Constructing a house price misalignment indicator: revisited and revamped

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Abstract

This paper replicates and augments a multiple indicator approach of Schneider (2013) and Lenarčič and Damjanović (2015) of the aggregate house price misalignment indicator with the intention of showing the under- and over-valuation in house prices in Slovenia with respect to economic fundamentals. The updated indicator incorporates a subset of underlying indices that better appropriate the post-Covid period. The main findings are that during the 2004-2008 economic boom period the aggregate misalignment indicator clearly indicates a significant over-valuation in house prices in Slovenia. Similarly, another boom(-ish) period is also observed from 2020 on until the present day, but not to the same extent as before. On the other hand, during the second phase of the global financial crisis there was an abrupt correction in house prices.

JEL classification: C43, E31, G12, R31.

Keywords: House prices, under-valuation, over-valuation, multiple indicator approach, PCA.

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1. Introduction

In this paper, we construct a house price misalignment indicator that mostly follows the Schneider (2013) and Lenarčič and Damjanović (2015) multiple indicator approach. We augment approach of the latter by adding two additional sub-indicators that broaden the supply perspective and add a central bank perspective to the banking sector perspective.

In short, the multiple indicator approach methodology utilizes a two-step approach, where the first step relates to derivation of weights for respective sub-indicators using the PCA methodology (Principal Component Analysis) and in the second step derives aggregates sub-indicators to obtain the composite house price misalignment series. The aim is therefore to combine various demand, supply and banking sector factors into one aggregate indicator, that sufficiently indicate an alignment of house prices with the current and expected state of the economy. Compared to the actual (nominal) house price index, published by the Statistical Office (SORS), the aggregate indicator reflects a fair-value pricing of housing market, reflecting macroeconomic and financial fundamentals.

The results show that there was a significant over-valuation in house prices in Slovenia, taking place during the 2004-2008 boom period, followed by an abrupt correction in house prices after the burst of the housing bubble and lasted until 2015. In the next fiver years, a recovery phase followed, in which house prices returned to a long-term average while macro-financial fundamentals stabilised as well. From 2020 onward, we have been observing a boom(-ish) phase, however the over-valuation in house prices have so far been more moderate relative to the over-valuation period between 2004 and 2008.

The rest of the paper is organised as follows. Section 2 presents stylised facts of the housing market in Slovenia. Section 3 discusses the multiple indicator approach methodology and the relevant literature. The sub-indicators that are needed for the construction of the house price

aggregate misalignment indicator are presented in Section 4. Section 5 presents the results of the construction of the aggregate misalignment indicator and provides a comparison with other over- and under-valuation indicators. Section 6 concludes.

2. Some stylised facts of the housing market dynamics

In this section, we present stylised facts of the housing market dynamics in Slovenia. The risks related to the housing markets play a significant role on the economic activity, especially in the household sector and consequentially in the banking sector via housing loans exposures. Significant house price increase may serve as a financial accelerator in the financial imbalances build-up process, which may cause even more severe and prolonged crises after the burst of a housing bubble. This leads to financial losses of banks and investors holding real estate as an investment and/or real estate collateral, while households face negative wealth effects. The negative equity effect and the deleveraging process results in a decrease of aggregate demand and may lead into a deflationary spiral (Eggertsson and Krugman, 2012).

Turning to the case of Slovenia, in the last couple of years the high demand for housing was accompanied by an increase in building material costs, for which we could assume that house prices could stay elevated in the near future, even if demand dries out. In 2020, the house price growth was relatively moderate, however, at the beginning of 2021 the growth of house prices started to accelerate, following fast-paced post-Covid recovery in Slovenia. The nominal house prices, today, consequentially, already significantly exceed the price levels observed in 2008. In real terms, however, house price dynamics, corrected for HICP inflation, is comparable to the 2008 peak. Moreover, an offsetting effect to the nominal house price growth could be implied by a pick-up in the number of building permits in recent years, thus implying an increase of housing supply.

Further on, the demand for housing has likewise been in the post-Covid period in important way supported by fiscal policy[1] and the accumulated savings that have been channeled in the housing market.

