

Socio-economic factors associated with house prices. Evidence based on key macroeconomic aggregates globally

Gabriela Lewandowska ¹, Michal Taracha ², Kamil Maciuk ³

¹ AGH University of Science and Technology, Mickiewicza 30 Av, 30-059 Krakow, Poland;
gabrielalewandowska29@gmail.com

² Collegium of Economic Analysis, SGH Warsaw School of Economics,
Madalińskiego 6/8 Street Warsaw 02513, Poland;
mtarac@sgh.waw.pl; ORCID 0000-0002-3597-7888

³ AGH University of Science and Technology, Mickiewicza 30 Av, 30-059 Krakow, Poland;
maciuk@agh.edu.pl; ORCID 0000-0001-5514-8510

Abstract: The aim of this paper is to assess the association between macroeconomic factors and house prices in selected OECD countries. In this paper, authors describe selected socioeconomic factors, adapt a transparent methodology based on the OECD database and derive results shedding a light on the main drivers shaping the trends of the real estate prices. Two main economic aggregates, inflation and gross domestic product (GDP) were analysed for the OECD member and non-member countries for which complete data have been made available for the period of 1990-2020. The OECD provides data for 60 countries in total, out of which 38 are members of the organization. Nevertheless, due to missing observations in certain countries, the analysis was carried out in 19 of them. The aim of the study was to determine how GDP and inflation dynamics are correlated with changes in property prices. Among the analysed countries, Japan and South Africa could be distinguished as outliers in terms of inflation, whereas in the case of GDP, Italy, Japan, Ireland and Norway stood out. Additionally, 12 representative countries were described in detail. These countries comprised four groups of three countries divided across two dimensions: the first, based on the highest and the lowest correlation coefficient, and the second, based on the measure used to calculate the correlation coefficient (correlation of the house prices with GDP and correlation of the house price with inflation). On the basis of the analyses, it was shown that the association between GDP and house prices is stronger than that between inflation and house prices – in most cases, prices increased at a similar rate as GDP. A particularly high correlation between GDP and house prices was found for Norway, New Zealand and Sweden, indicating a potentially higher marginal housing consumption responsiveness to changes in housing wealth in these highly developed countries, characterised by particularly low housing transaction costs and efficient mortgage market. It was deduced that such characteristics lead to a higher wealth elasticity of demand for new houses.

Keywords: GDP, inflation, human population, economic activity, real estate, apartments, macroeconomics, OECD, house prices, Pearson correlation coefficient.

1. Introduction

The real estate housing market is a vital part of the national economy of most countries around the world [1]. The need for security is one of the basic needs driving the demand. It also triggers people's desire to own their own apartment or house [2]. As a result, residential market accounts for 60-80% of the broader real estate market [3]. The increase in demand for real estate is related to market development [4]. Consequently, high demand for homes drives home prices up. The value and a high number of houses bought and sold are linked to the country's economic development [5]. Studies have indicated that macroeconomic aggregates are crucial in describing and analysing the situation in the real estate market [6]. Among others, the real estate market is influenced by the gross domestic product (GDP) and the inflation rate [7], [8]. However, we cannot generalize the data from all the studied countries and regions [9]. Residential real estate prices are also influenced by the prices of construction materials and the prices of land for housing development [10], [11]. Real estates were compared with other financial assets as potential hedge during high inflation [12]–[14]. Another interesting aspects deal with the impact of the COVID-19 pandemic on the housing market [15]–[17], detecting house price bubbles [18] and Pearson correlation between real estate markets in different countries.

The Organisation for Economic Co-operation and Development (OECD) is an international economic organization of 38 highly developed and democratic countries [19]. The key partner-countries of the organization are Brazil, China, India, Indonesia and South Africa [20]. The main goal of the organization is to promote policies aimed at the highest possible and sustainable economic growth of its member countries [16]. It also aims to raise employment and living standards in the OECD member countries while maintaining financial stability [21]. As regards the real estate housing market, conclusions from a significant OECD Economics Department Working Paper by P. Catte et al. (2004) highlighted the importance of housing market completeness (in terms of a variety of products and a wide range of potential borrowers). It was found that in countries having large, efficient and responsive mortgage markets (characterised among others by low transaction costs), the impact on marginal housing consumption was relatively strong [22].

The aim of this engineering study is to assess the influence of macroeconomic factors on average prices per square meter of houses in the OECD member countries. Basing on the aforementioned articles and studies concerning the impact of macroeconomic elements on residential real estate market prices, the data compilation is divided into three parts. The first part will consider the theoretical literature that presents the macroeconomic aggregates that have the strongest impact on the real estate market and to present the definitions of these aggregates. The next part will involve selecting and presenting the research methodology adopted in such a way as to show the impact of the selected factors on the real estate market. The last section will include the results of the conducted research - concerning the impact of macroeconomic factors on real estate prices in the OECD countries.

