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Structural and Cyclical Risks in Housing Markets in OECD Countries

This paper analyses the housing markets of OECD countries using a scoring model. This model is based on a European Systematic Risk Board approach to risk assessment of housing markets but extends this approach in two important ways. First, this paper distinguishes between cyclical and structural risk factors. Markets facing higher susceptibility to cyclical risks necessitate a distinct policy approach to prevent or handle disruptions, as opposed to markets primarily affected by structural risks. Second, it illustrates that scoring models contain subjective aspects, e.g. in the choice of weighting factors. We develop four distinct models to weigh risk factors. We show that these different weighing schemes have a significant impact on the estimated risk scores. For policy decisions, such models can therefore only be an indication of the vulnerability of housing markets to crises. Therefore, several scenarios and models should be calculated in parallel to reduce subjectivity.

Following a decade-long period of growth, nominal housing prices in OECD countries experienced a downturn in the latter half of 2022 and the first half of 2023. Data reveals a decrease of 9.92% in Germany and 1.66% in the overall euro area, as illustrated in Figure 1. Additionally, other countries, including Canada, the United States, Australia, Japan, the United Kingdom and New Zealand have been observing a decline in their nominal residential property prices (Szemere, 2023).

Given the substantial price increases in almost all OECD countries prior to this recent decline, there is growing concern about a new financial and economic crisis induced by distortions on housing markets. Financial crises often follow downturns in housing markets: the stock market crash in Japan was preceded by a bursting residential real estate bubble (Posen, 2006), the 2007-2008 financial crisis had its origins in excessive credit financing of residential real estate, and the savings and loan crisis (late 1980s and early 1990s) in the US started with the correction of commercial real estate loans that no longer held their value (Wilmarth Jr, 2008). According to Jordà et al. (2016), financial crises following corrections in real estate markets are more severe than financial crises induced by other situations. With this in mind, it is important to understand the risks associated with housing markets for three main reasons. Firstly, real estate accounts for the largest share of the tangible assets in an economy: the gross fixed assets tied up in real estate in Germany, for example, amounted to €22.2 billion in 2022 and thus correspond to about five times the GDP (Destatis, 2023). Secondly, real estate is financed by a high proportion of debt capital, and this tempts private and institutional investors to take greater financing risks (Kindleberger and Aliber, 2005). Thirdly, declining real estate prices negatively affect households' propensity to consume (Yao et al., 2015), companies' propensity to invest (Summers, 2016) and banks' propensity to lend (Dagher and Kazimov, 2015), thereby reinforcing a recessionary tendency.

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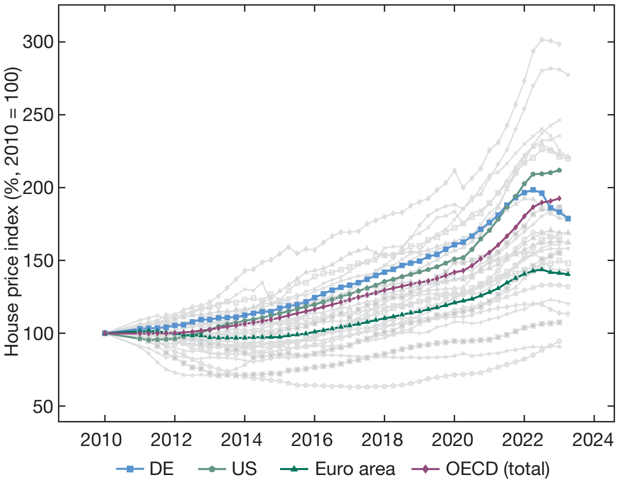
This article adds to the understanding of real estate risks by differentiating cyclical and structural real estate market risks. We measure these risks employing a scoring model that builds upon similar models by the European Systemic Risk Board (ESRB, 2016) or Just and Ebner (2006). The methodology presented in this paper deepens approaches in two important ways. First, we differentiate between cyclical and structural risk factors. Second, we also develop a set of scenarios and weighting factors within the scoring to reduce the arbitrariness of the approach. The remainder of this article provides a brief literature review on property market risks, followed by an illustration of the methodology and data used, and a discussion of the results.

Figure 1
Development of house price indices in different countries (2010-2023)



Notes: AT, BE, BU, CR, CZ, DK, EE, FI, FR, EL, HU, IE, IT, LV, LT, LU, NL, NO, PL, PT, RO, SK, SI, ES, SE, CH and UK are displayed in grey.