On balance, the stylized facts, described above, would point towards continuing upward pressures on house price growth, based on imbalances between housing supply and demand, with less-favourable financing conditions implied by monetary tightening offering only limited offsetting effects. In case of Slovenia, the growth rates of housing loans decelerated quite significantly as the ECB's interest rate hikes took place in the last year. On the hand, the costs in the construction sector continue to be elevated thus keeping house prices to be high.

Nevertheless, similar house price trends can be observed in the EU, as housing supply lags behind the demand in majority of member countries.

3. Multiple indicator approach

A vast literature, related to the housing markets, is tackling the analysis of the volatility of house prices and the housing bubble identification with different modelling techniques (i.e. Early Warning Systems (EWS), quantile regressions, Markov-switch models, panel regressions, autoregression models such VAR and VECM models, more complex structural models such as DSGE models, etc.).[2] Hott (2009), for example, concludes that similar to the asset prices (for example stocks) also house prices display greater volatility in comparison to financial and macroeconomic aggregates (fundamentals). As discussed in the previous section and compared with the relevant literature presented above, house prices in Slovenia were growing at a

[1] See for example fiscal stimulus effects studies of Arigoni, et al. (2023), and Garcia et al. (2023).
[2] We will only mention a few: Schaller and van Noorden (2002), Darracq Paries and Notarpietro (2008), McMillen (2008), Zietz, Zietz and Sirmans (2008), Hott (2009), Gattini and Hiebert (2010), Iacoviello and Neri (2010), Dreger and Kholodilin (2011), Chen, Gan, Hu and Cohen (2012), Gerdesmeier, Lenarčič and Roffia (2012), Kholodilin, Michelsen, and Ulbricht (2014), O'Meara (2015), Engsted, Hviid and Pedersen (2016), Kajuth, Knetsch and Pinkwart (2016), Cerutti, Dagher and Dell'Ariccia (2017), Kholodilin and Michelsen (2017), Geng (2018), Micallef and Debono (2020), Ciochetta et al. (2023).

significantly higher pace than suggested by the fundamentals before the burst of the bubble in 2008, while they were experiencing a greater fall during the burst period. Signs of a more pronounced misalignment have once again been on the rise in post-Covid period.

Deviation of house prices from the macroeconomic and financial fundamentals enables policy makers and researchers to analyse the over- and under-valuation in house prices (in relative terms, of course). Compared to the rest of the literature the methodological approach adopted in this paper is to give a greater weight on distancing the demand, supply and banking factors contributing to the house price misalignment in a given moment in time. This is achieved by utilising a multiple indicator approach that was seminally done by Schneider (2013), Lenarčič and Damjanović (2015) and partially UBS (2012). The fundamental idea of this particular approach is to extract components driving the common variation of variables related to the housing market, and then weigh the importance of each particular variable with respect to how strongly its variability relates variation of housing market.

Further on, Micallef (2016), Micallef (2018) and Hertrich (2019), have continued with a similar multiple indicator approach with several extensions to the existing methodology. Micallef (2016) introduces different types of house price indexes in order to compute a misalignment indicator but downsizes the number of sub-indicators from seven (as in Schneider, 2013; Lenarčič and Damjanović, 2015) to five.[3] Similarly, Micallef (2018) finds that the dynamics of the misalignment indicator, including the peaks and troughs, display similar dynamics to analyses made by utilisation of different statistical filters. Hertrich (2019) on the other hand introduces a different sub-indicator that implements an interest rate risk perspective, as low interest rates for longer periods of time may generate house price misalignments. He adds that

[3] Compared to Schneider (2013) and Lenarčič and Damjanović (2015), Micallef (2016) does not apply the Loan bearing capacity and Price-to-hypothetical borrowing volume sub-indicators.

low interest rates and solid debt-servicing capacity act as strong factors in house price imbalances.