2. Socio-economic factors

Residential property prices are influenced by macroeconomic factors. It is a set of selected data showing how, over a certain period of time, the basic tendencies of economic development of a given country are presented [23]. Macroeconomic factors provide a view of how such tendencies affect the prices of products and services produced in all economic sectors and industries. Thus, these factors determine the overall demand. The analysis of the literature on macroeconomic factors and real estate prices indicates that inflation and gross domestic product (GDP) have the strongest impact on real estate prices among other macroeconomic aggregates.

We can measure GDP (defined as the end result of unit production) in three different ways (European Parliament 2013):

- The value-added (production) approach: Output is the sum of added gross value of individual branches or instate sectors, which are increased by taxes and decreased by subsidies received for given products;
- The expenditures approach: Total spending on products and services, increased by exports and decreased by imports;
- The income approach: Income is the sum of outgoings for a given account, where incomes are created.

Economic growth favours the supply-side in the residential real estate market, which drives up prices for products and services, most notably home prices.

In this paper, GDP is analysed according to the resource approach which is an extension of the value-added approach – measuring GDP as the sum of all resources used in the production process (taking into account both final and intermediate goods).

Another factor affecting house prices is inflation, defined as an increase in the price level of an economy during a certain period of time. In this study, inflation will be described more narrowly as the demand-pull inflation: the state of the economy resulting from an excess of demand over supply. The inflation index used in this study is based on two price indexes: the CPI (consumer goods index) and PPI (producer goods index) factor [24]. In general, prices of materials and services are very much dependent on the inflation index. In this study, real property prices will be used to analyse the real estate market. The real (actual) property price can be defined as the ratio of the nominal price index to the expenditure index of people in each country [25]. In this study, the real property prices are constructed by subtracting the inflation rate from the nominal price. It is also worth mentioning that the nominal property price constitutes an accumulation of the prices of newly built houses and the prices of already existing houses that have been sold.

3. Methods

The housing real estate market was analysed in 60 countries for which the data was available in the OECD.Stat database. At the same time, 38 of these countries belong to the organization itself (Fig. 1).

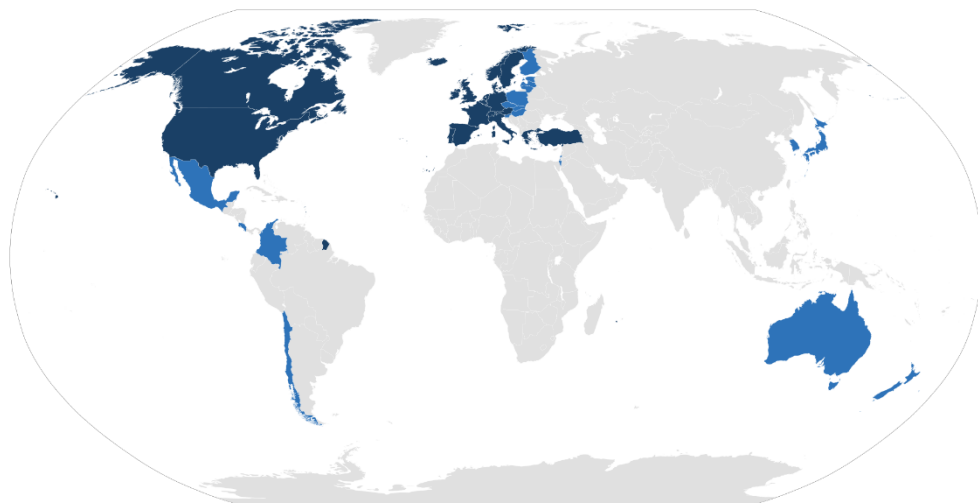


Fig. 1. OECD countries (navy blue - founding member countries, blue - other member countries [26])

The time period of the analysis has been narrowed down to the period from 1990 to 2020. Reduction of observations from certain years was necessary due to the small number of countries for which accurate data were available. Inflation rates were provided for 51 countries, of which full data were available for 41 countries. Data on GDP were available for 50 countries, with complete data encompassing 26 of them. Real property prices were reported for 49 countries, but only 25 out of them had complete data for the selected period of 1990-2020. Only the countries that had met the aforementioned requirements were analysed, while most countries had been eliminated due to the missing data. One of the major reasons for the occurrence of the missing data is the fact that certain countries joined the organization after 1990. Eventually, 19 countries were taken into consideration in the analysis (Fig. 2).



Fig. 2. Countries included in the analysis

Data from the OECD database were used to develop the analysis, and average prices of houses from the secondary and the primary market were studied using Person correlation coefficient, the most popular in measurements of linear correlation. This method was chosen because it best shows how macroeconomic factors affect residential property prices. Basing on the calculated correlation coefficient, 12 countries were selected and described in detail. The countries were selected basing on the highest and lowest correlation coefficient for the two selected macroeconomic factors.

