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FACTOR ANALYSIS OF THE HOUSING MARKET IN UKRAINE (2003–2023)

The residential real estate market plays a key role in the development of global and national economies, since it has acted as a powerful driver of GDP growth, increasing the level of employment, household incomes, and profitability of financial institutions, construction organizations and trading enterprises. The house price growth has two dimensions, threat to financial stability and source of economic development. The aim of this research is to formulate a list of criteria, based on which one can decide whether the house price at a given stage of housing market development needs to be constrained or not. The aim is achieved by a multi-perspective analysis of residential real estate market in Ukraine and its evolution. This research is based on general scientific and special methods of cognition, including abstract logical reasoning, grouping, and statistical analysis. The factors that contribute to the growth of house prices are formed using the method of principal component analysis, and the effect is estimated using least squares regression. Five stages of the evolution of the Ukrainian residential real estate market are identified according to two general indicators: housing price growth and credit activity. The segmentation is based on significant changes in market conditions and/or changes in housing price drivers, as well as changes in the regulatory environment. Factors

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ФАКТОРНИЙ АНАЛІЗ РИНКУ ЖИТЛА В УКРАЇНІ (2003–2023)

Ринок житлової нерухомості є потужним драйвером розвитку світової та національної економік, що впливає на зростання ВВП, підвищення рівня зайнятості, доходів населення, прибутковості фінансових установ, будівельних організацій і торговельних підприємств. Зростання цін на житло може розглядатись з двох позицій: як загроза фінансовій стабільності та як джерело економічного розвитку. Метою цього дослідження є формування переліку критеріїв, за якими можна обумовлювати ті чи інші заходи макропруденційної політики, спрямовані на обмеження вартості житла на ринку нерухомості через багатоаспектний аналіз ринку житла в Україні та його еволюції. В основу дослідження покладено загальнонаукові та спеціальні методи пізнання: абстрактно-логічний, групування; статистичні. Фактори, які сприяють зростанню цін на житло, формуються за допомогою методу аналізу головних компонентів, а вплив оцінюється за допомогою регресії найменших квадратів. Виділено п'ять етапів еволюції українського ринку житлової нерухомості за двома загальними показниками: зростання цін на житло та кредитна активність. Поділ заснований на значних змінах ринкових умов і (або) змінах драйверів цін на житло, а також на змінах у регуляторному середовищі. Досліджено фактори, що впливають на ціни на

affecting house prices at each of these stages were investigated using principal component analysis to identify variables for regression analysis. A set of criteria has been formed using which one can assess if the current rise in housing prices poses systemic risks to the national financial system and overall economy. Three hypotheses were put forward and their empirical verification was carried out, according to the results of which it was established that demand factors had the greatest impact on housing prices during the observation period; macro-financial conditions primarily affect prices on the primary real estate market; lending conditions affect price dynamics mainly only at the first stage of development of the housing market in Ukraine, which are determined in this study. The main drivers of the housing market in Ukraine are the unemployment rate, income growth levels, and population size. The conclusions drawn can significantly contribute to the monitoring system of the housing market in Ukraine and the analysis of the systemic risks it generates.

Keywords: real estate market, systemic risk, financial stability, regression analysis, principal component analysis, risks, macro-prudential policy.

житло на кожному з цих етапів з використанням методу аналізу головних компонентів, щоб визначити змінні для регресійного аналізу. Сформовано набір критеріїв, за допомогою яких можна судити, чи є поточне зростання цін на житло джерелом системних ризиків для стабільності національної фінансової системи та економіки в цілому. Висунуто три гіпотези та проведено їх емпіричну перевірку, за результатами якої встановлено, що фактори попиту найбільше впливали на ціни на житло протягом періоду спостереження; макрофінансові умови передусім впливають на ціни на первинному ринку нерухомості; умови кредитування впливають на цінову динаміку переважно лише на першому етапі розвитку ринку житла в Україні до поділу, запропонованому в цьому дослідженні. Основними драйверами ринку житла в Україні стали фактори попиту: рівень безробіття, доходів та чисельність населення. Зроблені висновки можуть суттєво сприяти системі моніторингу ринку житла в Україні та аналізу системних ризиків, що він генерує.

Ключові слова: ринок нерухомості, системний ризик, фінансова стабільність, регресійний аналіз, метод аналізу головних компонент, ризики, макропруденційна політика.

JEL Classification: G21.