Considering the studies above, the multiple indicator approach to derive misalignment indicator in general follows a two-step procedure. In the first step, we determine the weighting factors of sub-indicators by applying the PCA with which the cyclical co-movement of the separate sub-indicators is emphasized. In other words, the respective sub-indicators can be expressed as a linear combination of orthogonal latent factors determining the house market

$$x_{i,t} = \alpha_{i,1}F_{1,t} + \alpha_{i,2}F_{2,t} + \cdots + \alpha_{i,j}F_{j,t} + \varepsilon_i \quad (1)$$

The variable $F_{j,t}$ is a principal component factor, extracted from a set of observed stationary housing market indicators, while $\alpha_{i,j}$ is a factor loading of a variable i on factor j. Derived from the principal component method, the first principal component factor explains the largest proportion of the common variance, while each succeeding component factor explains the highest possible variance conditional on the orthogonal constraint to the preceding component factor(s).

In the second step, the aggregate misalignment indicator can be derived by weighting the sum of all sub-indicators

$$MI_t = \sum_i^I w_i x_{i,t} \quad (2)$$

The term w_i represents the weights and is calculated by normalising the sum of pre-weights, v_i, to 1. The pre-weights v_i are obtained from a multiplication of the squared factor loadings

$\alpha_{i,j}$ of a variable a variable i on factor j and the explained fraction of the dataset variance ϕ_j by factor j, so that

$$v_i = \alpha_{i,j}^2 \phi_j \tag{3}$$

Finally, the dataset variance ϕ_j is defined as

$$\phi_j = \frac{\sigma_j^2}{\sum_j^J \sigma_j^2} \tag{4}$$

where factor j represents a factor on which a particular variable i has the largest loading, so that $j = \text{argmax}(\text{abs}(\sigma_j^2))$.

4. Sub-indicators

In our analysis, we focus on 9 sub-indicators to cover different macro-financial aspects, influencing house market areas and corresponding imbalances. In comparison to Lenarčič and Damjanović (2015) set of housing market indicators is broadened to better account for change policy and macroeconomic landscape in the post-Covid era. In particular, the additional sub-indicators relate to construction value relative to the house prices and the interest rate risk (the so called "Taylor rule residuals"), where we follow the Hertrich (2019) definition and partially the definition by Schneider (2013). The remaining sub-indicators are the house price-to-CPI ratio, house price-to-income ratio, house price-to-rent ratio, house price-to-construction costs

ratio (Tobin's Q), real housing investments-to-GDP ratio, house price-to-hypothetical borrowing volume (affordability), and loan bearing capacity. These seven sub-indicators closely follow the definitions of sub-indicators of Lenarčič and Damjanović (2015) and will be presented after the definition of novel two sub-indicators.

4.1 House prices-to-construction value ratio

We present a novel sub-indicator, house prices-to-construction value ratio. In contrast to the house price-to-construction costs ratio (specified in more detail in section 4.6.), which solely represents the supply-side perspective, the house prices-to-construction value ratio may also in part represent the demand-side perspective, since larger wealth of households may also drive house price upward due to increased construction value of flats (larger flats, more exquisite material used, etc.), alongside the rising construction costs (see Fields, 2023, for instance). The house prices-to-construction value ratio is written down as

$$HPCV = \frac{(nominal)\ house\ price\ index}{construction\ value\ index} \tag{5}$$

In order to ensure sufficiently long time series that would contain the whole business cycle, including the build-up of the global financial crisis, we consider the longest time series available, the (nominal) house price index of existing flats published by the Statistical Office of the Republic of Slovenia (SORS).[4] [5] In more detail, the house price index of existing flats is split into two distinct periods. Firstly, a period from 2007Q1 onward and secondly a 2000Q1-

[4] SORS constructs the nominal house price index by following a hedonic method using log-linear regression function based on transaction prices and set of explanatory variables including floor area of the dwelling and its squared value, age of the dwelling and its squared value, tourist attraction of the municipality area where the property is situated, and the gross domestic product and its squared value corresponding to the statistical region of the transacted property.

[5] Due to relatively low share of newly built flats in the total house price index, the total house price index and the house price index of existing flats move almost hand in hand (the correlation coefficient amounts to more than 99%, based on a 2007Q1-2023Q1 sample period).

2006Q4 period. The distinction between the two is in the statistical methodology used by SORS to calculate the house price index of existing flats. Nevertheless, assuming similar dynamics regardless of the methodology used by SORS and consequently combining both periods enables us to carry on the analysis from 2000 onward, since the total house price index only spans from 2007Q1 onward. The construction value index is also obtained at SORS and is defined as the value of construction put in place.

