Wages react similarly, with a decline of 1.1% in the long run, whilst the unemployment rate is also affected by the shock, increasing by approximately 0.6 percentage points by the end of the horizon. A similar impact is registered by the RPPI exhibiting a sharp decline on account of the assumed proportionately higher contraction in demand for housing relative to supply.

Figure 5: Variable responses to a standard deviation shock on mortgage rate



Overall, there is enough evidence to suggest that a bi-directional relationship between loans and RPPI exists in Cyprus. In other words, an increase in the outstanding amount of total domestic loans will bring an increase in residential property prices and vice

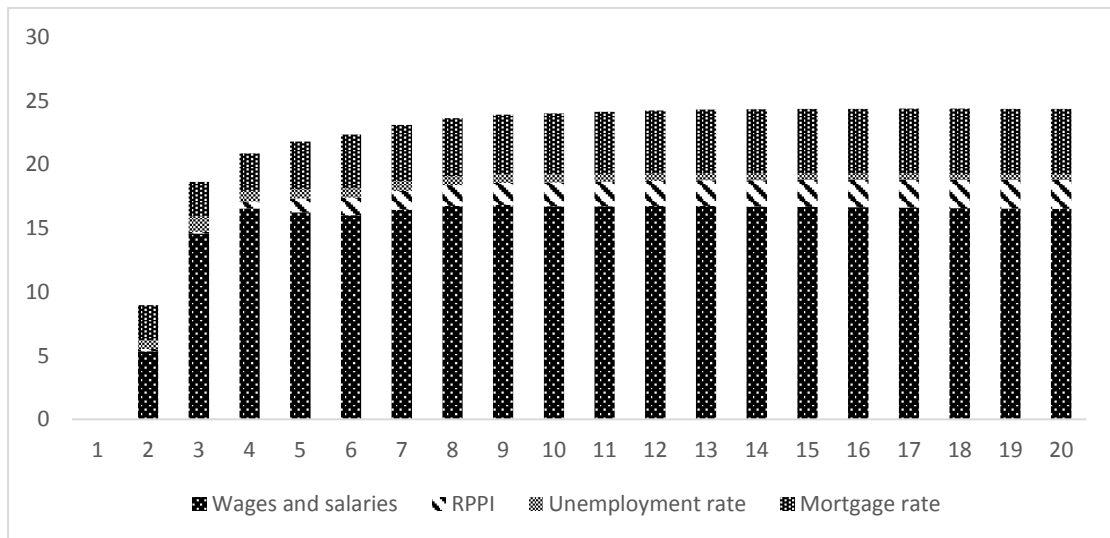
versa. At the same time, an increase in residential property prices, driven, for example, by a rise in foreign demand for housing, will eventually lead to an increase in the level of lending by domestic residents, as higher prices necessitate higher lending. A similar conclusion can be reached regarding the relationship between unemployment and residential property prices, with the former declining after an increase in the latter and vice versa. Simply put, higher (lower) unemployment results in lower (higher) residential property prices, given the loss (gain) of aggregate purchasing power.

Another factor which seems to affect both unemployment and residential property prices is the mortgage rate. When the mortgage rate increases, the cost of repayment increases as does the cost of funding, which leads to lower disposable income. As a consequence, unemployment increases and property prices decrease. There is also evidence of a strong negative impact on wages. Further to this, a negative relationship is affirmed between wages and the unemployment rate. It is also notable that a standard deviation shock on the unemployment rate has very significant effects on all variables included in the estimated VECM. An overview of the contribution of each variable to the other variables' variance can be found in the following section.

4.3. Variance decomposition

Figures 6 to 10 indicate the percentage of the variable's variance which can be explained by the variance of the remaining variables used in the model. Figure 6 shows that only 25% of the variance of loans can be explained by the remaining variables, in a 20-quarter horizon. The lion's share of that 25% is explained by wages, underlying the close relationship between the two. The RRPI and the mortgage rate also explain a part of the variance, while, in contrast, unemployment explains the least amount.

Figure 6: Variance decomposition of loans



In the case of wages, 40-45% of the variance can be explained by the other variables (Figure 7). The unemployment rate explains the largest part of the variance in the long-run, even though its impact is minimal upon impact. In contrast, loans have a larger impact in the short run but the effect dies out in the long run. The mortgage rate also plays some part in explaining the wage variance, while the RPPI has an insignificant role.