Introduction

The residential real estate (RRE) market plays a key role in the development of global and national economies, since; on the one hand, it acts as a powerful driver of GDP growth, increasing the level of employment, household incomes, profitability of financial institutions, construction organizations and trading enterprises. On the other hand, it is a source of risks that can potentially threaten financial stability, as proven by the Global Financial Crisis (GFC) of 2007–2009. Among the main causes of the GFC there was global overvaluation of house prices (HP), paired with high private debt levels. The two drivers reinforced each other, creating "vicious circle", the process in which global economy was accumulating systemic stress and imbalances, which then amplified the consequences. The imbalances on the housing market were transferred to the financial sector through the collateral channel since buoyant credit activity was not supported by the quality of loans. Corrections of HP and rising ratios of non-performing loans negatively impacted the financial standings of lenders. That, in turn, led to widespread worsening of banks' financial conditions and even bank failures, contributing to global financial instability (Aoki and Nikolov, 2012). Therefore, the housing market is constantly in the spotlight, being investigated and analyzed by the regulators of the financial sector (here and after – regulators).

Depending on the stage of the cycle of real estate market, regulators can use a toolkit of levers and instruments of macroprudential policy, aimed at ensuring financial stability and preserving economic growth. The housing market in Ukraine developed amid the negative impact of four major financial crises: the GFC, which hit Ukraine in 2008–2009; the social-economic crisis of 2014–2015, deepened by the Russian aggression in the Eastern part of Ukraine and the annexation of Crimea; the crisis, provoked by the coronavirus pandemic in 2020 and the one, caused by Russia's full-scale war on Ukraine. These frequent imbalances destabilized the RRE market in Ukraine and generally resulted in low demand due to poor financial standings of households; and in unnaturally weak mortgage lending with the mortgage-to-GDP ratio of 0.55 % as of the end of Q3 2021 (National Bank of Ukraine, 2021).

The HP growth has two dimensions: threat to financial stability and source of economic development. Rapid asset price growth is usually considered as a source of systemic risk that should be immediately limited. However, by restraining the HP growth too early and without solid grounds, regulators risk to lose an important source of economic growth. Therefore, we would like to formulate a list of criteria, based on which one can decide whether the HP at a given stage of RRE market development needs to be constrained or not.

After the GFC, the RRE market became an extremely popular topic for investigation by both scholars and regulators across the globe. Lang et al. (2022) and Lo Duca et al. (2019) investigated the role of housing market in the general economy and, thus, the importance of developed macroprudential toolkit in response to risks to financial stability stemming from the RRE market. Égert and Mihaljek (2008), Hlaváēek and Komárek (2011), Duca et al. (2021), Maynou et al. (2021), Shmygel and Hoesli (2023) and Di Casola et al. (2022) explored and described the drivers of HP cycle and the current developments on the housing markets all across the globe. The tradeoff between the benefits and threats of active housing market were discussed by Nguyen and Bui (2020) and Zhang et al. (2018).

Lang et al. (2022) in their paper analyzed the links between real estate markets, the economy and the financial system. They outlined three general reasons of systemic importance of the real estate market.

The paper by Lo Duca et al. (2019) presented a framework that the European Central Bank employs to assess the risks to financial stability that arise from the housing market and to design the response of macroprudential policy.

The research on what drives the HP growth became very popular after the GFC. It is generally accepted to believe that the main fundamental factors can be divided into two general groups: supply and demand fundamentals (Égert and Mihaljek, 2008). Many authors agreed that the HP growth is primarily demand-driven. Hlaváēek and Komárek (2011), who studied the

RRE market in Czech Republic, claimed that the housing prices on the local market are driven by demand factors, such as wage growth and unemployment rate. Additionally, according to Maynou et al. (2021), the analysis of twelve European countries confirmed that the fundamental HP drivers are mainly fiscal factors and unemployment. According to Di Casola et al. (2022), based on the estimates of country-specific Bayesian vector autoregression (BVAR) models, HP change in the advanced countries during 2020–2021 was mainly driven by the demand factors.

In their paper on detection of the HP bubbles, Shmygel and Hoesli (2023) argued that the principal drivers of HP growth are demand-side factors as aggregate income and the rate of unemployment. Except from that they claimed that the lending conditions are, despite undoubtedly being among the factors that can contribute to the HP dynamics, are not the drivers of fundamental HP, since they tend to explain not only the intrinsic HP growth, but the bubble build-up as well.

In their article, Lo Duca et al. (2021) conducted a thorough research of the drivers of HP growth and investigated the links that connect housing markets, credit markets, HP expectations, financial stability and the wider economy.

The tradeoff between the advantages of buoyant housing market to economic growth and its threats to financial stability were discussed by Nguyen and Bui (2020). In their paper, the authors stated that more active RRE market gives a positive signal and stimulates other sectors of the economy as long as it remains within reasonable limits. This thought was confirmed by Zhang et al. (2018), who claimed that active demand on the housing market positively affects the loan portfolios of banks on initial stages. But the links between activity on the RRE market and financial stability become more direct and sensitive when the cycles on this market change. According to Jarmulska et al. (2022), during booms on RRE markets, both the HP growth and lending activity tend to be vigorous.

The aim of this research is an analysis of RRE market in Ukraine that is centered on the main indicator of this market – the HP growth. We want to analyze the evolution of housing market in Ukraine from the perspective of which factors contributed to its dynamics.