4.2 Interest rate risk

With the exception of last year, the last decade was characterised by a period of extremely low interest rates in Europe. Consequentially, this may induce banks to take excessive risks either by under-pricing risks and/or by increasing banks' loans exposure, thus fuelling the demand for housing (McQuinn and O'Reilly, 2008).

Following Hertrich (2019), we take advantage of the theoretical model of housing prices developed by McQuinn and O'Reilly (2008) which links the hypothetical borrowing volume with different types of interest rates, i.e. utilising actual interest rate and an implied interest rate. The idea behind it is that as an exogenous increase in interest rates could translate into a significant decrease in the borrowing volume and a consequential drop in housing prices (Sommer, Sullivan, and Verbrugge, 2013), the interest rate risk transmission channel proxied by the ratio of the hypothetical borrowing volume using the 3-month EURIBOR rate and the Taylor-rule implied interest rate provides a fundamental reference for house prices. The interest rate risk sub-indicator is defined as

$$IRR = \frac{HPBV\ with\ 3m\ EURIBOR}{HPBV\ with\ Taylor\ rule\ interest\ rate} \quad (6)$$

where $HPBV$ represents the hypothetical borrowing volume, which is explained in more detail in section 4.8. and equation (12). The 3-month EURIBOR rate stands for Euro Interbank Offered Rate and is based on the interest rates at which a panel of the largest European banks borrow funds from one another by eliminating the highest and lowest 15% of all quotes. On the other hand, constructing a Taylor-rule implied interest rate is a bit more challenging. Here we follow the methodology of Damjanović and Masten (2016) that built upon Wu and Xia (2016).

4.3 House price-to-HICP ratio

The real house price index probably most clearly summarizes housing market developments in Slovenia as by the economic reasoning would suggest that this sub-indicator should be stationary in the long-run. The ratio is defined as

$$RHP = \frac{(nominal)\ house\ price\ index}{HICP\ index} \tag{7}$$

The real index is obtained by deflating the nominal house price index of existing flats by the HICP inflation index. Both indexes are available at SORS.

4.4 House price-to-income ratio

The house price-to-income ratio sub-indicator represents the households' purchasing power as it implies a measure of affordability of housing ownership. In the build-up to the financial crisis (2004-2007) it can easily be observed that the growth of the residential prices significantly surpassed the household disposable income growth. To some extent, the same dynamics is observed in recent years as well. Consequently, the detachment of house prices from the income of households indicates housing bubbles evolution in Slovenia.

$$HPInc = \frac{(nominal)\ house\ price\ index}{household\ income} \tag{8}$$

We proxy the household income with the net wage dynamics, that is extractable at SORS.

4.5 House price-to-rent ratio

The price-to-rent ratio sub-indicator is meant to compare the costs of owning a housing property relative to renting it. The bigger the value of the price-to-rent ratio the better it is to buy a housing property. In the long term, the expectation is that the ratio should be stationary, since an increase in the ratio makes renting a more attractive option, in turn leading to reduced demand for home ownership. Despite that, most of the deviations in the price-rent ratio is related to changes in future returns and not to changes in rents (Krainer and Wei, 2004).

$$PE = \frac{(nominal)\ house\ price\ index}{rental\ index} \tag{9}$$

We obtain the rental index from the HICP inflation index provided by SORS and is defined as actual rentals for housing.

4.6 House price-to-construction costs ratio

With house price-to-construction costs ratio sub-indicator we measure the supply-side activity and its evolution. This sub-indicator may be considered as one of the most important long-term supply-side cost factor. The ratio resembles the Tobin's Q indicator or put it differently a company's performance indicator, i.e. market value-to-replacement costs ratio. If Tobin's Q value exceeds a critical threshold value, it can be interpreted as an over-valuation in a company's stock, or to put into the context of house price-to-construction costs perspective, an over-valuation in house prices in relation to construction costs. In the boom period, house prices in Slovenia grew at a much faster pace than construction costs. During the global financial crisis period and the consequential housing bubble burst the price-to-construction costs ratio faced a

significant correction. Compared to the boom period from pre-2008, we now observe a different dynamic. The growth in construction costs is soaring in comparison to the growth in house prices.

$$HPCC = \frac{(nominal)\ house\ price\ index}{construction\ costs\ index} \tag{10}$$

The construction costs index is obtained from SORS as well.

