# Trends and drivers of housing affordability in the EU: Insights from panel data analysis

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**SUMMARY**

Housing affordability is a crucial issue that affects both individual and societal well–being. Affordable housing ensures that households can meet their basic living needs without experiencing undue financial stress. It influences labor mobility, consumer spending, economic growth, and resilience. Typically, housing affordability is measured by the proportion of household income spent on housing costs, including rent or mortgage payments, utilities, and maintenance. However, no single metric is universally accepted (cost–to–income ratio, residual income approach or subjective measures assessing households' perceptions of their housing affordability). These diverse indicators reflect the complexity of housing affordability and highlight the need for comprehensive analysis using multiple metrics, which is the purpose of this paper. Panel analysis of the socio–economic and demographic demand and supply drivers of housing affordability is essential for developing effective policies that ensure all citizens have access to adequate and affordable housing, as many European Union countries have faced a housing affordability crisis characterized by rising housing prices, housing costs and insufficient housing units supply.

**KEYWORDS**

*EU members, housing affordability, housing costs, panel data*

## 1. Introduction

Housing affordability pertains to the financial capacity of households to afford housing costs relative to their income. This concept is concerned with the overall economic burden of housing expenses on households. In contrast, affordable housing refers to specific housing units that are priced at levels deemed affordable for low to moderate income households, often provided through public policy initiatives, subsidies, or regulations (Kikerec, 2024). This research focuses exclusively on housing affordability, examining the extent to which households can afford to purchase or rent housing. Effective housing policies are essential for addressing housing affordability issues. These policies can include measures to increase the supply of

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affordable housing, provide financial assistance to low income households, and implement regulations to stabilize housing markets with respect to housing prices. Additionally, demographic policies that address population growth, migration, and household formation can significantly impact housing affordability.

In recent decades, most EU countries have faced a housing affordability crisis, characterized by rising housing costs and an insufficient supply. Housing prices and rental rates have increased significantly in many European urban centers due to high demand, limited supply, and speculative investments in real estate. Meanwhile, wages and salaries have stagnated, making it increasingly difficult for both low and middle income households to afford adequate housing (Kikerec, 2024). As a result, many households have been forced into displacement, gentrification, and long commutes for those unable to afford housing near their workplaces. For the same reason, a shift toward renting rather than owning has been observed in many EU countries, including Germany, Sweden, the Netherlands, and Denmark, even though two-thirds of the EU population still live in households owning their housing unit (EUROSTAT, 2023).

Previous studies illustrate distinct findings based on the varying measurements of housing affordability, different explanatory variables, and diverse methodological approaches. Some studies rely on conceptual analysis (Anacker, 2019) or meta–analysis (Lee et al., 2022) while others employ econometric techniques such as fixed-effects modeling (Filić, 2022) and spatial regression (Ismail and Wilhelmsson, 2024).

This paper contributes to the ongoing studies on housing affordability by addressing three key research questions. First, it explores the theoretically specified drivers that shape housing affordability in the EU. By reviewing the existing literature and empirical findings, the paper identifies the most important factors that influence housing affordability. Second, the paper investigates whether these drivers continue to have a significant impact on housing affordability when different measures of affordability are employed within a panel data analysis. According to this objective, three housing affordability proxy measures are utilized as dependent variables: (a) the share of housing costs for low income households, (b) the housing cost overburden rate for low income households, and (c) the housing cost overburden rate for all households. Through robust testing and model comparison, the analysis reveals that some factors retain their significance across various affordability measures. Standard panel data methodology is applied within the pooled model, individual–specific fixed effects model (FE individual), individual and time–specific fixed effects model (FE two–ways), individual-specific random effects model (RE individual), and individual and time–specific random effects model (RE two–ways). Accordingly, appropriate goodness–of–fit comparison as well as diagnostic checking was conducted.

Finally, the paper examines the implications of the findings for improving housing affordability policies of the EU member states by analyzing demand drivers, such as migration, employment, urbanization, and household size and supply drivers of housing affordability, including housing prices, construction costs, and building permits. The empirical results offer valuable insights for the development of more effective, evidence–based housing policies that ensure access to adequate and affordable housing for all citizens, with the potential to mitigate the affordability challenges faced by both low income and middle income households (Kikerec, 2024). These insights can enhance the knowledge of policymakers and stakeholders, helping to shape interventions that address the housing affordability crisis and contribute to urban planning and urban development.