Figure 7: Variance decomposition of wages

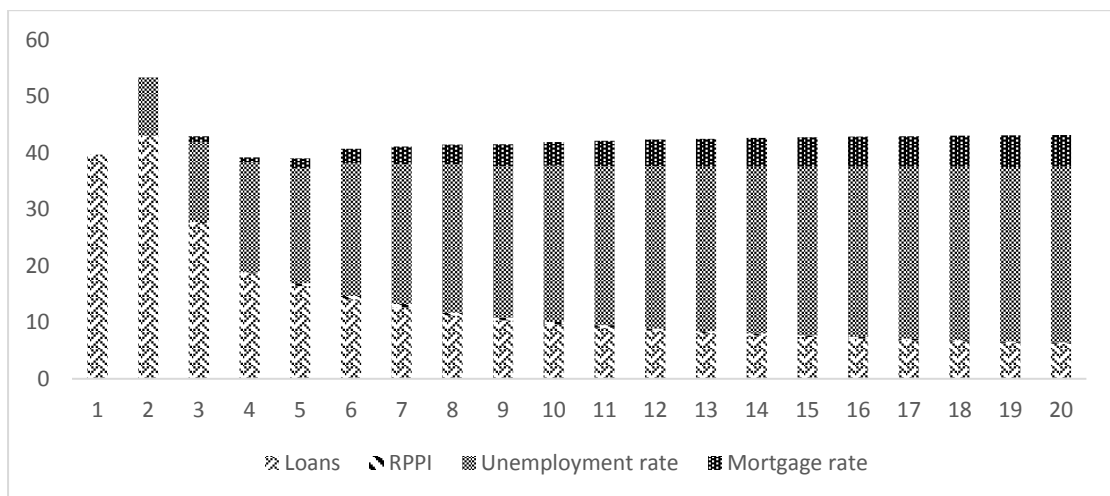
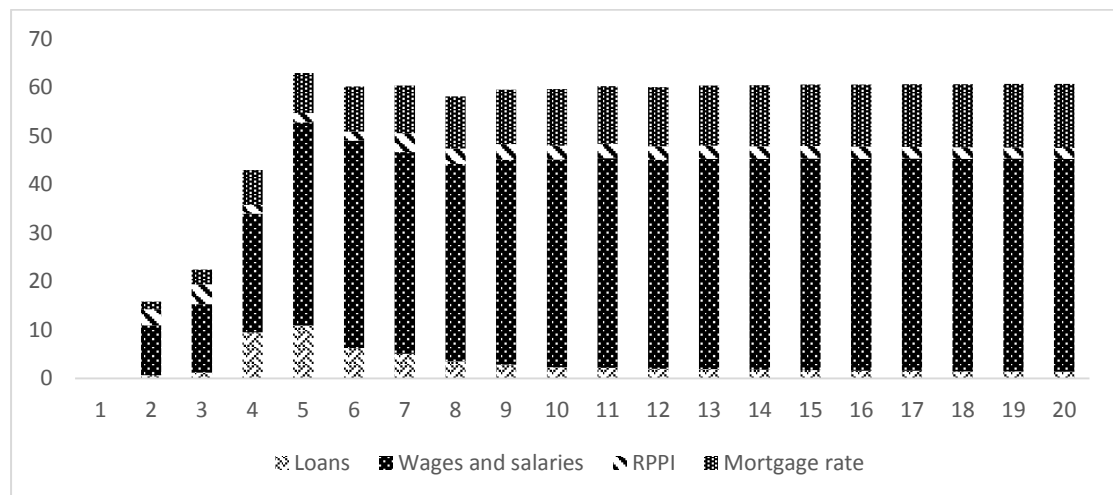


Figure 8: Variance decomposition of RPPI



Figure 9: Variance Decomposition of unemployment rate



Loans have a strong impact on the variance decomposition of RPPI (Figure 8) maintaining their impact throughout the 20-period horizon. Wages also have a large and persistent effect, while unemployment and the mortgage rate have a minimal impact. Interestingly, more than 60% of the variance of the RPPI can be explained by the VECM variables. The unemployment rate, as seen in Figure 9, is affected mostly by wages and the mortgage rate to a smaller extent. The RPPI has a minimal effect and loans have some short-run effect which is eliminated in the long run. Finally, with regards to the mortgage rate (Figure 10) loans explain the largest part of the variance.