4. Results

There are many factors impacting the property prices, the two most important ones being inflation and GDP. An increase in inflation can affect property prices in different ways. In general, when inflation rises, property prices also tend to rise, which results from a drop in the purchasing power of the currency (following a monetary tightening, domestic interest rate appreciation and the subsequent depreciation stemming from the discrepancy between the domestic and the foreign interest rates) causing the nominal prices of all goods, including real estate, grow. Inflation can also lead to a decrease in the value of money in the long term, which makes property investments appear more attractive compared to other assets. GDP growth can also affect property prices, its rise, increase the overall economic activity, income and lead to better job prospects and higher employment. This, in turn, can increase the demand for property, for both residential and investment purposes. Greater demand can lead to higher property prices, however, it is important to bear in mind that the correlation between inflation, GDP and property prices is not clear-cut and many other factors may affect this relationship. For example, when the increase in property prices is caused by local factors, such as a lack of available land or limited supply, inflation and GDP may exert less of an impact on these prices. In addition, the relationship between these variables may vary across different countries and regions.

Fig. 3 presents the percentage increase in annual inflation between 1991 and 2020 analysed for OECD countries with complete data, i.e., for 19 countries. Data are presented relative to 2015, the reference year (=100%). In this way, values from different periods could be compared in a consistent manner and show the dynamic information concerning the changes in time-series (bearing in mind the non-additivity problem). The black dashed line shows the inflation averaged over 19 countries, while coloured lines indicate inflation in individual countries. Since 1990, an increase in inflation could be observed in each country. The biggest spike (which is especially visible in the chart for the line corresponding to Ireland, marked in olive colour) occurred around 2008 – during the global financial crisis. After the crisis, changes in inflation roughly returned to a steadily increasing trend and slightly slowed down. In the chart below, two standout countries are noticeable. The first one is Japan marked in red, above the mean. At the beginning of the period under study, Japan's inflation rate relative to the other countries was very high. This discrepancy between Japan and the average for all the analysed countries remained until 2010. The second country that stands out is South Africa (marked in blue). At the beginning of the analysed period, inflation rate in South Africa was the lowest among the countries in the analysis. However, in the following years, inflation in South Africa was steadily increasing at a very fast rate, relative to other countries, and after 2015, inflation in South Africa surpassed other countries.

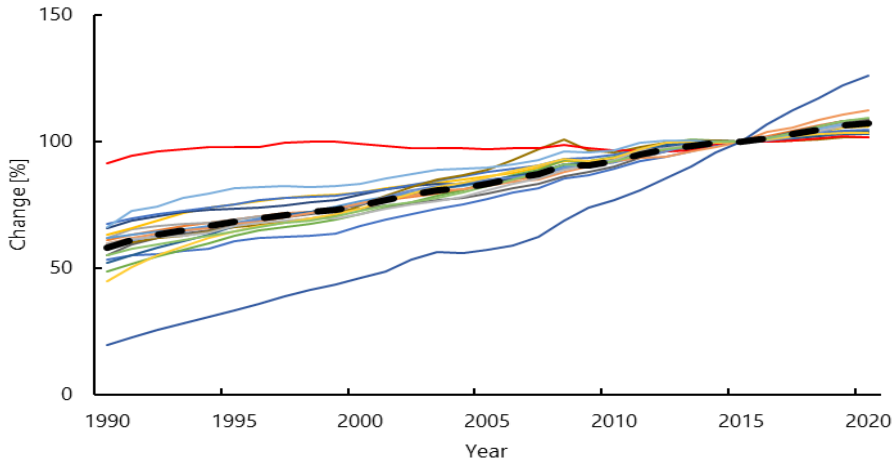


Fig. 3. Inflation, 2015 =100% [27]

Fig. 4 shows changes in annual GDP (in percentages relative to 2015) over the same time period (of 1990-2020) for the 19 analysed countries. The black dashed line indicates the average GDP indicator, while the coloured lines indicate individual countries. Since the beginning of the period under study, a noticeable increase in GDP could be observed for each country. Despite the steady growth, slight slowdowns or drops occurred around 2008, during the world economic crisis. At the end of the studied period, another slight slowdown occurred, which could have been related to the outbreak of the COVID-19 pandemic. One could point out two countries that stand out from others. The first one is Ireland (marked in red, dashed line), which had the lowest GDP until 2015 and experienced a large decrease in GDP (measured as relative to the value from 2015) after the crisis. For the entire period under study, Ireland's GDP was lower than GDP averaged over all countries. Another country that stands out is Norway, marked in dashed navy-blue colour. At the beginning of the period under study, it had the second lowest GDP. However, after 2000 Norwegian GDP growth accelerated and in 2007 became higher than the average for the countries studied. The other countries worth a description are Italy (dashed green line) and Japan (dashed brown line). Both of these countries have the highest and almost equal GDP at the beginning of the studied period. After 1997, Japan's GDP fell behind relative to that of Italy, but it remained above the average GDP calculated for all the 19 countries. In the following years, the GDP in Japan (measured as relative to the value from 2015) fell below the average for all the 19 countries. However, the GDP of a less developed Italy remained above the average of all the countries for the entire studied period.