## 2. Theoretical concept and previous studies review

Housing affordability is a complex concept that is defined and measured in various ways in literature and public policies (Bogdon and Can, 1997). Essentially, it refers to the ability of households to afford adequate housing at acceptable costs (Stone, 2006). However, there are different interpretations of this basic concept regarding what is considered adequate and affordable housing. The cost–to–income ratio is the most commonly used measure of housing affordability in literature (Bogdon and Can, 1997). It refers to the share of household income that is spent on housing, whether it is rental costs, mortgage payments, or other housing expenses such as utilities and maintenance (Stone, 2006). Although there is no universally accepted consensus, most authors consider ratios below 30% to indicate affordable housing, while ratios above 50% point to excessive housing costs and unaffordability (Jewkes and Delgadillo, 2010). Eurostat regularly publishes statistics on the share of EU households with housing costs above 40% as a measure of "overburden" (EUROSTAT, 2023). The main advantage of this measure is its simplicity of calculation and interpretation. Despite the criticism that neglects the absolute level of housing costs and total household income, e.g. a 40% ratio may represent dramatically different absolute costs and material conditions for a poor and a wealthy household Lux and Sunega (2020), remains the dominant housing affordability measure in academic and policy circles (Hsieh and Moretti, 2019).

Unlike the cost–to–income ratio which is based on relative figures, absolute amounts and an assessment of the material standard a household can afford are used in the residual income approach, taking into account real housing costs. According to this concept, housing is affordable if after paying all housing costs (rent, mortgage installments, utilities) the household is left with enough funds to cover other basic living expenses and maintain a minimally acceptable standard of living (Stone, 2006). However, it also requires determining that "minimum standard", which carries normative challenges and comparability difficulties. This measure also has its critics, but the fact is that it more realistically reflects households' financial situations (Chaplin, 1994; Chaplin and Freeman, 1999).

Subjective measures of housing affordability are based on perceptions, experiences and assessments of households themselves regarding the affordability of housing costs and satisfaction with living conditions, collected through surveys, e.g. EU–SILC (European Union Statistics on Income and Living Conditions). Subjective measures commonly include: assessments of the affordability of current housing costs, perceived financial strain of housing costs, satisfaction with apartment size, quality and amenities and sense of housing security (Heylen, 2021). Subjective measures complement "hard" statistics and provide insight into the affordability experience from the citizens' perspective (Kikerec, 2024).

Housing affordability can also be viewed through the prism of access to mortgage lending, i.e. the ability of households to take out housing loans to purchase real estate (Lerman and Reeder, 1987). Since most households finance the purchase of an apartment or house through borrowing, lending terms and creditworthiness crucially affect the affordability of homeownership. Therefore, affordability measures based on the share or number of households meeting the conditions for obtaining mortgage loans with "reasonable" interest rates and repayment terms can be found in the literature (Bogdon and Can, 1997). However, "reasonable" lending conditions are relative and hardly comparable between countries. Different definitions and measures of housing affordability lead to different assessments and policies. Therefore, it is important to analyze them critically.

Economic factors are crucial for determining housing affordability and the three main economic factors are real estate prices, household incomes and creditworthiness (Hsieh and Moretti, 2019). Real estate prices, whether for purchasing or renting housing, have a direct impact on affordability. When prices rise faster than household income growth, affordability decreases. A significant drop in real estate prices can temporarily increase affordability, however, it is unsustainable in the long run without price and income stabilization (Kikerec, 2024). The second important factor is household income. Higher average incomes allow larger housing cost outlays without compromising basic living needs (Chaplin and Freeman, 1999; Lux and Sunega, 2020). Lower incomes constrain households' ability to afford housing costs. Households in the lower income deciles are especially vulnerable (Yates, 2008). The third key factor is access to mortgage lending (Lerman and Reeder, 1987). Income and creditworthiness determine households' ability to absorb these costs (Hancock, 1993). Therefore, it is imperative to observe them in an integrated manner when designing public policies to improve housing affordability.