Source: OECD (2023d).

Measuring structural and cyclical risk on housing markets

Scholars have conducted extensive research on real estate risks, focusing on issues such as lending and fluctuations in housing prices, and their connections with monetary policies, financial institutions and stock markets. Studies by Kallberg et al. (2014) and Pavlov et al. (2015) highlight the negative impact of misguided financial decisions, while Drouhin et al. (2016) emphasise the consequences of extreme housing price variations. Zhou et al. (2021) delve into the relationship between monetary policies and real estate risks by synthesising the risk indices through advanced big data analysis techniques, while Baulkaran et al. (2019) link them to stock market trends.

These risks have been measured, for example, by combining index systems and statistical tests with techniques like time-varying parameter models and big data analysis (Saiyed et al., 2016). Bourassa et al. (2019) employ indicators and capital asset pricing models, whereas Yang et al. (2018) define systematic risk measurement indicators.

In the European Economic Area, the ESRB analyses residential real estate (RRE) markets, emphasising the economic significance of housing. Employing a methodology based on three risk dimensions (collateral, funding and household stretches), equally weighted key risk indicators (covering house price trends, household indebtedness, income ratios and financial asset-to-debt ratios, among others) are compared against critical thresholds. The assessment categorises vulnerabilities as "low", "medium" or "high", indicating areas necessitating intervention through macroprudential policies or changes in other policy sectors influencing RRE vulnerabilities.

Despite the RRE sector's resilience during the pandemic, uncertainties remain, especially concerning household income and debt as well as the sensitivity of the market to rising interest rates. The ESRB advocates macroprudential policies and broader reforms to address housing supply-demand imbalances besides issuing specific recommendations to countries with insufficient policies (European Systemic Risk Board, 2019). Mareš (2015) delves into the stability of European banking scoring models, drawing comparisons with the challenges faced by American banks during the mortgage crisis. A continuously updated, comprehensive scoring system is advocated after identifying crucial sub-factors such as disposable income and loan history. The Central Bank of Malta (2021) highlights the complex connection between cyclical and structural dimensions. Rising household debt and property prices can amplify existing structural vulnerabilities. If unaddressed, high cyclical risks can disrupt the housing market, impacting loan quality in the banking sector. Similarly, housing supply shortages can exacerbate cyclical risks, leading to increased debt.

This paper extends the ESRB approach by distinguishing between cyclical and structural risk factors, highlighting the subjective nature of scoring models. By exploring multiple scenarios simultaneously, it emphasises the importance of diverse risk assessment models.

Data and methodology

The methodological framework consists of three steps. Step 1 entails the *identification of risk indicators*. Twelve indicators, supported by literature, are selected and categorised into cyclical and structural risks to differentiate vulnerabilities over long- and short-term perspectives. Step 2 involves *scoring*. Country data from 28 OECD countries is assigned scores based on deciles[1] ranging from one (low risk) to ten (high risk) for each variable within the cyclical and structural risk categories, facilitating an overall score for each country. Step 3 focuses on *stress testing and scenario analysis*. Implementing stress testing through simulations for indicators and countries, the evaluation assesses potential adverse event impacts on the residential real estate sector. The resulting variance is used for a weighting procedure based on individual indicators.

1 An underlying cross-sectional normal distribution is assumed.

Table 1
Description of variables in different categories

Category	Abbr.	Variable	Favourability[1]	Main data source
Cyclical domain	ANHPG	Average nominal house price growth (2012-2022)	Low values	OECD (2023e)
	DHPSP	Development of house prices since peak	High values	OECD (2023e)
	GDPG	Forecast for GDP growth (2023-2024) compared to 2015-2022 average	High values	OECD (2023a)
	CBR	Change of bond rates (10y) from trough to today	Low values	Trading Economics (2023)[2]
	CORL	Change in total outstanding residential loans, (2021-2010)	Low values	European Mortgage Federation (2022)
	HDIID	Development in household debt as proportion of net disposable income	Low values	OECD (2023b)[3]
	ACC	Average annual rates of change for total construction calendar adjusted, 2005-2021	High values	Eurostat (2023)
Structural domain	EPCSP	Expected population change from peak to 2030	High values	OECD (2023c), United Nations (2023)
	ASHCII	Average share of housing costs in disposable household income, growth (2010-2022)	Low values	European Union (2023)
	SFVI	Share of gross financing with variable interest rate (up to 1 year) in 2021	Low values	European Mortgage Federation (2022)
	HDII	Household debt as proportion of net disposable income, 2021	Low values	OECD (2023b)[4]
	ORLP	Proportion of outstanding residential loans to GDP	Low values	European Mortgage Federation (2022)