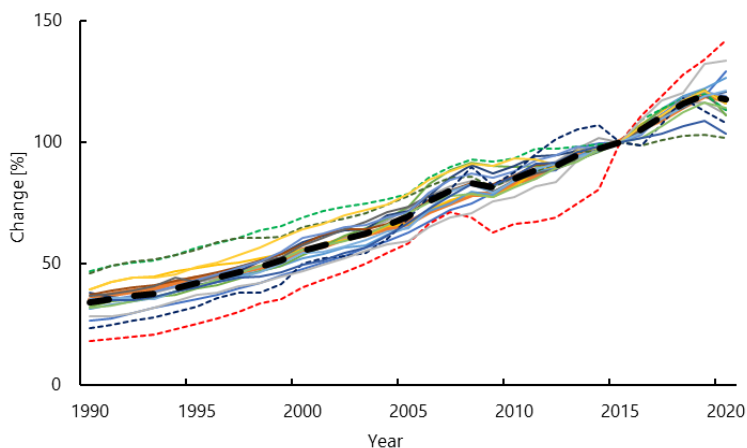


Fig. 4. GDP, 2015 = 100% [28]

Twelve countries with the lowest and the highest Pearson correlation between house prices and, respectively, inflation and GDP were selected for a detailed analysis. Figures 4-7 present relations between both macroeconomic aggregates and the real estate prices. Fig. 5 presents graphs representing countries for which the correlation coefficient between house prices and inflation was the lowest: the Netherlands, Denmark and South Africa. Fig. 6 shows three countries with the highest correlation coefficient between house prices and inflation: Ireland, Japan and Finland. Fig. 7 shows countries with the lowest correlation coefficient between house prices and GDP: Portugal, Italy and Germany. Finally, Fig. 8 illustrates countries with the highest correlation coefficients between house prices and GDP: Norway, New Zealand and Sweden. Each graph shows house prices (black line), GDP (blue) and inflation (red). The vertical axes in the graphs represent the annual values of these three variables, expressed as percentages of a base year, 2015 (=100%). The horizontal axis represents the timeline from 1991 to 2020.

Graphs presented in Fig. 5 indicate that inflation in all the countries was increasing throughout the entire period of the analysis. In the Netherlands, correlation coefficient was of -0.3, which indicates a weak correlation – rising aggregate inflation versus falling house prices. We observe a slight increase in GDP in 2000 and a decrease in 2007 followed by an increase from 2015. From the beginning of the analysed period until 2008, real estate prices were increasing. There was also a downward trend until 2014. In the last examined years, prices were increasing. In Denmark, the correlation coefficient amounted to -0.42 which shows that the association between inflation and house prices was negative, similarly to the Netherlands. The graph shows a continuous increase in GDP in Denmark throughout the analysed period with a drop in 2008. At the beginning of the analysed period, house prices in Denmark were decreasing. From 1994, an increase with small changes was observed, whereas from 2003 to 2007, a considerable increase in prices was noticeable. From 2007 to 2011, there was a sharp decline in prices followed by a steady increase. In South Africa, the correlation coefficient was of -0.50. A common upward trend in South African GDP is evident. Throughout the analysed period, GDP increased mildly. However, an acceleration followed by a decrease occurred in 2007 and 2018. Real house prices decreased from 1990, but from 2003 to 2007 a sharp increase in prices was observed. From 2009, real prices remained at a similar level. The probable reason was the global economic crisis of 2008. A sharp decrease occurred again after 2020, when the COVID-19 pandemic broke out.

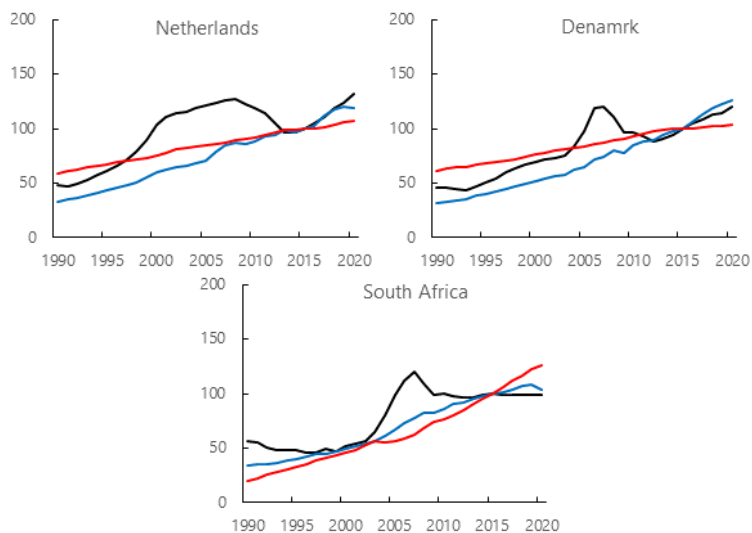


Fig. 5. Annual house prices (black line), GDP (blue) and inflation (red) relative to 2015 (=100%) in countries with the lowest correlation coefficient between inflation and house prices