However, their effect decreases over time. In contrast, the RPPI impact, although small in the short run, increases over time. The unemployment rate has a stable impact throughout the horizon, while wages have only a minimal impact. Furthermore, the mortgage rate is the variable that is least explained by the remaining VECM variables, an expected result given that interest rates change usually via discretionary policy choices.

Figure 10: Variance Decomposition of mortgage rate



Overall, the results of this section are supportive of the findings in section 4.1 as loans and the RPPI have a strong bi-directional relationship. Naturally, the extent of this relationship is not equal as loans appear to have a larger effect on the RPPI than the opposite. The mortgage rate has a muted response all variables, excluding the unemployment rate and loans. Wages are, as before, heavily affected by the unemployment rate with the reciprocal relationship also being observed. Interestingly, the RPPI has an effect on the mortgage rate, suggesting that in times of higher demand for housing, it would possible for banks to raise their interest rates in an effort to secure more profits. In summary, the results confirm that the multi-directional link between housing, credit and the macro-economy in Cyprus holds.

4.4. Policy implications

The link between credit, housing market and the macro-economy is one of crucial importance to economic and financial stability. Understanding the link between these variables could also provide a clearer picture of the interrelationship of monetary policy with macroprudential policy. Consequently, these results can be employed as the reference point for bank stress testing and scenario analysis as they contain very useful information about how economy reacts to shocks in variables such as the unemployment rate and the residential property prices. As suggested by Vazquez et al (2012), this is the first step in creating stress testing scenarios.

Our findings highlight the importance of credit and house price developments for safeguarding financial system stability and stress that policymakers should keep a close look at developments in both the real and financial economy when evaluating macroprudential policies. However, this could be difficult to achieve, especially within a monetary union where monetary policy is homogeneous while countries exhibit significant regional differences. On such case is the euro area, where the ECB's monetary policy is based on euro area aggregates.

If significant regional differences in house prices and credit dynamics exist the common monetary policy could, at times, prove to be ineffective. Our findings support the view expressed by Goodhart and Hofmann, (2004, 2007, 2008) that a way to overcome the problem of a homogeneous monetary policy in heterogeneous countries within the euro area, would be to consider a secondary financial instrument at the regional level that could directly address the link between credit and house prices, such as the LTV ratio. In addition, we also note that when demand for housing loans increases, banks appear to raise their interest rates in an effort to secure more profits, further destabilising the

system as the overall debt burden should increase through increases in the amount that needs to be repaid.

5. Conclusions

The aim of this paper is twofold; first, to understand how domestic loans and residential property prices in Cyprus interact with each other; and second, to determine how these variables impact the overall domestic economy. In this respect, a VECM was employed to assess the relationship of loans, residential property prices and domestic macroeconomic conditions. Specifically, the outstanding amount of domestic total loans, wages, the unemployment rate, the residential property price index and the mortgage rate were used as dependent variables, for the period 2006Q1-2016Q4 and a dummy variable was included as an exogenous variable to account for the period when there was a strong credit expansion was recorded in Cyprus.

The empirical results offer a number of interesting insights. First, a distinct link between credit, housing prices and the macro-economy is found to exist for Cyprus, consistent with other related literature. At the same time, a significant multidirectional link between these variables also holds in the estimation. Loans appear to influence house prices and vice versa. The results further suggest that shocks to house prices and loans have significant repercussions on economic activity, with the macro-economy also having a strong effect on the aforementioned variables. More specifically, a shock to the unemployment rate is found to have significant permanent effects on house prices and wages but less so on loans and the mortgage rate.

The variance decomposition of the shocks indicates that the response of house prices to a loan shock is approximately of a similar magnitude to the opposite shock. Unemployment is found to have a similar response, in terms of magnitude, on wages

and residential property prices. On the other hand, most of the variance of the mortgage rate shock is due to its own dynamics. This can be explained by the fact that prior to 2013 lending rates in Cyprus had been, for their most part, isolated from changes in the macro environment.

Overall, the results of this study confirm the existence of a link between house prices, loans and the macro-economy in Cyprus. However, it should be emphasised that these are by no means definitive. First and foremost, the sample size is limited by data availability, an issue which will hopefully be dealt with in the future. As such, all estimations and subsequent results are thus limited to that extent. Second, given that these are currently the only available results for Cyprus, future studies by other researchers will further assist in understanding this link. Finally, a very interesting complication of the above results relates to the issue of non-performing loans (NPLs) and their impact on the domestic economy. As this is beyond the scope of this paper, we leave this very promising field open for future research.

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