Notes: [1] The column indicates whether low (high) values for a variable are related to low (high) risk for housing markets. [2,3,4] In cases where data is unavailable from one source, additional sources have been considered to ensure the completeness of the data set, which again enhances the overall depth and reliability of the analysis.

Source: Own depiction.

Identification of indicators

During economic upswings, housing demand and prices tend to surge. Conversely, during economic downturns, reduced demand can trigger price corrections and, occasionally, market instability. Moreover, real estate cycles are frequently exacerbated by supply that is often lagging behind demand fluctuations. To evaluate these cyclical risks, the subsequent indicators are incorporated (see Table 1):

Firstly, the average nominal house price growth (2012-2022) is included to reflect price trends in the housing market. Then, the housing price development since peak indicator assesses whether the market has already corrected and whether timely intervention is still feasible (Bengtsson et al., 2020; Borio and Drehmann, 2009). Furthermore, the projected GDP growth (2023-2024) vs. the long-term average (2015-2022) indicates potential economic downsides, reflecting the risk of economic downturns for real estate prices (Ciocchetta et al., 2016).

The change in the 10-year bond rates indicator explores the implied interest rate pressure on real estate financing markets, considering costs for investors and relative attractiveness compared to fixed-income alternatives. The change in the total outstanding residential loans (2021-2010) indicator offers insights into the extent of residential borrowing. During economic upswings, borrowing tends to increase, impacting market dynamics. Adding the development of household debt as a percentage of net disposable income enriches the analysis by considering adverse events like income shocks and rising interest rates, particularly in over-indebted private sectors (Drehmann and Juselius, 2012). The last cyclical indicator, the average annual rate of change for total construction, measures the supply-side risk (Ciocchetta et al., 2016).

In the second domain, structural risk factors include: expected population change from peak to 2030, average share of housing costs in disposable household income (growth 2010-2022), proportion of outstanding residential loans to GDP,[2] share of gross financing with variable interest rate (up to one year) in 2021 and household debt as a proportion of net disposable income (2021). These indicators provide insights into potential long-term downward pressures and structural vulnerabilities related to population changes, housing affordability, banking system stability, interest rate fluctuations and household finances

2 This can be seen as potential indicator of banks' Common Equity Tier 1 capital.

(Bengtsson et al., 2020; Drehmann and Juselius, 2012; European Systemic Risk Board, 2016).

Ranking of unweighted scores

Our developed scoring tool, a modification of the ESRB (2019) model, is based on the following steps. First, we arrange the values for each variable in ascending order. Table 1 (column 4) shows which indicators are positively (negatively) correlated with the risk on housing markets.

Subsequently, deciles spanning from 10% to 100% of the complete value spectrum are defined. Variables positioned within the lowest 10% range are assigned a score of 1 (or 10 for those that favour higher values). Similarly, variables surpassing the 90% threshold of the value distribution receive a score of 10 (or 1 for those favouring higher values). Each country receives a score for each indicator, which are aggregated into compound scores for cyclical and structural domains, as well as a total score. At this stage, similar to the ESRB model, all indicators are given equal weight (equal weights scenario), but recognising the potential impact of weighting, we explore assigning weights to indicators, as discussed in the following section (Drehmann et al., 2010).

Stress testing and weighting procedure

Following Lausberg and Krieger (2021), we use stress tests to assign deviating indicator weights. We differentiate between four scenarios, which are displayed in Table 2. These involve subjecting the sector to hypothetical shocks to evaluate its resilience, estimating the influence on key indicators and vulnerabilities (Chenet et al., 2021; European Systemic Risk Board, 2016).

The weighting process unfolds in three iterations:

Initially, each variable is subject to upside and downside scenarios, calculating scores based on deciles for each scenario, and then determining absolute changes in scores across all scenarios and countries.