Fig. 6 shows graphs of the countries with the highest correlation coefficient of inflation to real house prices. In the charts below, we can see more intense changes near 2008. In Ireland, the correlation coefficient was of -0.54 , reflecting a relatively mild negative correlation. This also shows that inflation was rising and prices were falling. Inflation was increasing from the beginning of the period under analysis. From 1995 to 2008, there was a steeper increase in inflation. In the following year, one could observe a subsequent decrease in inflation followed by stabilisation. The graph showing GDP presents a similar trend and only after the fall of 2009 a sharp rebound was recorded. At the beginning of the period under study, real house prices recorded a slight increase. After the period of 1996-2007, prices increased sharply. They were falling subsequently until 2012. Afterwards, house prices increased steadily. In Japan, the correlation coefficient was equal to 0.50 which shows that the correlation is mild and positive, and prices were rising along with inflation. The inflation rate remained at a similar level throughout the period. Small increases and decreases could be observed, e.g., an increase until 1993 and a decrease in 2009. Japanese GDP was increasing throughout the analysed period except for 2010 when a decrease was recorded. Real house prices followed a similar pattern until 1991. From 1991 to 2008 prices fell sharply, while in the following years they remained at similar levels. After 2015, a slight increase in house prices could be observed. In Finland, the Pearson correlation coefficient amounted to -0.3 . Such a value indicates that as inflation rises, house prices fall. Inflation in Finland was steadily increasing throughout the period. A slightly larger increase in 2008 was noticeable. After 2015, inflation stayed at a similar level. At the beginning of the analysed period, after 1993 it rose mildly, but a stronger increase was marked in 2008 and after 2015. Real house prices fell until 1993. Between 1993 and 2007 prices increased with an only decrease in 2001. After 2007, prices were decreasing. In the countries described above, we see the impact of inflation and GDP on prices. Additionally, the impact of the economic crisis is noticeable.

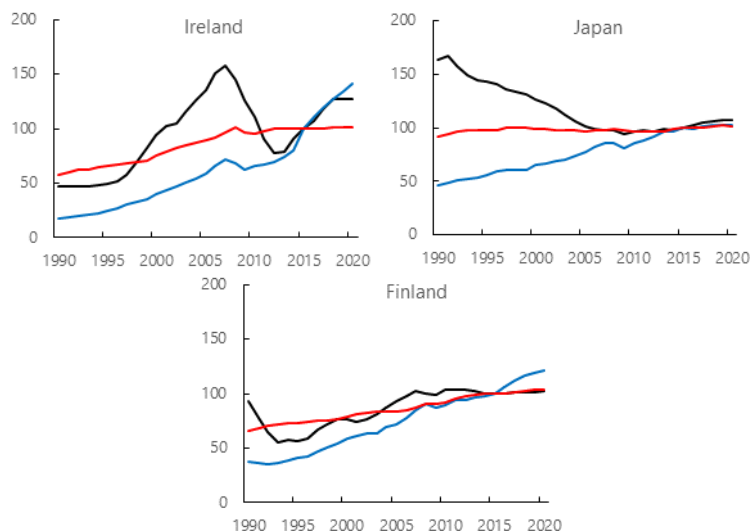


Fig. 6. Annual house prices (black line), GDP (blue) and inflation (red) relative to 2015 (=100%) in countries with the highest correlation coefficient between inflation and house prices

Fig. 7 shows countries with the lowest correlation coefficient of real price to GDP. For the following three countries, inflation follows a similar pattern of a mild growth throughout the analysed period. The correlation coefficient calculated for Portugal was -0.38, which indicates a mild negative correlation. The growth slowed down around 2008 and a slight decrease was noticed afterwards in 2011. In the following years, Portuguese GDP rebounded and, after 2019, it fell again. At first, house prices in Portugal increased, then after 1993 they fell. From 1997 to 2001, house prices increased. Meanwhile, in the following years, they decreased. A larger decline was marked around 2008, while in the next two years house prices held steady. From 2010 to 2015, prices decreased again and increased after 2015. The correlation coefficient calculated for Italy amounted to 0.08, which reflects a very weak correlation. In Italy, the GDP was growing mildly. From 2004 to 2011, a steeper growth could be observed. From 2011 to 2015, GDP had similar values. After 2015, an increase was observed until 2019, followed by a decrease after 2019. Real house prices have a similar sinusoidal pattern. By 1993, prices were rising. In the next 4 years, prices fell and then rose until 2008. In the following years, prices were steadily decreasing. The correlation coefficient calculated for Germany was of 0.20, reflecting a weak positive correlation. As in Italy, GDP and house prices were increasing. In Germany, GDP grew only mildly. From 2005 to 2007 a sharp increase was noticeable. Then a slight decline, followed by an increase from 2009. In 2019, German GDP decreased. Real house prices rose slightly until 1995. In subsequent years, prices fell until 2009 and then increased sharply. GDP did not have a high association with prices, which is visible at the beginning of the analysed period, where GDP increased, and prices fell. The influence of the economic crisis is noteworthy, after which the real prices fell.