In this research, *three hypotheses* were put forward and tested by estimating the statistical significance of the OLS regression coefficients. This is done by calculating the p-values for each separate coefficient, based on the input variables, which are the fundamental drivers of house prices in our research. The p-value lower than 0.05 suggests that the null hypothesis that the coefficient is close to zero (has no impact on house prices) is rejected. The results of hypothesis testing are provided in the Results section. The first hypothesis is that the demand partition has the highest contribution to the HP growth throughout the whole period of observation. The second hypothesis is that the macro financial partition has lower effect on the HP growth on the

secondary RRE market. The third hypothesis is that the lending conditions had the strongest impact on the HP growth during the first stage of RRE development, as outlined in the following sections.

This research is structured as follows. First, we will identify the phases of Ukrainian housing market development and analyze it from the perspective (the second step, respectively) of what drives the HP growth. As a final step, will form a set of criteria with the help of which we can judge whether the current house price growth is a source of systemic risks to the stability of national financial system and economy in general.

The first step of this research is to distinguish the stages of evolution of the residential real estate market in Ukraine. This step fully relies on an expert judgment based on economic sense and the data on dynamics of residential HP on the real estate market of Kyiv city and the stock of loans issued for the purchase and construction of housing to individuals (stock of mortgage). Thus, the pivotal moment of every stage is the point where the dynamics change crucially or there are grounds to believe that the drivers/circumstances on the residential real estate market have changed drastically.

Next, we identified the drivers that contribute to the growth of HP. Based on the literature; we distinguished four general groups of fundamental factors that can possibly define the dynamics of HP as the principal indicator of the housing market. The general partitions of factors are the following: macro financial (MF) conditions, lending conditions (LC), demand factors and supply factors. These partitions are formed using the principal component analysis method and the data, described in the following section.

Principal component analysis (PCA) is a method that helps to reduce the dimensionality of dataset while increasing interpretability but minimizing information loss. While decreasing the dimensionality of data, the PCA preserve as much variability as possible. The PCA reaches this goal by creating new uncorrelated variables that are linear functions of the inputs in the original dataset (Jolliffe and Cadima, 2016). The advantage of partitioning is that it improves the forecasting power of the regression model by extracting common trends in macro financial variables, hence filtering out idiosyncratic noise, which may be endemic in countries with illiquid markets (Prasad et al., 2019).

Within the principal component analysis, we subtracted the first two dimensions from every partition for further analysis. It is a common practice to choose only certain percentage of variation explained to decide how many dimensions must be included in the further analysis. The focus is often on the first few dimensions. For this research, since we mostly care about identifying factors and not on predicting fitted variables, we chose the cut-off point of 55–60 % of variation explained by dimensions. Then, we estimated the correlation between eight (two dimensions * four partitions) potential variables, to avoid multicollinearity in the further regression

analysis. We also calculated the relative contribution of input data among every partition to better understand the composition of output data.

After estimating correlation and selecting variables, we performed the OLS regression analysis to identify the factors that influenced the HP growth on different stages. In order to do it, we built a multi-factor ordinary least squares model of the following form:

$$House\ prices_t = \beta_0 + \beta_1 Macrofinancial\ Conditions_t + \\ +\beta_2 Lending\ Conditions_t + \beta_3 Demand\ Partition_t + \beta_4 Supply\ Partition_t + \varepsilon_t, \quad (1)$$

where $House\ prices_t$ is a dependent variable in time "t" and X_t are the partitions of fundamental factors of HP dynamics, created with the help of PCA method.

Data. The Ukrainian residential real estate market analysis is built on the case of the Kyiv city. Since it is the capital of Ukraine, it is also the biggest, the most populated and economically active city. In addition, Kyiv has the most active real estate and construction markets. For this research, we used data for Kyiv city, where available and for the Ukraine in general for the variables that must be used on the macro-level. To perform the second step, the regression analysis, needed for and estimation of drivers of HP during different periods of the evolution of the Ukrainian residential real estate market, we formed a list of factors that are deemed to explain the behavior of HP as fully as possible. We outlined the four general categories of factors that can be considered as drivers of house price dynamics: macro financial conditions, lending conditions, demand-side factors and supply-side factors. All factors that were considered within each partition are displayed in the *Table 1*.

Table 1

Partitions of drivers[1] of HP in Ukraine

Macro financial conditions	Lending conditions	Demand-side factors	Supply-side factors
Real Gross Domestic Product growth y-o-y, %	ER-adjusted mortgage stock to GDP, %	Number of population in Kyiv city, million persons	Real residential construction cost index in Ukraine, %
Output gap, %	Google search, word "credit"	Disposable real aggregated income, UAH million	Commissioned dwellings in Kyiv, m^2
Inverted Current Account Deficit to GDP, %	New mortgage lending to GDP, %	Inverted DE seasoned unemployment rate in Kyiv city, %	Commissioned dwellings in Ukraine, m^2
	Inverted interest rate on mortgage, %		

Source: compiled by authors.