4.7 Real housing investments-to-GDP ratio

The sub-indicator real housing investments-to-GDP ratio, simplistically defined as

$$RHInvGDP = \frac{real\ housing\ investment}{real\ GDP} \tag{11}$$

and represents a typical supply-side perspective. It is reflecting the infusion of real estate capital to support the housing development process. Similarly as the real GDP dynamics, real housing investments usually move in a pro-cyclical direction, but are more susceptible to house price volatilities and housing market vulnerabilities in compared to the GDP dynamics. This sub-indicator can also indicate boom and bust periods in the housing market as high ratio of real housing investments-to-GDP implies a housing market overheating, especially during the so-called pre-high-cost boom years (Detken and Smets, 2004). Both data series are extracted from SORS.

4.8 House price-to-hypothetical borrowing volume

The interpretation of price-to-income ratio as a measure of housing affordability has one important limitation. It ignores the importance of interest rate dynamics. Interest rates can

determine the share of household income allotted to pay mortgage instalment. In order to account for both characteristics (i.e. the disposable income and the interest rate dynamics) we utilise the affordability indicator proposed by Hertrich (2019) and we do that by linking the house prices to hypothetical borrowing volume. To compute the latter we assume that a household will dedicate a fixed percentage of its income $c \times Y_t$ for mortgage payments for a loan with assumed repayment period of 20 years ($T = 20$)

$$HPBV = c \times Y_t\left(\frac{1-(1+R_t)^{-T}}{R_t}\right) \quad (12)$$

R_t is the gross interest rate, c is a constant, and Y_t is the average net salary in Slovenia in constant prices at time t and is available at the SORS. For the gross interest rate, we use the annualised agreed rate (AAR) for loans to households for purchase with a maturity of over ten years (new business) for Slovenia, available at the ECB's Statistical Data Warehouse (SDW).[6] The constant is set at 0.4, for which we assume that a household will have a fixed percentage of income at its disposal for debt-servicing. To assure the consistency between the sub-indicators and to track the deviation of the house prices from the affordable income and borrowing volume for households, we include the inverted affordability indicator in the misalignment indicator construction

$$AFF^{-1} = (HPBV/House\ prices)^{-1} \quad (13)$$

[6] The AAR rate is only available from 2005Q4 onward. Before this we use interest rates for housing loans to physical persons that are available in Bank of Slovenia Statistical Monthly Bulletin.

Schneider's (2013) affordability indicator closely follows the dynamics of the price-to-income ratio with two notable differences. It more precisely captures the high inflation period in the beginning of the observing sample (see Schneider, 2013), which coincided with record high interest rates. The second difference is the prolonged period of deteriorated affordability of housing purchase coinciding with severe borrowing and financial conditions in the years of 2007 and 2008, which is not the case of the price-to-income ratio sub-indicator as it ignores the interest rates and other financial conditions.

4.9 Loan bearing capacity

The loan bearing capacity sub-indicator somewhat relates to the affordability sub-indicators. It was first introduced by Schneider (2013) and later on utilised in Lenarčič and Damjanović (2015), Micallef (2016), Micallef (2018) and Hertrich (2019). The idea is linking the households' hypothetical borrowing volume to the actual amount of housing loans that are granted to households. In the second half of 2008, the loan bearing capacity sub-indicator amounted to approximately 50% of the 2004 value, which indicates the built up exposures of the banking sector to a systemic risk in the housing market and thus unwanted household positions to meet repayment obligations of outstanding housing loans. The highest amounts of the sub-indicator coincides heavily with the low interest environment and cheap credit activity of Slovenian banks in the years of 2004 and 2005, essentially contributing to the perceived better loan-servicing capacity and built-up of banks' risky assets related to that period. Similar dynamics were also observed in recent years, as interest rates hit the record lows. In order to track deviations of from the fundamentals we utilise the inverted loan bearing capacity sub-indicator in the computation process of the aggregate misalignment indicator. The loan bearing capacity is defined as