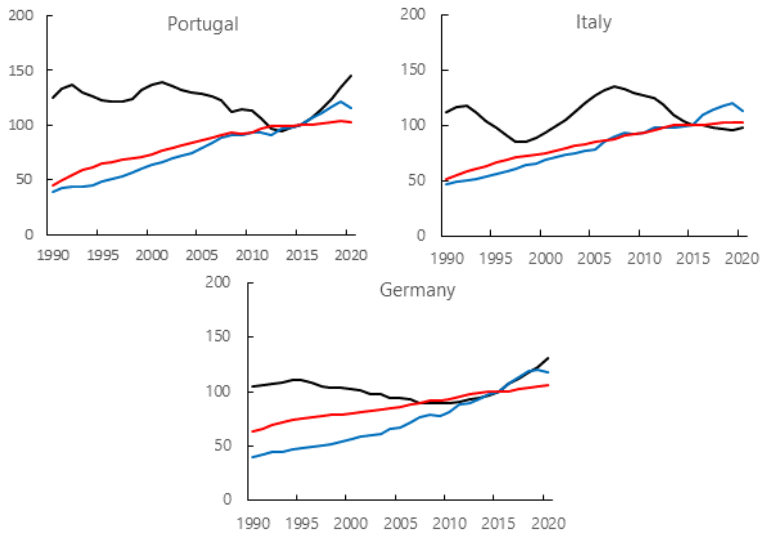


Fig. 7. Annual house prices (black line), GDP (blue) and inflation (red) relative to 2015 (=100%) in countries with the lowest correlation coefficient between GDP and house prices

Moving on to Fig. 8, showing countries with the highest correlation coefficient of GDP to the real house price, the inflation graph shows a common upward trend over the entire period for all the countries. Graphs for GDP and real prices are very similar. One could deduce from these graphs that real prices are highly positively correlated with GDP. The correlation coefficient in Norway was of 0.99, which shows an almost perfect linear correlation. Norway saw an increase in GDP with noticeable larger increases, for example in 2000. However, there was a decline after 2009. Until 2014, GDP was characterised by an upward trend. In the following year, a decline was observed. From 2016 to 2018, GDP was increasing and, in the most recent years, it decreased. Real housing prices were declining in the beginning. After 1993, they increased. More rapid increases were marked in 2000 and 2007, then they were decreasing for two years (2008,2009). From 2009 to the end of the analysed period prices were increasing. Correlation index in New Zealand was of 0.98, which shows almost a perfect correlation. In New Zealand, GDP during the whole analysed period was increasing. Real house prices did not change until 1993. Until 1997 they increased and stabilised for four years. By 2007, house prices increased sharply and then dropped the following year. Until 2010, prices remained stable and then rebounded sharply until the end of the period under study. For Sweden, the correlation coefficient was equal to 0.97, showing almost perfect positive correlation. In Sweden, GDP grew mildly until 2005. For the next two years the growth was steeper and then fell. In the following years, GDP was rising gently.

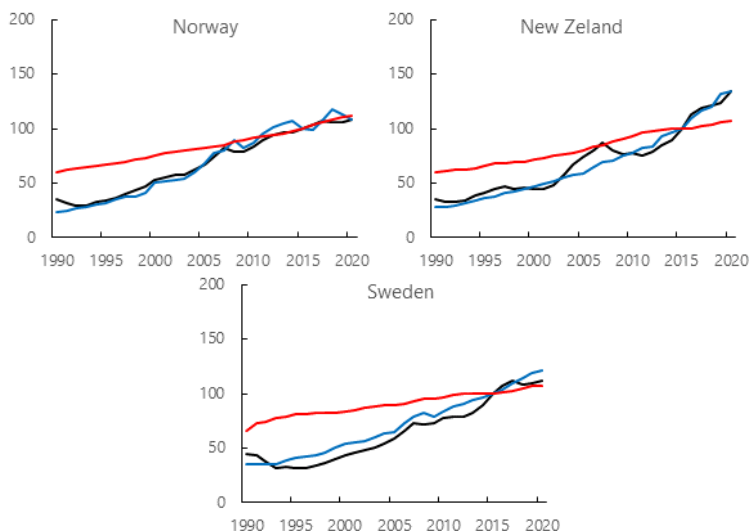


Fig. 8. Annual house prices (black line), GDP (blue) and inflation (red) relative to 2015 (=100%) in countries with the highest correlation coefficient between GDP and house prices

Real prices were initially falling until 1997 and then were rising until 2007. In the following year, prices changed only by a small margin. By 2017, prices were steadily increasing. After 2017, they experienced a slight drop. For the countries shown in Fig. 8, the correlation coefficient has a positive sign. A positive correlation indicates that when GDP increases real estate prices increase as well. The effect of GDP on real property prices is noticed in high degrees. Furthermore, the graphs show that GDP and real estate prices were strongly affected by the economic crisis in 2008.