[1] Due to high seasonality some variables were seasonally adjusted with the help of the R-interface of X-13-ARIMA.

The dependent variable for the regression analysis is the real exchange rate adjusted HP on primary and secondary residential real estate markets of Kyiv city. The data series starts in Q1 2003 and is available on the quarterly basis. The housing prices on both sub-markets are adjusted to the exchange rate movements, according to the methodology described by Shmygel and Hoesli (2023), in order to get a dependent variable that describes solely the events on the RRE market.

The residential real estate market of Kyiv is divided into two sub-markets: primary and secondary. The primary RRE market is the market in which the newly built housing is offered to individuals, who become its first-time owners. In turn, the secondary RRE market consists of the transactions between two or more individuals: a seller and a buyer. Taking into account this division, we will build two identical in terms of a set and form of independent variables models: one with HP on the primary and the other with HP on the secondary market as the dependent variables of the model.

The exchange rate adjusted gross stock of mortgage loans, issued to individuals, used in the lending conditions partitions follows the same methodology for the correction for the exchange rate movements, as the dependent variable, but, instead of 40 % correction, the whole, 100 % of FX rate movement is subtracted from the variable.

The disposable real aggregated income demand-side variable is complex and is calculated based on the methodology, described by Shmygel and Hoesli (2023), as follows:

$$Disposable\ real\ aggregated\ income_t = Av.salary\ per\ month_t \times \\ \times Number\ of\ population_t \times \%\ of\ disposable\ income\ in\ aggregate\ income_t \quad (2)$$

This variable is perfectly tailored to serve as the complex demand-side driver of the HP dynamics, since it incorporates two of the most important fundamental factors: households' income and number of population.

1. Identification of the stages

In order to identify stages of the Kyiv residential real estate market's development, we employed an expert judgment based on the information on dynamics of residential HP on the real estate market of Kyiv city and the mortgage stock and economic sense. According to *Figure 1*, the only period of buoyant mortgage lending in Ukraine was before the GFC, when the gross mortgage portfolio of Ukrainian banks reached its peak and the ratio of exchange rate adjusted gross stock of mortgage loans, issued to individuals to GDP was 9.4 %.

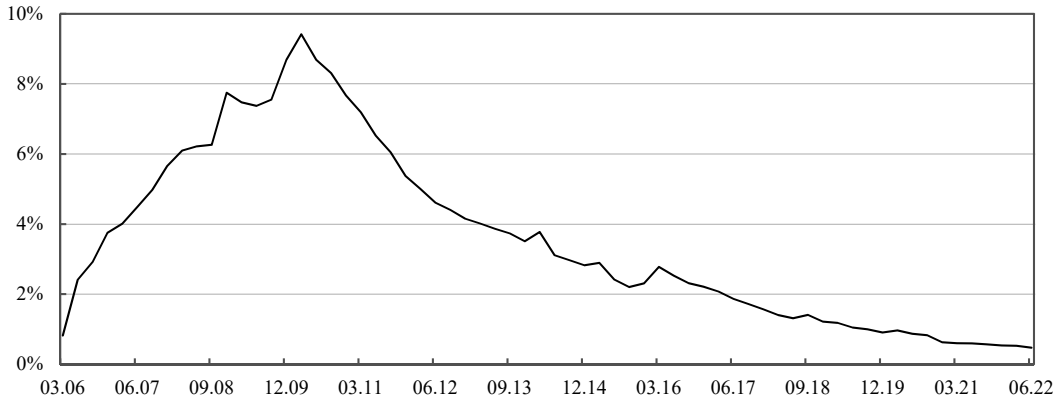

Figure 1. Exchange rate adjusted gross stock of mortgage loans to individuals to GDP, %

Source: compiled by authors using data from the National Bank of Ukraine (National Bank of Ukraine, 2023).

However, this growth was supported by the build-up of systemic risks, since the loan standards were low and most of the loans were issued in foreign currency, while the currency risks were not addressed by either the lenders or the borrowers. After 2009, the new mortgage lending was almost inactive in Ukraine with existing portfolios shrinking due to low quality of loans, high rate of non-performing loans and mass write-downs by banks. The new mortgage lending picked up in mid-2020, due to lower interest rates on the market and the launch of state support program. However, this recovery started from a very low base and coincides in time with restructuring and write-downs of legacy non-performing mortgage, left after the crises of 2008–2009 and 2013–2016. Therefore, it did not affect the ratio of mortgage stock to GDP and is unnoticeable in the *Figure 1*. After the start of full-scale Russian war in Ukraine in February 2022, the mortgage lending completely stopped for the first three month of war with only a few mortgage loans per month issued later this year.