$$LBC = \frac{new\ loans\ volume}{household\ income} \tag{14}$$

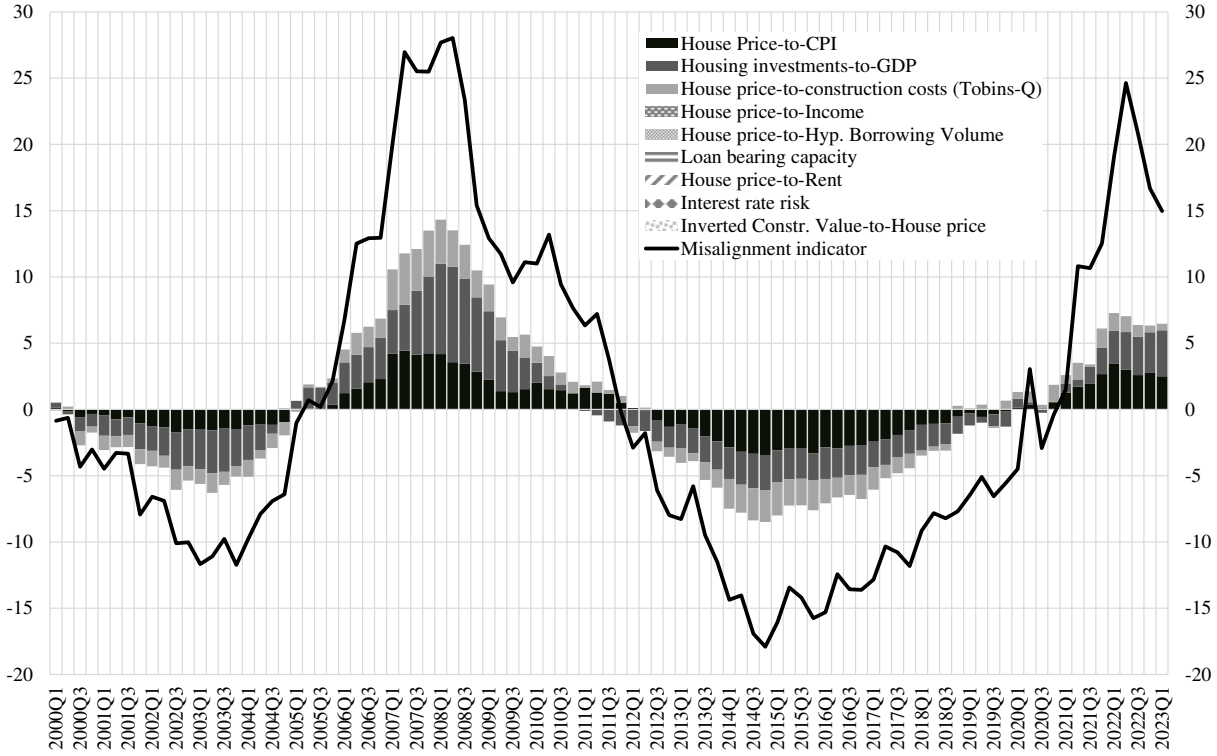
5. Aggregate misalignment indicator

Taking into account the 9 sub-indicators we obtain the aggregate misalignment indicator, which is presented in Figure 1. It shows a clear over-valuation pattern during the boom cycle in 2008, and reaches close to 30% of house price over-valuation relative to the fundamentals in its peak at the end of 2008. Major forces of the build-up before the 2008 bubble burst were expectedly the loan bearing capacity, suggesting that households were building up debt for residential purchases, and housing investments that were way above the long-term average with respect to GDP. In addition, some other factors contributed quite significantly such as the ratios of house prices relative to income, rents and construction costs, indicating overvaluation relative from the perspective of the expected return. From the onset of the global financial crisis house prices in Slovenia declined significantly reaching the bottom in 2015, and driving them deep into the under-valuation territory, mostly due to the credit crunch phase, leading to declining housing investments. Later on, also the negative contribution of the interest risk is observed, as the Taylor rule implied interest rate was significantly lower than the actual interest rate despite the latter being at the zero lower bound (ZLB) already.[7] With the economy pickup, extremely low interest rate environment across the Euro Area (with the exception of last observed quarters) and the Taylor rule implied interest rate converging and exceeding the actual interest rate, the growth in house prices started to accelerate in last couple of years, which drove the misalignment indicator back to the over-valuation territory, implying another boom(-ish) period of house prices, with a short-lived but a significant peak over 20% (in relative terms against fundamentals, of course). With key policy rates on the rise in the last two years, the loan bearing