The final weight results from the overall changes (share) observed across all considered variables. The sum of these weighted scores is first built within each respective category (cyclical or structural) before computing the overall score for each country (see part A of Table 3).

In subsequent iterations, each country undergoes isolated stress testing within the scenarios, while the remaining countries stay unaffected. Firstly, deciles for the respective indicators are computed for each country's upside and downside scenarios, assessing deviations from the collective baseline shared among all countries.

Table 2
Weighting procedures with key features

Name	Key feature	Interpretation/Implication
Equal weights scenario	Weights are applied equally to all indicators.	Assumes uniform impact of vulnerabilities in financial markets across all countries.
Weighted difference scenario (upside- and downside-based)	Variable weighting based on relative changes following a standardised ten percent shock for each indicator (upside- and downside scenarios).	Reflects countries' vulnerability to specific dimensions, emphasising variables exhibiting significant changes.
Country-specific shock resilience scenario	Shocks impacting each country separately while others remain unchanged.	Emphasises individual countries' resilience to isolated shocks wherein both upside and downside scenarios are considered, before normalising these changes against the overall variations observed across all indicators and countries.
Adjusted country-specific shock resilience scenario	Deciles are adjusted for all shocks in all countries before calculating risk scores.	Ranks countries based on comprehensive vulnerability to shocks across various dimensions, highlighting countries with significant vulnerabilities.

Source: Own depiction.

Following this procedure for each country, the individual country-specific scores within each variable are consolidated, and the absolute change from the downside to the upside scenario is computed. The weighting for each indicator is subsequently determined by evaluating its alteration to the overall changes across all considered variables. If no changes occur, indicators receive a modest weight to avoid complete neglect in the overall score (manual weighting). This overall score contributes again to a ranking for all countries (as seen in part B of Table 3).

The last scenario differs in decile calculation, deduced from country-specific upside and downside scenarios across all countries (part C of Table 3). This provides insights into how a country's upside and downside scenarios compare to the global range of possibilities, providing a broader perspective on its relative performance.

Results for OECD countries

Reference: Equal weights scenario

For our baseline scenario, we apply equal weights to the different indicators similar to the ESRB (2019).

Table 3
Weighting scenarios for different indicators

Variable	Cyclical domain							Structural domain				
	ANHPG	DHPSP	GPDG	CBR	HDIID	CORL	ACC	EPCSP	ORLP	SFVI	HDII	ASHCII
A) Weighted difference scenario (upside- and downside-based)												
Absolute change	31	45	35	111	12	21	20	2	23	26	24	6
Share	0.087	0.126	0.098	0.312	0.0337	0.059	0.056	0.006	0.065	0.073	0.067	0.017
Final weight	0.087	0.126	0.098	0.312	0.0337	0.059	0.056	0.006	0.065	0.073	0.067	0.017
B) Country-specific shock resilience scenario												
Absolute change	56	28	84	28	84	28	28	0	28	84	450	38
Share	0.060	0.030	0.090	0.030	0.090	0.030	0.030	0.00	0.030	0.090	0.481	0.041
Manual weight								0.01				
Final weight	0.060	0.030	0.090	0.030	0.090	0.030	0.030	0.01	0.030	0.090	0.476	0.041
C) Adjusted country-specific shock resilience scenario												
Absolute change	8	1	0	0	9	0	0	0	0	0	0	7
Share	0.32	0.04	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Manual weight			0.02	0.02		0.02	0.02	0.02	0.02	0.02	0.02	
Final weight	0.276	0.035	0.017	0.017	0.310	0.017	0.017	0.017	0.017	0.017	0.017	0.241

Note: See Table 1 for information about different indicators.

Source: Own depiction.

Cyclical risks indicate higher volatility in residential housing markets for Luxembourg, Slovakia and Czechia, whereas Cyprus, Latvia and Ireland show lower risk. In the structural domain, Portugal, Finland and Greece face the highest long-term risks (see Figure 2), while Hungary, Croatia and Slovenia have comparatively lower risks. Overall, Luxembourg, Finland and Sweden have the highest risk, while Croatia, Ireland and Latvia have the lowest risk in the residential real estate market. While Luxembourg consistently ranks as a high-risk country across both dimensions, Ireland and Croatia demonstrate lower risk levels in certain aspects. Notably, the last-ranked country's score is about half the magnitude of the top-ranking country's score.