Housing affordability is impacted by various demographic factors pertaining to the size, composition, and lifecycle stage of households. Key determinants include household formation rates, population growth, migration flows, trends in household size and type, and age distribution dynamics (Kikerec, 2024). Rising levels of household formation, due to young adults moving out of family homes or partnership breakdowns, generate substantial demand for affordable starter homes (Yates and Milligan, 2007). High population growth rates through natural increase or immigration also feed into greater housing needs across all segments (Myers and Ryu, 2008; Myers and Pitkin, 2009). Within many countries, trends of declining household sizes, aging populations, and growth in single–person households further impact affordability pressures and policy responses required. Rapid growth in the number of households, whether due to young adults setting up homes or immigrant flows, reduces affordable housing availability if construction lags behind. Many countries have witnessed homeownership rates declining among young cohorts over recent decades, linked to housing becoming less affordable for first-time buyers on average incomes (Cigdem and Whelan, 2017). Greater private rental demand similarly squeezes affordability for lower-income households seeking to rent (Yates and Milligan, 2007). Strong population expansion through elevated births, extended longevity, or immigration therefore risks amplifying constraints across multiple tenure options for disadvantaged groups. Ongoing social shifts towards smaller households on average, through lower fertility rates, partnership breakdowns, aging, and increased lifespans spent living alone, alter aggregate housing needs. A larger number of smaller households increases population–adjusted residential demand and potentially hinders per–capita affordability (Myers and Ryu, 2008; Myers and Pitkin, 2009). Housing affordability barriers vary across age groups and are often most problematic for those entering employment or retiring. High rents and house prices hinder labor market flexibility among young workers when moving jobs involves unaffordable relocation costs. At later life stages, declining incomes for retirees heighten affordability stresses. Spatial mismatches between the geographical spread of housing versus employment opportunities also dampen affordability, especially for younger and lower income households (Ong et al., 2013).

Housing affordability is also shaped by various institutional forces, particularly regarding housing supply responses, subsidy programs, and regulatory policies pursued by governments (Kikerec, 2024). When appropriately calibrated, housing policies can improve affordability across ownership, private rental, and social rental market segments.

However, inadequately addressing housing and planning system constraints risks compounding affordability pressures over time. Boosting the housing supply through upzoning land, funding social housing projects, and addressing construction sector barriers can mitigate mounting affordability issues in growing cities (Gurran and Phibbs, 2013; Gurran et al., 2018). Insufficient market-rate housing development to accommodate household growth and evolving locational preferences lessens affordability by intensifying bidding competition for available properties (Glaeser and Gyourko, 2018). Constraints such as zoning restrictions, infrastructure funding gaps, construction costs, and fledgling build-to-rent sectors commonly hinder supply responses across countries and require policy efforts targeting identified blockages (Barker, 2004). Government–provided rent assistance payments and home purchase grants help recipient households better afford their existing housing. However, such demand–side subsidies risk being capitalized into higher rents and prices if not coupled with actions countering supply constraints (Fenton, 2010). More construction–linked subsidies can avoid inflationary effects while aiding marginal occupants (Whitehead, 2007). Stamp duty reductions and shared equity schemes supporting prospective buyers also assist affordability at a cohort level alongside economy-wide impacts from stimulating transaction activity (Helderman and Mulder, 2007). Planning regulations fundamentally shape housing market operations and pricing signals guiding construction. Urban containment boundaries, density controls, approval lags, car parking mandates, and building code obligations variously influence development feasibility and affordability outcomes (Gurran et al., 2018). Reforms streamlining approvals, allowing greater densification, reducing mandatory developer contributions and easing codes provide scope to improve affordability where responsibly implemented. Though regulations aim to enhance amenity and sustainability, an overregulated system hampers responsiveness and affordability.

Using a statistical model that captures pricing dynamics, Blackwell et al. (2023) have found that deregulation and market–driven competition have not significantly improved affordability, especially in high–demand urban areas. Dubois and Nivakoski (2023) contributed to the EU context by examining housing affordability across Europe based on Eurofound's survey data, which includes both objective indicators (e.g. cost-to-income ratios) and subjective measures (e.g. perceived financial strain). The methodology reveals how inadequate and unaffordable housing disproportionately affects low income households, with urban areas experiencing greater affordability challenges due to demand and supply mismatches. Similarly, in the EU context, Filić (2022) employs a panel data approach to analyze housing affordability, focusing on various socio–economic and demographic drivers. Exploring housing market volatility, Engsted et al. (2016) used time–series data from the OECD to investigate the presence of speculative bubbles in housing prices. They employed cointegration tests and found that house prices in advanced economies exhibit volatile trends driven by speculation, which can lead to affordability crises as prices outpace income growth, which highlights the need for financial regulations to stabilize housing prices.