According to the *Figure 2*, the active lending that preceded the GFC was also contributing to the overvaluation of HP and, thus, a bubble build-up. Although there is another spike in early 2015, this one is completely explained by a sharp hryvnia devaluation and is not considered a bubble according to the results of analysis done by Shmygel and Hoesli (2023). Apart from this short episode, the prices were mostly stable from post-bubble period in 2010 to the end of the period of observation. In the mid-2020, the prices began to gradually rise, responding to the recovery of mortgage lending. However, this growth was moderate and was brought to an end by the start of war in Ukraine. Following the full-scale invasion of Russia into Ukraine, the HP became chaotic, particularly on the primary market, since they weren't controlled by basic market forces anymore, but by the relative distance from the frontline and sellers' internal expectations.

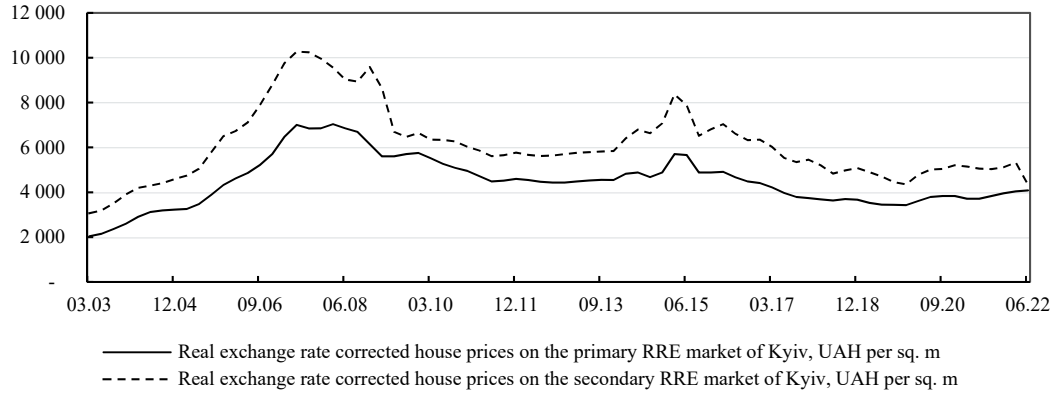

Figure 2. HP on the RRE sub-markets of Kyiv city

Source: compiled by authors using data from the real estate agencies and the NBU.

The analysis of data, provided on the *Figures 1, 2*, allowed us to formulate five distinct stages of development of residential real estate market in Ukraine, as follows in *Table 2*.

Table 2

Stages of development of residential real estate market in Ukraine

Stage	Distinct features of the stage
First (before Q1 2009)	Period of house price bubble and its formation, buoyant mortgage lending
Second (Q2 2009 – Q4 2013)	House prices fell following the bubble burst, the new mortgage lending almost inexistent, existing mortgage stock shrinking
Third (Q1 2014 – Q2 2020)	House prices relatively stable, except from the short hryvnia devaluation period, the new mortgage lending almost inexistent, existing mortgage stock shrinking
Fourth (Q3 2020 – Q1 2022)	House prices slowly pick up following the gradual recovery of mortgage lending
Fifth (since Q1 2022)	House prices chaotic, the market is not controlled by the demand and supply drivers, new mortgage lending almost inexistent

Source: compiled by authors.

2. Identification of factors

The next stage of this research is focused on the factors that contributed to the HP growths and thus, the residential real estate market development in Ukraine. We have previously formed four partitions of variables that, in theory, are driving the change of HP on both primary and secondary housing markets of Kyiv. With the groups of potential input variables being formed, we proceeded to the principal component analysis, the results of which are presented on the *Figure 3*. On the panels A to D we depicted the shares of variance that is explained by the new components, constructed from the input variables, provided in the *Table 1*. For the further

analysis, we subtracted two dimensions from each partition in order to proceed to the next stage of regression analysis.