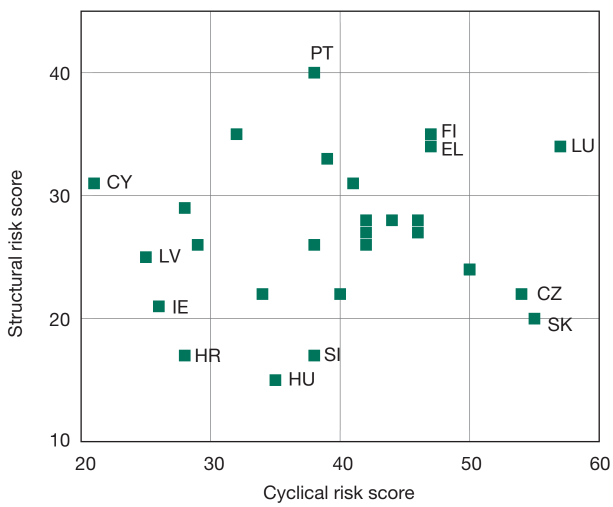
The baseline analysis assumes uniform risk structures, but country-specific risk profiles may vary as indicated in Figure 2, emphasising the need for appropriate indicator weighting.

Weighted difference scenario (upside- and downside-based)

To address the lack of differentiation, variable weighting based on the relative changes following a 10% change in each indicator for each country (upside and downside scenarios) is introduced. This method prioritises variables that exhibit the highest changes, in the form of high weights, indicating greater vulnerability and consequently higher risk for each country.

Within the cyclical dimension, Poland, Bulgaria and Romania emerge as highly responsive to property market

Figure 2
Cyclical vs. structural risk scores for different countries



Source: Own depiction.

fluctuations. In the structural category, Sweden, Finland and Portugal face long-term challenges in their housing finance structure. Countries like Croatia, Estonia and Ireland are less affected by property market value changes. Hungary, Slovenia and Croatia show greater stability and resilience in their housing markets. Considering the overall scores, Poland emerges as the country with the highest risk score, closely followed by Luxembourg, the United Kingdom and Bulgaria, while Croatia, Ireland and Estonia show the lowest overall risk.

Country-specific shock resilience scenario

In this scenario, where shocks impact only a single country while the others remain unchanged, and the intervals are only adjusted for each country-specific shock separately, the assessment emphasises individual countries' resilience to isolated shocks.

As a result, the total household debt, relative to disposable income, carries substantial weight. Consequently, excessive indebtedness elevates risk scores. Luxembourg, evaluated with the highest risk score within the cyclical domain, is particularly sensitive to adverse events in its property market. It is closely followed by Austria and Slovakia, while Ireland, Latvia and Cyprus record the lowest risk scores. The structural realm's results demonstrate the high vulnerability of countries like Sweden, the Netherlands and Finland. Croatia, Hungary and Slovenia present stability in this category, due to their comparatively late-established funding mechanisms. Overall, Sweden, Luxembourg and Finland fall into the high-risk category, followed by the Netherlands, Denmark and Portugal. The lowest risk category includes Bulgaria, Latvia and Croatia.

Adjusted country-specific shock resilience scenario

Ranking differences arise when adjusting the deciles to account for all shocks in all countries before calculating the risk scores. The cyclical dimension results indicate that Luxembourg, Czechia and Slovakia are most vulnerable to changes in property market values. Spain, Bulgaria and Cyprus on the other hand, show better resistance. The structural realm's reordering emphasises Greece, Luxembourg and Bulgaria as being especially susceptible to long-term vulnerabilities. Meanwhile, Latvia, the United Kingdom and Croatia exhibit greater stability. In summary, with the adjusted weighting approach, Luxembourg, Sweden, Austria and Czechia emerge as the countries with the highest risk. The second highest risk group, encompassing Finland, Portugal and France, also reflects significant vulnerabilities. Latvia, Cyprus and Romania display the biggest resilience to shocks.

Summary

Analysing these scenarios reveals a pattern: some countries maintain stable scoring positions, while others exhibit score fluctuations depending on the weighing scheme.

Several countries consistently emerge as either high risk or low risk across the different weighting approaches, as shown in Table 4. Luxembourg and Finland consistently maintain a high-risk position within the cyclical risk and structural risk categories. Sweden exhibits a relatively high-risk position in most scenarios. In contrast, Croatia and Latvia consistently rank among the least risky countries.