## 3. Research methodology and empirical results

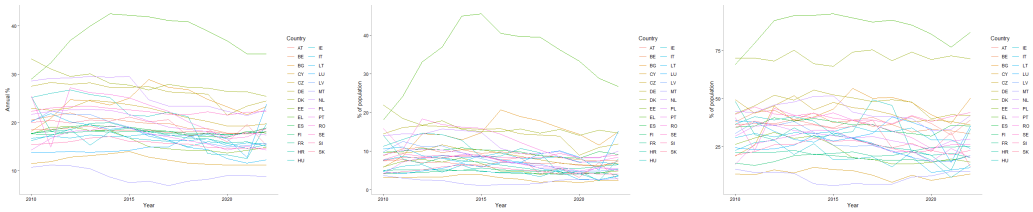
In this research, the price–to–income ratio is not used due to its numerous drawbacks, as explained in the previous section of the paper, despite being commonly used in existing empirical studies. There is a lack of papers addressing housing affordability indicators other than the price–to–income ratio, and this research aims to fill that gap (Kikerec, 2024).

The three potential indicators of housing affordability (the share of housing costs of low income households, the housing cost overburden rate of low income households, and the housing cost overburden rate of all households) exhibit extremely high positive correlations (0.91, 0.92, and 0.93), which justifies the reason to alternate with these proxy measures as dependent variables (Kikerec, 2024). Furthermore, this research provides a comprehensive panel data analysis with detailed explanations of all diagnostic checks in the post–estimation phase, an aspect often ignored in existing studies employing similar methodology. Identifying the best fitting panel model is not straightforward, nor is determining which variables are most relevant for reducing housing overburden or improving affordability.

Table 1. *Descriptive statistics of three potential affordability proxies over years across EU members*

| | Share of housing cost of low income households | | | Housing cost overburden rate | | | Housing overburden rate of low income households | | |
|---|---|---|---|---|---|---|---|---|---|
| year | mean | min | max | mean | min | max | mean | min | max |
| 2010 | 20.30 | 10.70 | 33.20 | 9.04 | 3.10 | 21.90 | 33.68 | 10.90 | 71.10 |
| 2011 | 20.36 | 11.20 | 32.30 | 9.51 | 3.00 | 24.20 | 34.59 | 10.50 | 78.80 |
| 2012 | 21.24 | 11.00 | 37.00 | 10.30 | 2.60 | 33.10 | 37.07 | 11.90 | 90.50 |
| 2013 | 21.32 | 10.40 | 39.90 | 10.49 | 2.50 | 36.90 | 36.99 | 11.20 | 93.10 |
| 2014 | 21.15 | 8.70 | 42.50 | 10.55 | 1.60 | 44.90 | 36.86 | 5.80 | 93.30 |
| 2015 | 20.75 | 7.50 | 42.20 | 10.17 | 1.10 | 45.50 | 35.61 | 4.80 | 94.00 |
| 2016 | 20.15 | 7.80 | 41.90 | 9.67 | 1.40 | 40.50 | 35.36 | 5.70 | 91.90 |
| 2017 | 19.63 | 6.90 | 41.10 | 9.24 | 1.40 | 39.60 | 34.94 | 5.60 | 89.70 |
| 2018 | 19.12 | 7.80 | 40.90 | 8.60 | 1.70 | 39.50 | 32.92 | 5.60 | 90.70 |
| 2019 | 18.54 | 8.20 | 38.90 | 8.25 | 2.30 | 36.20 | 31.98 | 9.20 | 88.20 |
| 2020 | 17.59 | 9.00 | 36.90 | 7.24 | 1.90 | 33.30 | 29.09 | 7.50 | 83.40 |
| 2021 | 17.57 | 9.00 | 34.20 | 7.15 | 2.40 | 28.80 | 28.67 | 8.80 | 76.70 |
| 2022 | 18.37 | 8.80 | 34.20 | 7.89 | 2.50 | 26.70 | 30.98 | 10.90 | 84.50 |

Source: author's calculation in RStudio using data provided by EUROSTAT



(a) Share of housing costs of low income households (b) Housing cost overburden rate (threshold 40%) (c) Housing cost overburden rate of low income households

Figure 1. *Affordability proxy measures across EU members*

Before conducting panel data analysis, descriptive statistics of three potential affordability proxies over years across EU members are reported in Table 1. Minimum and maximum demonstrate that affordability greatly varies across countries, e.g. 84.50% of the Greek population in 2022 lived in low income households (below 60% of median equivalised income), where housing costs represent more than 40% of disposable income), while the mean indicates upward trending of housing cost overburden rate. Likewise, it can be concluded

that housing is more affordable in Ireland, Cyprus, Malta, and Lithuania due to their lower housing costs and overburden rates (Figure 1).