5. Conclusions

There are many factors impacting the real estate prices. Among them, one could point out GDP, inflation, interest rates, unemployment or government policy. GDP is one of the most important economic indicators; its growth translates into a greater economic activity, the expansion of businesses, increased income and employment. This, in turn, increases demand for real estate, for both housing and investment purposes. An increase in GDP can lead to an increase in property prices, especially in regions with a limited supply of housing. Inflation, i.e. a general increase in prices in the economy, can lead to a decrease in the currency purchasing power, which in turn increases property costs. When inflation is high and there is no corresponding increase in wages, this can limit people's ability to buy property, which can result in the subsequent price falls. At the same time, the level of interest rates has an impact on mortgage availability. When interest rates are low, the cost of borrowing against property is lower, which increases demand for property and can lead to higher prices. Conversely, when interest rates are high, the cost of borrowing is higher, borrowers' creditworthiness diminishes (and the change in the real value of balance sheets makes borrowers additionally worse off in accordance with the so-called Fischer's channel of the monetary policy transmission [29]), which can limit people's ability to buy property and leads to price falls. The level of unemployment has an impact on the demand for property. High unemployment can limit people's ability to buy property and therefore result

in a decrease in prices. Conversely, low unemployment and increased employment opportunities contribute to a greater demand for property, which can make prices go up. Government decisions and regulations can have a significant impact on property prices as well. For example, changes in zoning regulations, facilities for obtaining mortgages, housing subsidy programmes, etc., can affect the supply and demand for property and thus influence prices.

In this paper we have investigated macroeconomic factors affecting residential real estate prices. It should be reiterated that real prices adjusted for inflation (nominal prices minus the inflation rate) were used in the analysis. The factors analysed were GDP and inflation. GDP was analysed in the paper according to the resource-side approach. Inflation represents the health of a country's economy. For this purpose, the data obtained from the website of the international economic organization of highly developed countries (the OECD) were used. The data were filtered: first, the data availability was analysed, and then the correlation coefficient was calculated. Scientific literature shows that GDP and inflation can be the main macroeconomic factors that influence real estate prices. Countries included in the OECD.Stat database were the ones covered in the analysis. Results showed that there was an upward trend in the value of correlation coefficients comparing inflation and real estate prices. In particular, in 2008, there was a noticeable increase in the value of such coefficients. The GDP coefficient follows a similar trend in all the countries. The visual analysis indicated large changes in the association between GDP and real estate prices occurring between 2008 and 2020. 12 countries with the highest and the lowest correlation coefficient were singled out and analysed in detail. For most of the countries, the main factor influencing the real estate prices was the GDP coefficient indicating the impact of business cycle on property prices of each country. Finally, the analysis indicated that increasing inflation was associated with a downward trend of real estate prices. The main reasons for decreases and increases in property prices were the economic crisis in 2008 and the outbreak of COVID-19 pandemic in 2020.

Relevant conclusions can be also related to the group of countries having the highest correlation between GDP and house prices, namely Norway, New Zealand and Sweden. A high correlation might reflect the relatively strong association between the business cycle and the real estate housing market in these countries. Since these three countries are characterised by a particularly high level of social development, low transaction costs (including housing transaction costs) as well as mortgage markets that are efficient and complete (in terms of a wide range of potential borrowers – including younger households), such characteristics seem crucial for a higher marginal consumption responsiveness to changes in housing wealth. In other words, basing on this finding, a particularly high wealth elasticity of demand for new houses is expected to be observed in highly socially developed societies.