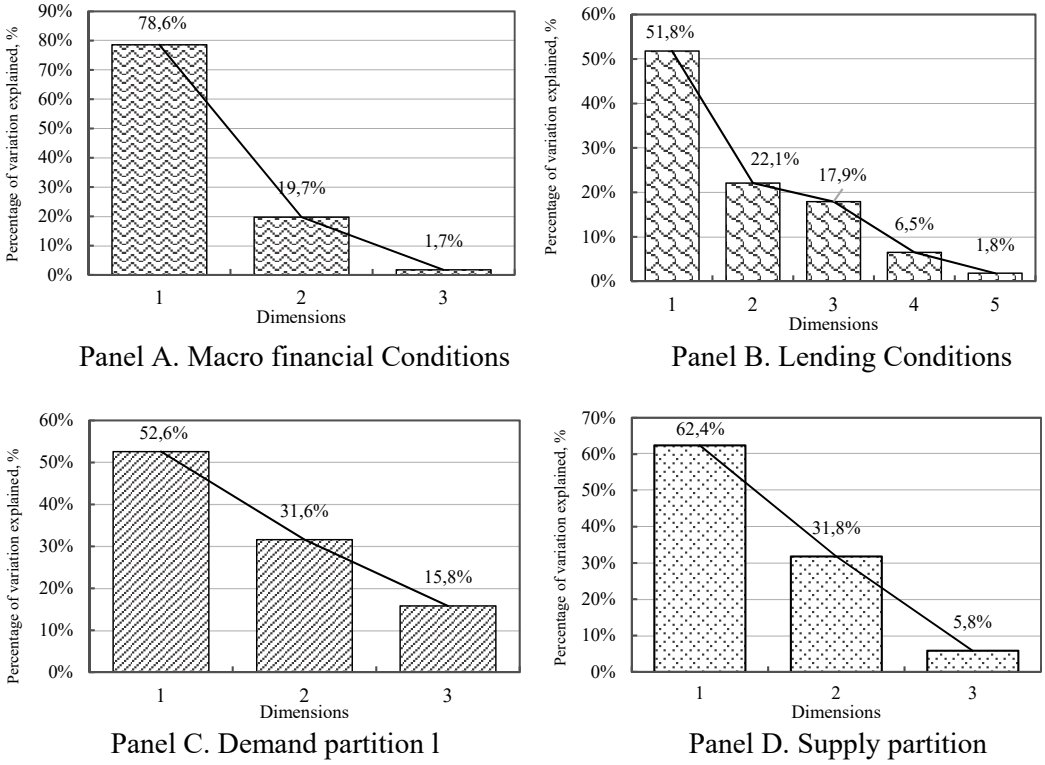

Figure 3. Panels A-D. Percentage of explained variance of the components of Macro financial, Lending Conditions, Demand and Supply partitions

Source: compiled by authors using R.

However, our initial plan was not to arrive with the final regression model with the highest measures of predictive power since we didn't intend to predict the fitted values. Our ultimate aim for this research was to identify fundamental factors of HP growth and analyze their contribution and its direction on each of the stages of RRE development. Thus, we planned to use only one of the dimensions with the greatest share of inputs' variability explained. However, due to high correlation between the first components of the macro financial and demand partitions, we decided to continue our research with the second component of the macro financial conditions partition.

The rationale for choosing to give up the first component of the macro financial conditions over the first component of the demand partition is that it is generally considered that demand-side factors are the main fundamentals of HP dynamics, as according to Geng (2018).

The largest contributors to the newly constructed variables of macro financial conditions, lending conditions, demand-side and supply-side partitions are, respectively: Inverted current account deficit to GDP, Exchange rate adjusted mortgage portfolio to GDP, Disposable real

aggregated income and Total area of commissioned dwellings per quarter in Kyiv city with 1Q lag.

In the *Table 3*, we provide results of the regression analysis for both baseline models: with dependent variable from the primary and from the secondary RRE market of Kyiv.

Table 3

Regression summary statistics for the multi-factor baseline model

	House prices on the primary RRE	House prices on the secondary RRE
Macro financial Conditions partition	–0.059***	–0.037*
Lending Conditions partition	–0.029***	–0.004
Demand partition	–0.069***	–0.067***
Supply partition	0.005	–0.004
Constant	–0.024*	–0.031*
Number of observations	58	58
R^2	0.636	0.522
Adjusted R^2	0.609	0.486
Note:	*p<0.1; **p<0.05; ***p<0.01	

Source: compiled by authors using R.

In this stage of research, *three hypotheses* were put forward and their empirical verification was carried out. The *first hypothesis* was that the demand partition has the highest contribution to the HP growth throughout the whole period of observation. The *second hypothesis* was that the macro financial partition has lower effect on the HP growth on the secondary RRE market. The *third hypothesis* was that the lending conditions had the strongest impact on the HP growth during the first stage of RRE development, as outlined in the previous sub-chapter. All three hypotheses were not rejected, as discussed in detail further.

According to the results of regression analysis in the *Table 3*, we obtained useful insights on the Kyiv housing market. It is worth noting that the supply-side variable, *total area of commissioned dwellings per quarter* is not significant for both sub-markets. This can be explained by the fact that during the period from 2009 to mid-2020 the mortgage lending was nearly nonexistent, due to the events and reasons that will be explained further. The absence of mortgage lending significantly impaired the housing demand and even contributed to the HP being uncorrelated with the demand fundamentals. However, this is not only the case for demand-side variables: extremely low levels of mortgage lending made HP on the primary real estate market[1] inelastic to the volumes of newly introduced housing due to two reasons. Firstly, in the case of more buoyant construction, the real estate

[1] The prices secondary RRE market, in theory, also must respond to the increasing housing stock, however with a bigger lag and to a lesser extent than the prices on primary market, thus the following reasoning is given only for the latter.