Table 2. *List of demand and supply drivers of housing affordability*

| Variable | Description | Measurement unit |
|---|---|---|
| PRICE | Housing price | Index (2015=100) |
| CONSTRUCTION | Construction producer price | Index (2015=100) |
| SIZE | Average number of persons per household | Persons |
| PERMITS | Building permits | Index (2015=100) |
| URBAN | Population living in urban areas | % of population |
| MIGRATION | Net–migration (immigration – emigration) | % of population |
| OWNERSHIP | Population living in owning dwellings | % of population |
| EMPLOYMENT | Total employment rate within age 15–64 | % of labor force |

Note: data are provided by EUROSTAT public sources

Among explanatory variables in Table 2 (demand and supply drivers of housing affordability) the highest and positive correlation (0.85) is observed between house price index with respect of purchasing existing or newly built dwellings and construction producer price index of new residential buildings, which was expected. For the same reason both variables will be omitted from panel analysis due to multicollinearity issue and because these prices are already embedded, although indirectly, in housing affordability indicators through mortgage or rental payments (Kikerec, 2024). Variable "size" which measures the average household size, will be also omitted as it is almost time–invariant. Therefore, five variables will be used: building permits, degree of urbanization, net–migration, ownership and employment rate, while three housing affordability proxies will be swapped in the new panel model specification (Kikerec, 2024). For each dependent variable 5 static panel models are estimated: (1) pooled model, (2) FE individual, (3) FE two–ways, (4) RE individual, and (5) RE two–ways. The first part of Table 3 presents parameter estimates with standard errors in parenthesis, the second part provides commonly used goodness–of–fit measures (coefficient of determination, adjusted coefficient of determination, Akaike Information Criterion, Bayes Information Criterion and Root Mean Squared Error), while the third part exhibit panel diagnostic tests (F–statistic, Breusch–Pagan statistic, Hausman statistic, Wooldridge and Pesaran CD statistic).

When the share of housing costs in disposable income of low income households is considered as the dependent variable (HA proxy), a two–ways fixed effects model is most appropriate, indicating that building permits, employment and ownership reduce housing costs (and hence improves housing affordability), while degree of urbanization increases housing cost and consequently diminishes housing affordability (Kikerec, 2024). For example, a 1% increase of employment improves housing affordability on average by 0.212%. Likewise, a 1% increase of building permits improves housing affordability on average by 0.013%, assuming all other variables are constant. Contrary, housing affordability worsens by 0.038% if population living in urban areas increases by 1%. Although negative, net–migration is not statistically significant variable. It should be noted that only building permits are taken into logs as variable which is not expressed in percentages, while other variables are. A best fit model FE two–ways is validated through diagnostic checking when comparing to other models (Table 3). In that context, the F statistic was first applied to test the significance of individual–specific effects, as well as both individual and time effects, in a fixed–effects (FE)

model to determine whether these effects improve the model's fit compared to a pooled panel model (a model without individual effects). Under the null hypothesis, it is assumed that all individual effects are equal to zero. If the null is rejected, then the FE model is preferable to the pooled model. The results suggest that both FE individual and FE two–ways provide a better fit compared to the pooled model.

Table 3. *Panel models results with housing costs share of low income households as HA proxy*