[7] Here we assume that the excess liquidity via non-standard monetary operations measures did not play a role in determining the contribution of interest rate risk.

capacity sub-indicator started to reduce the aggregate misalignment indicator value as the high growth in housing loans began to moderate.

Figure 1. Aggregate misalignment indicator



Source: SORS, ECB SDW, author's calculations.

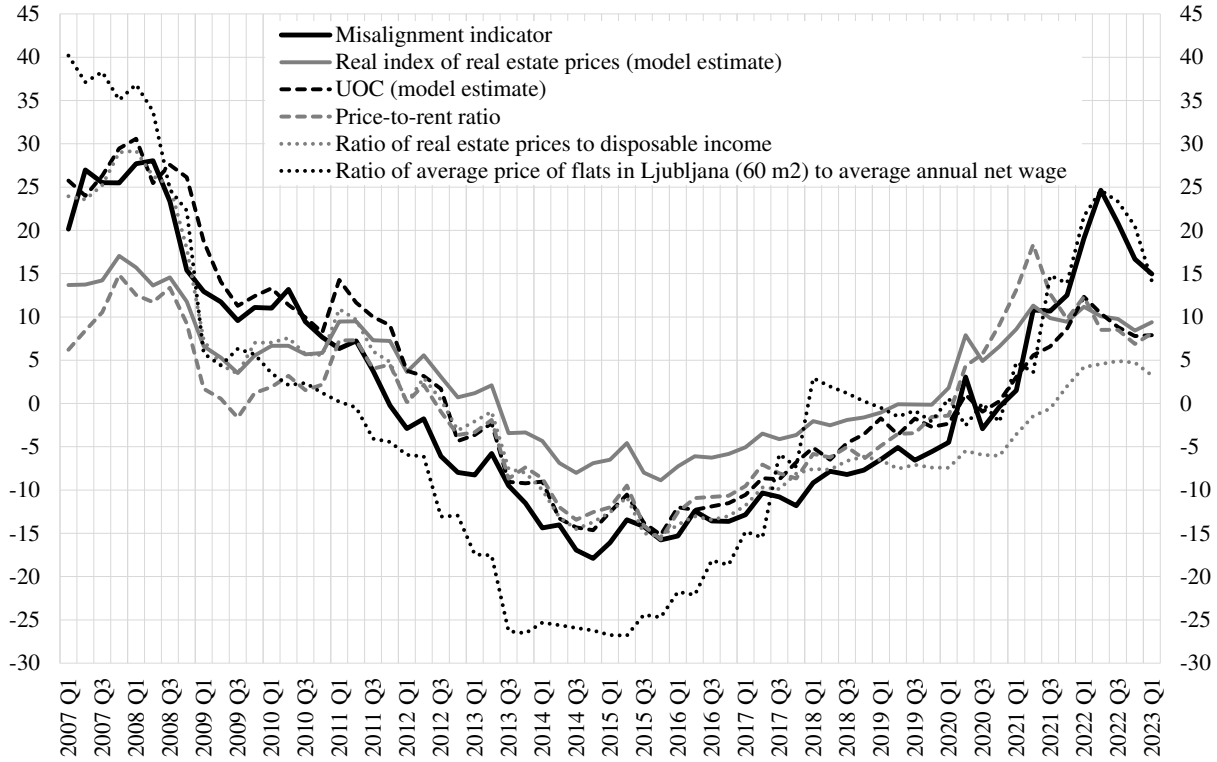
The findings of the dynamics of the under- and over-valuation episode around the GFC in the housing markets across other European countries are consistent with conclusions made in Schneider (2013), Lenarčič and Damjanović (2015), Micallef (2016), Micallef (2018) and Hertrich (2019), for example. Also the suggested severity of the housing bubble in 2008 is close to the findings in the cases of Spain, Ireland, Belgium, United Kingdom and Netherlands (see for example Fradique Lourenço and Rodrigues, 2014; Malzubris, 2008 and others). Similar to the examples above, in Slovenia, the severity of the 2008 boom-bust was more pronounced

compared to other core EU countries where the identified over-valuation figures stood around 5 to 10% in urban housing markets.