Some countries experience variability in their rankings due to the complexity of their risk profiles. Bulgaria's rating, for instance, witnesses significant fluctuations across different approaches. Portugal's and Germany's rankings, primarily in the middle of the distribution, also change substantially, showing that their risk profiles can change based on the specific weights applied.

Table 5 summarises the results for each country in the reference scenario with regard to indicator-driven impact.

Despite variations in outcomes arising from the distinct weighting approaches employed in different methods, notable correlations persist among these ranks, indicating general similarities in their assessments. The equal weights method is remarkably responsive to changes in cyclical risk. In contrast, the weighted differences scenario shows agility in addressing shifts in structural risks, making it a valuable tool for evaluating sector resilience. The adjusted country-specific shock resilience scenario reacts to changing cyclical market conditions. The country-specific shock resilience scenario assesses both structural and cyclical risks comprehensively, revealing their combined impact on market stability. These correlations highlight the significant impact of the weighting procedure on the results concerning market vulnerabilities.

Concluding remarks

This paper analyses the cyclical and structural risks in OECD housing markets using a scoring model also employed in a similar form by regulators. Our model extends the regulators' approach in two key ways.

First, the indicators were differentiated into cyclical and structural risk factors. In this context, "risk" signifies economic fluctuations, structural weaknesses and financial

Table 4
Rankings of risk scores for different scenarios and countries

Rank	Equal weights scenario		Weighted difference scenario		Adjusted country-specific shock resilience scenario		Country-specific shock resilience scenario	
	Risk score	Country	Risk score	Country	Risk score	Country	Risk score	Country
1	47.42	LU	8.40	SE	9.41	LU	7.50	PL
2	42.00	FI	8.34	LU	7.41	SE	8.65	LU
3	41.58	SE	8.27	FI	7.08	AT	8.54	UK
4	40.67	CZ	7.86	NL	6.97	CZ	8.38	BG
5	40.42	SK	7.60	DK	6.87	FI	8.10	FI
6	39.17	AT	7.30	PT	6.84	PT	8.02	LT
7	39.17	BE	7.30	UK	6.63	FR	8.00	RO
8	38.83	PT	6.99	FR	6.56	DE	7.90	DK
9	38.50	PL	6.53	BG	6.44	SK	7.79	SK
10	38.08	DE	5.99	DE	6.40	MT	7.53	AT
11	37.33	FR	5.97	AT	6.28	NL	7.08	CZ
12	36.83	BG	5.70	CY	6.24	BG	6.96	BG
13	36.50	NL	5.49	EL	6.12	PL	6.74	HU
14	36.17	IT	5.46	IT	5.86	EL	6.63	SE
15	35.75	DK	5.42	IE	5.85	EE	6.07	NL
16	35.33	LT	5.29	ES	5.60	SI	5.39	IT
17	33.25	EL	4.96	CZ	5.51	IT	4.98	CY
18	33.00	UK	4.96	SK	5.32	IE	4.93	PT
19	32.50	RO	4.93	PL	5.27	LT	4.79	FR
20	29.25	SI	4.40	EE	4.82	HU	4.56	DE
21	29.00	MT	4.15	MT	4.69	BG	4.27	MT
22	28.42	EE	4.02	LT	4.64	UK	4.23	SI
23	27.75	ES	3.25	SI	4.52	ES	4.21	EL
24	26.67	HU	2.96	HU	3.99	DK	4.04	ES
25	25.17	CY	2.94	RO	3.91	HR	3.62	LV
26	25.00	LV	2.84	BG	3.88	LV	3.36	EE
27	23.92	IE	2.74	LV	3.75	CY	3.10	IE
28	23.42	HR	2.60	HR	3.58	RO	2.89	HR

Source: Own depiction.

instabilities, which can compromise market robustness and resilience. Recognising the importance of these distinctions is crucial, as varied regulatory interventions may be required based on the specific risk group. For instance, if the risk primarily arises from structural factors, counter-cyclical measures may be ineffective, and conversely, addressing changed financing structures may not suffice if the risk is predominantly cyclical. Our analysis reveals that countries exhibit diverse risk structures, emphasising the necessity for tailored policies in the face of a crisis.