| Variable | Pooled | FE individual | RE individual | FE two–ways | RE two–ways |
|---|---|---|---|---|---|
| Intercept | 51.184*** | | 57.424*** | | 57.024*** |
| | (5.796) | | (5.353) | | (5.389) |
| URBAN | −0.034 | 0.028 | 0.024 | 0.038* | 0.025 |
| | (0.025) | (0.018) | (0.018) | (0.018) | (0.017) |
| Log(PERMITS) | −0.999 | −1.738*** | −1.734*** | −1.268** | −1.683*** |
| | (0.674) | (0.397) | (0.389) | (0.431) | (0.392) |
| MIGRATION | −2.361*** | 0.034 | −0.021 | −0.255 | −0.050 |
| | (0.445) | (0.220) | (0.219) | (0.232) | (0.219) |
| EMPLOYMENT | −0.145** | −0.272*** | −0.265*** | −0.212*** | −0.264*** |
| | (0.052) | (0.046) | (0.044) | (0.063) | (0.045) |
| OWNERSHIP | −0.184*** | −0.188** | −0.176** | −0.197** | −0.175** |
| | (0.031) | (0.072) | (0.058) | (0.074) | (0.059) |
| Observations | 351 | 351 | 351 | 351 | 351 |
| $R^2$ | 0.200 | 0.397 | 0.378 | 0.189 | 0.358 |
| $R^2$ adj. | 0.188 | 0.338 | 0.369 | 0.075 | 0.349 |
| AIC | 2174.3 | 1408.6 | 1439.8 | 1376.5 | 1435.1 |
| BIC | 2201.3 | 1431.8 | 1466.9 | 1399.7 | 1462.1 |
| RMSE | 5.25 | 1.77 | 1.84 | 1.69 | 1.83 |
| F statistic | | 95.788*** | | 69.894*** | |
| BP statistic | | | 1431.3*** | | 1432.4*** |
| Hausman statistic | | 12.34** | | 116.29*** | |
| Wooldridge statistic | | 97.472*** | 112.07*** | 107.11*** | 112.33*** |
| Pesaran CD statistic | | 4.753*** | 4.905*** | −0.149 | 3.959*** |

Note: significance levels are indicated as $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$, while standard errors are in parenthesis

Thereafter, the Breusch–Pagan statistic was used to check the assumption of constant variance. Specifically, if the null hypothesis of zero variance in individual effects is rejected, this implies that a random effects (RE) panel model is more suitable than the pooled model. Accordingly, two Breusch–Pagan statistics were conducted: one for the RE individual model and the other for the RE two-ways model. In both RE models the null hypothesis was rejected, indicating that a random panel model is more adequate than a pooled model.

The Hausman statistic helps in deciding between fixed effects (FE) and random effects (RE) models by testing the null hypothesis of no correlation between the individual effects (also known as unobserved individual heterogeneity) and the explanatory variables, which is the key assumption of the RE model. If no difference is found between the random effects and fixed effects estimates, it indicates that the RE model is consistent and efficient. However, rejection of the null hypothesis typically favors the FE model, as it suggests that the FE model provides unbiased estimates. Accordingly, two Hausman tests were conducted, indicating that both fixed effects models are more suitable.

In the next step, the Wooldridge test for serial correlation in the error terms was utilized to all estimated models except the pooled one. The rejection of the null hypothesis confirmed significant serial correlation in all four models, indicating that the error terms are not independent over time. This could produce incorrect standard errors if not properly addressed (violation of the assumptions may be overcome by estimating dynamic panels instead of static panels or by utilizing robust standard errors).

Finally, the cross–sectional dependence was checked. The correlation between the cross-sectional units in the panel data can lead to biased and inconsistent estimates if ignored. FE and RE assume that the error terms are independent across cross–sections. For the same reason the Pesaran CD test was performed, indicating that the cross–sectional units behave independently of each other only for FE two–ways model, making it a potentially more robust.

Similar results are found in the other two panel model specifications. Specifically, when the housing cost overburden rate of low income households is considered as a HA proxy, net–migration is still not a significant demographic demand driver of housing affordability (Kikerec, 2024). On the other hand, the degree of urbanization significantly reduces housing affordability as it positively impacts the overburden rate at 5% significance level (Table 4).

Table 4. *Panel models results with overburden rate of low income households as HA proxy*