Finally, the dynamics of the misalignment indicator points to a prevailing imbalances that elevate the risk of downward price corrections as shown also in several studies such as Ciochetta et al., 2023; Hochstenbach and Aalbers, 2023; Valderrama, 2023, and more. Even more, Valderrama et al. (2023), for example, show that the European housing markets may already be at a turning point due to cost-of-living crisis as persistent high inflation has eroded real household incomes and surging interest rates made borrowers more vulnerable to financial distress. Similar patterns could likewise be observed in Slovenia as housing loans dynamics has been slowing down and tighter financing conditions together with lower real income make households more reluctant to taking on new housing loans. Nevertheless, while the misalignment indicator points to elevated housing risks on the basis of deviations from the fundamentals, its ex ante predictive power of turning points remains limited.

The dynamics exhibited by the misalignment indicator, derived in this paper, co-moves with alternative under/over-valuation indicators available. While indicators show similar dynamics in qualitative sense, they nevertheless vary in magnitude as they rely on different variables and their relative weighing to represent imbalances. For example, the indicator that is based on the unobserved components methodology (following the UOC methodology by Rünstler et al., 2018; Rünstler and Vlekke, 2018; Lenarčič, 2021) shows that the over-valuation in house prices is smaller compared to the aggregate misalignment indicator (Figure 2).

Figure 2. Co-movent of the misalignment indicator with alternative under- and over-valuation indicators



**Note: The real index of real estate prices (model estimate) was introduced in the Bank of Slovenia's Financial Stability Review, June 2019.*

Source: SORS, ECB SDW, Bank of Slovenia, Mapping authority, author's calculations.

Since house price cycles are more sensitive to business and financial cycles, they may potentially amplify the pro-cyclicality of the latter two and worsen the general economic conditions. Consequently, the understanding of main forces driving house prices represents an important task for policy makers in order to prevent any future misalignments in house prices and build-up of housing bubbles. In this respect, further prudential measures and instruments are being developed to strengthen the resiliency of financial sectors.

The misalignment indicator proved to work well as an informative tool for policy makers, but may lack robustness characteristic, especially from the perspective that a longer and more stable economic periods would have to be considered in the observed sample that is available. For

example, in the 90's the economy of Slovenia was faced with the transition period, which was characterised by a shortage of supply, undeveloped financial and investment markets and therefore an illiquid and undeveloped housing market. The supply shortage was evident until the 2004 when the pre-boom period was disrupted by the 2004-2008 bubble period, which was significantly characterized by an abundance of bank loans and soaring activity in the construction sector. As already said, the burst of the housing bubble led the housing market to descend to a slump with the bottom reached only in 2015. The following years were then subject to extremely low interest rate environment, again quickly turning the stabilisation period into a boom(-ish) one in recent years.

6. Conclusions

In this paper, we employ a statistical multiple indicator approach in order to construct an aggregate misalignment indicator of house prices based on macroeconomic and financial fundamentals. We augment the approach from the literature by adding two additional sub-indicators that broaden the supply perspective and add a central bank perspective to the banking sector perspective.

We find a significant over-valuation in house prices in Slovenia during the 2004-2008 boom period. After the burst of the housing bubble a longer period of correction in house prices lasted until 2015, when house prices in Slovenia reached the bottom. This is also indicated by a negative sign in the misalignment indicator, suggesting under-valuation in house prices compared to macro-financial fundamentals. From 2015 on, a recovery phase was taking place, so that house prices returned to a long-term average. Nevertheless, we observe a boom(-ish) period as of 2020, lasting until the present day, but the over-valuation in house prices still remain more moderate compared to the period from the 2004-2008 period.

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