Second, various scenarios and weighting algorithms were presented, which led to the results of the reference scenario of an equal weighting of all factors being changed, in some cases considerably. It follows that caution must be exercised when calibrating such risk models, as the weighting has a big impact on the results, the measured housing market risks. This gives the method an arbitrary element – ultimately, equal weighting of the factors is only one of many possibilities. Using different weighting schemes in parallel is then advisable. Further limitations of the analysis lie

Table 5
Indicator-based risk assessment by country

Country/ Indicator	Cyclical risk							Structural risk				
	ANHPG	DHPSP	GDPG	CBR	CORL	HDIID	ACC	EPCSP	ASHCII	SFVI	ORLP	HDII
AT	High	Medium	High	Medium	High	High	High	Low	High	Medium	Medium	Medium
BE	Low	Medium	High	Medium	High	High	High	Low	Medium	Low	High	High
BG	Low	High	Low	High	High	.	High	High	High	High	Low	.
HR	Medium	Low	Medium	Low	Low	Medium	Medium	High	Low	Low	Low	Low
CY	Low	Low	Medium	High	Low	Low	Low	Low	High	High	Medium	High
CZ	High	High	Low	High	High	High	High	High	Medium	Low	Medium	Medium
DK	Medium	High	High	Medium	Medium	Medium	Medium	Low	Low	Medium	High	High
EE	High	Low	Low	Low	High	Low	Low	High	Medium	High	Medium	.
FI	Low	High	High	Medium	Medium	High	High	Low	High	High	High	High
FR	Low	Medium	High	Medium	Medium	High	High	Low	High	Low	High	High
DE	High	High	High	Low	Medium	High	High	Medium	Medium	Low	High	Medium
EL	Low	Low	High	Low	Low	High	High	High	High	High	Low	Medium
HU	High	High	Medium	High	Low	Low	Low	High	Low	Low	Low	Low
IE	High	Low	Medium	Low	Low	Medium	Medium	Low	Medium	Medium	Low	High
IT	Low	High	High	Medium	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium
LV	High	High	Low	Low	Low	Low	Low	High	Low	High	Low	Low
LT	High	Medium	Medium	High	High	Medium	Medium	High	Low	High	Low	Low
LU	High	Medium	Medium	High	High	High	High	Low	High	Medium	High	High
MT	High	Low	Low	Medium	High	Low	Low	Low	Medium	High	High	Low
NL	Medium	Medium	High	Medium	Medium	Medium	Medium	Low	High	Low	High	High
PL	Medium	High	High	High	High	Low	Low	High	Low	High	Medium	Low
PT	High	Low	High	Low	Low	High	High	High	High	High	High	High
RO	Low	High	Low	High	High	Medium	Medium	High	Low	High	Low	Low
SK	Medium	Medium	High	High	High	High	High	High	Low	Low	Medium	Medium
SI	Medium	Low	Medium	.	Medium	Medium	Medium	High	Medium	.	Low	Low
ES	Low	Low	High	Low	Low	High	High	Low	High	Medium	Medium	Medium
SE	Medium	High	High	Low	High	High	High	Low	High	Medium	High	High
UK	Medium	Medium	High	High	Medium	High	.	Low	Low	Medium	High	High

Note: Risk levels are categorized as follows: Values ranging from one to three are designated as low risk, values between four and six are classified as medium risk, and values exceeding six are labeled as high risk.

Source: Own depiction.

in the availability of data: real estate markets are comparatively intransparent and this also applies to real estate financing markets. Of course, the presented scenarios do not capture all factors that contribute to a country's vulnerability. Elements such as regulatory policies, or market sentiment, which can significantly influence vulnerabilities, are not accounted for within this framework. Also, country-specific idiosyncrasies cannot be captured; for example, could Luxembourg's risk be overrated due to the country's small size and high stabilising dependency on European institutions? Moreover, the reliance of the methodology on deciles makes it sensitive to outliers. Although the assumption of data following a normal distribution is deemed acceptable after testing, real-world data frequently deviates, impacting the reliability of quantile-based scoring (Wooldridge, 2011).

For future analyses, it might be useful to measure the sensitivity of the results to model changes after integrating additional variables. Examining country-specific differences more closely would help identify the indicators contributing to increased risk in each country's housing market. The question would then focus on which factor in which country contributes to increased risk. This could help to compare and optimise national regulatory systems.

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