developers were unable to respond to it with accordingly lower prices, since up to the late 2020 they were working with almost zero marginality. Except from the infamous cases of bankruptcy of developers that defrauded nearly 30 thousand people, who never received the dwelling they had paid for, most of the developers were able to remain solvent because of the large volumes of construction and concomitant building of dozens of apartment complexes (National Bank of Ukraine, 2020). Secondly, they were unable to increase prices in times of stagnant construction activity due to inexistent mortgage lending and very low levels of demand on the market. According to the regression results, the most significant variable for both primary and secondary markets is the demand partition, as according to the literature and basic economic sense. The macro financial conditions and lending conditions partitions are more significant for the HP on the primary market, which also corresponds to the economic logic. We do not pay attention to the signs of the coefficients, since we use the standardized, PCA-transformed variables, which were also originally presented as growth rates. What is important for us is the interpretability of these coefficients in the graphical form as the distribution of factors that influence HP growth on different stages. According to the *Figure 4*, the lending conditions were playing significant role in the development of HP on the primary market only during the first stage of the real estate market development, from the beginning of 2003 to the early 2009 the demand factors. The lending conditions continue to contribute positively to the HP change during the crisis of 2008–2009 due to mortgage portfolio being on its historical heights. The significant role in the downfall of HP during the early second stage was played by demand factors, which is explained by falling disposable aggregated real income and rising unemployment. Another important driver of this contraction was macro financial variables, due to worsening economic conditions during the crisis.

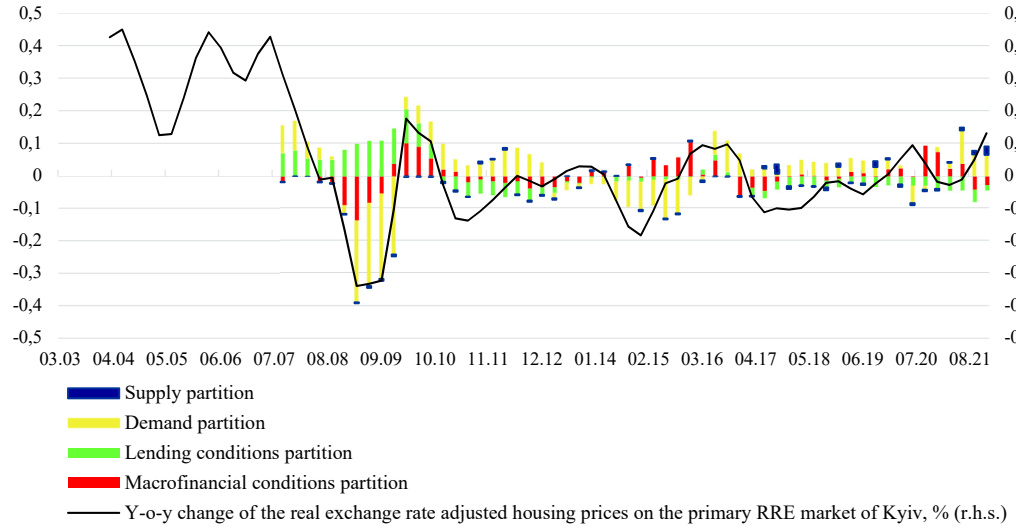

Figure 4. Distributions of factors that affect the house price growth on the primary RRE of Kyiv

Source: compiled by authors.

The same conclusion applies to the distributions of factors that affect the HP growth on the secondary housing market of Kyiv city. After the early second stage, the HP change was never significant with the demand partition generally negatively contributing to HP movement during the third stage and positively during the fourth. After the first stage, the lending conditions were only contributing to the fall of HP, since the new lending was almost inexistent and the stock of mortgage shrinking.

According to the *Figure 5*, the biggest contributor to the HP on the secondary market throughout all stages, also in accordance with the regression results, was the demand partition, with the second role played by the macro financial conditions.

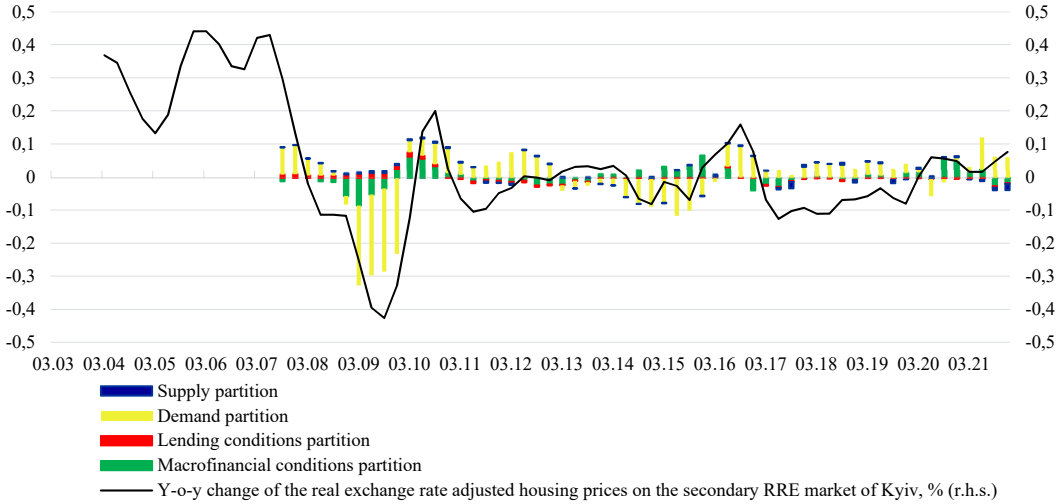

Figure 5. Distributions of factors that affect the house price growth on the secondary RRE market of Kyiv

Source: compiled by authors.