References

- [1] Rącka I. and Khalil ur Rehman S., “Housing Market in Capital Cities – the Case of Poland and Portugal”, *Geomatics and Environmental Engineering*, vol. 12, no. 3, (2018), p. 75. <https://doi.org/10.7494/geom.2018.12.3.75>
- [2] Sen J., “Security and privacy issues in cloud computing”, *Architectures and Protocols for Secure Information Technology Infrastructures*, (2014), pp. 1–45. <https://doi.org/10.4018/978-1-4666-4514-1.ch001>
- [3] Nykiel L., “Mechanizm dynamiki i zróżnicowania ceny na rynku mieszkaniowym”, in *Studia i Materiały Towarzystwa Naukowego Nieruchomości*, vol. 15, no. 3–4, 2007, pp. 45–57.
- [4] Kucharska-Stasiak E., “Rynek nieruchomości mieszkaniowych w procesie powstawania nierównowag makroekonomicznych”, *Świat Nieruchomości*, vol. 2, no. 96, (2016), pp. 5–10.
- [5] Mavrodiy A., *Factory analysis of real estate prices*, 2005.
- [6] Mach Ł., “Determinanty ekonomiczno-gospodarcze oraz ich wpływ na rozwój rynku nieruchomości mieszkaniowych”, *Ekonometria*, vol. 4, no. 38, (2014), pp. 106–116.
- [7] Gasparėnienė L. et al., “Assessment of the impact of macroeconomic factors on housing price level: Lithuanian case”, *Intellectual Economics*, vol. 10, no. 2, (Aug. 2016), pp. 122–127. <https://doi.org/10.1016/j.intele.2017.03.005>
- [8] Elmahi D. and Ahmed E., “Impact of Macroeconomic Variables on Housing Prices in Saudi Arabia: A VAR Approach”, no. December, (2020), pp. 1–12. <https://doi.org/10.20944/preprints202012.0715.v1>
- [9] Noszczyk T. et al., “Determining Changes in Land Use Structure in Małopolska Using Statistical Methods”, *Polish Journal of Environmental Studies*, vol. 26, no. 1, (Jan. 2017), pp. 211–220. <https://doi.org/10.15244/pjoes/64913>
- [10] Abraham J. M. and Hendershott P. H., *Patterns and Determinants of Metropolitan House Prices, 1977 to 1991*, 1992. <https://doi.org/10.3386/w4196>
- [11] Sabyasachi T., “Macroeconomic Determinants of Housing Prices: A Cross Country Level Analysis”, *Real Estate Finance*, vol. 10, no. Spring, (2020), pp. 229–238.
- [12] Essafi Zouari Y. and Nasreddine A., “Housing in the greater Paris area as an inflation hedge?”, *International Journal of Housing Markets and Analysis*, (2023). <https://doi.org/10.1108/IJHMA-08-2022-0118>
- [13] Fehrle D., “Hedging against inflation: housing versus equity”, *Empirical Economics*, no. May, (2023). <https://doi.org/10.1007/s00181-023-02449-z>
- [14] Wolski R., “Residential Real Estate as a Potential Hedge of Capital Against Inflation”, *Real Estate Management and Valuation*, vol. 31, no. 1, (2023), pp. 36–42. <https://doi.org/10.2478/remav-2023-0004>
- [15] Zhang X. and Yang E., “Have housing value indicators changed during COVID? Housing value prediction based on unemployment, construction spending, and housing consumer price index”, *International Journal of Housing Markets and Analysis*, (2023). <https://doi.org/10.1108/IJHMA-01-2023-0015>
- [16] Nicola M. et al., “The socio-economic implications of the coronavirus pandemic (COVID-19): A review”, *International Journal of Surgery*, vol. 78, no. January, (2020), pp. 185–193. <https://doi.org/10.1016/j.ijssu.2020.04.018>
- [17] Yang L. et al., “COVID-19 effects on property markets: The pandemic decreases the implicit price of metro accessibility”, *Tunnelling and Underground Space Technology*, vol. 125, (Jul. 2022). <https://doi.org/10.1016/J.TUST.2022.104528>
- [18] Shmygel A. and Hoesli M., “House price bubble detection in Ukraine”, *Journal of European Real Estate Research*, (2023). <https://doi.org/10.1108/JERER-10-2022-0031>

- [19] Delardas O. et al., “Socio-Economic Impacts and Challenges of the Coronavirus Pandemic (COVID-19): An Updated Review”, *Sustainability*, vol. 14, no. 15, (2022), p. 9699. <https://doi.org/10.3390/su14159699>
- [20] OECD, “Our global reach.” OECD, “Our global reach.” Available: <https://www.oecd.org/about/members-and-partners/> [Accessed: 01 April 2023]
- [21] gov.pl, “OECD - Organizacja Współpracy Gospodarczej i Rozwoju.” Available: <https://www.gov.pl/web/edukacja-i-nauka/oecd-organizacja-wspolpracy-gospodarczej-i-rozwoju2> [Accessed: 01 April 2023]
- [22] Catte P., “Housing Markets, Wealth and the Business Cycle”, 2004, pp. 127–147. https://doi.org/10.1787/eco_outlook-v2004-1-36-en
- [23] GUS, “Wskaźniki makroekonomiczne.” Available: <https://stat.gov.pl/wskazniki-makroekonomiczne/> [Accessed: 01 April 2023]
- [24] Kozak-Lisiecka T., “Inflacja w Polsce w 1999 r.”, *Gospodarka Narodowa*, vol. 158, no. 3, (2000), pp. 55–72. <https://doi.org/10.33119/gn/113946>
- [25] OECD, “Housing prices.” Available: <https://data.oecd.org/price/housing-prices.htm> [Accessed: 01 April 2023]
- [26] Wikipedia, “OECD.” Available: <https://en.wikipedia.org/wiki/OECD> [Accessed: 01 April 2023]
- [27] OECD, “Inflation (CPI).” Available: <https://data.oecd.org/price/inflation-cpi.htm> [Accessed: 01 February 2023]
- [28] OECD, “Gross domestic product (GDP).” Available: <https://data.oecd.org/gdp/gross-domestic-product-gdp.htm> [Accessed: 01 July 2023]
- [29] Chmielewski T. et al., “Monetary transmission mechanism in Poland. What do we know in 2017”, NBP Working Papers, (2018).