In the *Table 4* we present a short summary of the HP drivers across all stages of RRE development.

Table 4

Impact of HP drivers changes across the stages of RRE development

Stage	Impact of main factors	
	Primary RRE market	Secondary RRE market
First stage (before Q1 2009)	Demand and lending conditions partitions contribute to rising HP before the crisis; Demand and MF partitions contribute to falling HP during the onset of crisis	Demand partition contributes to rising HP before the crisis; MF partition contributes to fall of HP during the onset of crisis
Second stage (Q2 2009 – Q4 2013)	Demand partition positively contributes to the HP change before 2013; LC partition negatively contributes to the HP change before 2013; All partitions contribute negatively during 2013	Demand and MF partitions positively contribute to the HP change before 2013; Demand and MF partitions negatively contribute to the HP change during 2013

End of table 4

Stage	Impact of main factors	
	Primary RRE market	Secondary RRE market
Third stage (Q1 2014 – Q2 2020)	Demand and LC partitions contribute negatively before mid-2016; LC partition contributes negatively further; Demand contributes positively from mid-2016 to the Q1 2020, when the coronavirus crisis started	Demand partition contribute negatively before mid-2016; Demand contributes positively from mid-2016 to the Q1 2020, when the coronavirus crisis started; MF partition contribute positively before mid-2016 with insignificant impact further
Fourth stage (Q3 2020 – Q1 2022)	Demand partition contributes positively throughout whole stage; LC partition contributes negatively further; MF partition contributes positively throughout first half of the stage	Demand partition contributes positively throughout whole stage; MF partition contributes positively throughout first half of the stage
Fifth stage (since Q1 2022)	The impact not defined due to chaotic prices and market being in disequilibrium	

Source: compiled by authors.

3. A set of criteria to define whether the HP growth is threatening financial stability

Based on the results, obtained within the course of this research and described in the previous sub-sections, we have formulated a set of criteria, based on which it is possible to conclude whether the HP growth contributes to the general economic growth and remains safe for the financial stability. The HP growth remains within the corridor of safe values if the following criteria are met:

- The regulator executes restrictive or intentionally and well-informed expansionary mortgage market-oriented macroprudential policy; *AND.*
- (a) The HP growth is explained by market forces (demand and supply) or macro financial conditions with lending conditions being at least driver of second importance; *AND.*
- (b) The Mortgage-loans-to-GDP ratio is below 2 percentage points above its long-term trend (Basel Committee on Banking Supervision, 2010); *OR.*
- There are no signs of HP overvaluation (price bubble) according to the bubble detection framework, as according to Shmygel and Hoesli (2023).

As follows from the set of criteria, in case the first and the second OR third criteria are not met, the HP growth needs additional attention and analysis, with the mortgage market-oriented macroprudential policy possibly being shifted to restrictive. The rationale for making this conclusion based on only two but not all the criteria is based on the fact that the tendencies on the mortgage and residential real estate market not always coincide, because the markets are affected by multiple forces and are much more complex than

it can be regarded in theory. Since these two markets are not always moving together, an abnormal dynamic in either of them can be a source of disruptions that, amplified by an overly liberal prudential policy, can lead to severe episodes of financial instability.

Conclusions

We have singled out five distinct stages of RRE market development in Ukraine based on two general indicators: HP growth and lending activity. The division was based on the significant changes of market conditions and (or) changes of HP drivers, as well as on shifts in the regulatory environment. Then we investigated the HP drivers on each of these stages, using the principal component analysis method to form variables for the following OLS regression method. The analysis has showed that the housing cycle of the RRE market in Ukraine was mostly impacted by the demand-side factors: unemployment rate, as well as income and population growth. Three hypotheses were put forward and tested. It was proven that the demand factors have the highest impact on house price growth throughout the observation period; macro financial conditions mostly influence the prices on primary housing market; and the lending conditions were affecting the price dynamics the most in the first stage of housing market development during the active pre-crisis mortgage lending. Finally, we have formed a set of criteria with the help of which we can judge whether the current HP growth is a source of systemic risks to the stability of national financial system and economy in general. The conclusions, drawn within the process of this research, could significantly contribute to the framework of monitoring RRE market by the National Bank of Ukraine and to the analysis of systemic risks stemming from it.

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