| Variable | Pooled | FE individual | RE individual | FE two–ways | RE two–ways |
|---|---|---|---|---|---|
| Intercept | 47.515*** | | 42.682*** | | 42.702*** |
| | (6.488) | | (6.300) | | (6.309) |
| URBAN | −0.018 | 0.044** | 0.044** | 0.051** | 0.044** |
| | (0.028) | (0.021) | (0.021) | (0.022) | (0.021) |
| Log(PERMITS) | 0.392 | −2.480*** | −2.296*** | −1.997*** | −2.298*** |
| | (0.755) | (0.475) | (0.464) | (0.526) | (0.464) |
| MIGRATION | −1.389*** | 0.177 | 0.169 | 0.009 | 0.169 |
| | (0.498) | (0.263) | (0.261) | (0.283) | (0.261) |
| EMPLOYMENT | −0.378*** | −0.193*** | −0.212*** | −0.206*** | −0.211*** |
| | (0.058) | (0.055) | (0.053) | (0.077) | (0.053) |
| OWNERSHIP | −0.178*** | −0.195** | −0.150** | −0.163* | −0.150** |
| | (0.035) | (0.087) | (0.069) | (0.090) | (0.069) |
| Observations | 351 | 351 | 351 | 351 | 351 |
| $R^2$ | 0.180 | 0.299 | 0.283 | 0.164 | 0.283 |
| $R^2$ adj. | 0.168 | 0.231 | 0.272 | 0.047 | 0.273 |
| AIC | 2253.4 | 1534.0 | 1564.3 | 1516.1 | 1564.0 |
| BIC | 2280.4 | 1557.2 | 1591.4 | 1539.2 | 1591.0 |
| RMSE | 5.88 | 2.12 | 2.20 | 2.06 | 2.20 |
| F statistic | | 82.452*** | | 57.564*** | |
| BP statistic | | | 1415.3*** | | 1416.3*** |
| Hausman statistic | | 6.142 | | 6.073 | |
| Wooldridge statistic | | 129.80*** | 144.39*** | 136.06*** | 144.25*** |
| Pesaran CD statistic | | 2.152** | 2.304 | 0.889 | 2.301** |

Note: significance levels are indicated as $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$, while standard errors are in parenthesis

Unlike the results from the first proxy, the Hausman test here do not reject the null hypothesis, indicating no significant difference between the fixed and random effects esti-

mates. This suggests that the random effects model is consistent and efficient, making it a suitable choice. The FE individual shows significant cross–sectional dependence, while the FE two–ways model does not, suggesting that when both individual and time effects are incorporated, the cross–sectional independence assumption might hold better.

Table 5. *Panel models results with respect to overburden rate of all households as HA proxy*

| Variable | Pooled | FE individual | RE individual | FE two–ways | RE two–ways |
|---|---|---|---|---|---|
| Intercept | 129.772*** | | 134.709*** | | 130.209*** |
| | (16.869) | | (14.752) | | (14.831) |
| URBAN | −0.143** | −0.024 | −0.025 | −0.002 | −0.018 |
| | (0.072) | (0.048) | (0.047) | (0.047) | (0.046) |
| Log(PERMITS) | 0.231 | −1.435 | −1.325 | 0.676 | −0.488 |
| | (1.963) | (1.062) | (1.040) | (1.127) | (1.058) |
| MIGRATION | −4.606*** | −1.231** | −1.259** | −2.092*** | −1.602*** |
| | (1.294) | (0.590) | (0.583) | (0.607) | (0.586) |
| EMPLOYMENT | −0.564*** | −0.552*** | −0.558*** | −0.522*** | −0.575*** |
| | (0.150) | (0.122) | (0.118) | (0.165) | (0.126) |
| OWNERSHIP | −0.640*** | −0.813*** | −0.729*** | −0.764*** | −0.713*** |
| | (0.090) | (0.194) | (0.162) | (0.193) | (0.161) |
| Observations | 351 | 351 | 351 | 351 | 351 |
| $R^2$ | 0.176 | 0.270 | 0.260 | 0.156 | 0.214 |
| $R^2$ adj. | 0.164 | 0.199 | 0.249 | 0.038 | 0.203 |
| AIC | 2924.2 | 2099.5 | 2126.8 | 2051.1 | 2105.9 |
| BIC | 2951.2 | 2122.7 | 2153.9 | 2074.3 | 2132.9 |
| RMSE | 15.28 | 4.73 | 4.91 | 4.42 | 4.76 |
| F statistic | | 115.58*** | | 88.55*** | |
| BP statistic | | | 1624.0*** | | 1625.6*** |
| Hausman statistic | | 1.832 | | 130.04*** | |
| Wooldridge statistic | | 67.18*** | 75.21*** | 71.82*** | 74.38*** |
| Pesaran CD statistic | | 6.221*** | 6.310*** | −1.637 | 2.560** |

Note: significance levels are indicated as $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$, while standard errors are in parenthesis

Table 6. *Two–ways fixed effects models with robust standard errors considering three HA proxies*

| | Housing costs of low income households | Overburden rate of low income households | Overburden rate of all households |
|---|---|---|---|
| URBAN | 0.038** | 0.051*** | −0.002 |
| | (0.015) | (0.014) | (0.036) |
| Log(PERMITS) | −1.268*** | −1.997*** | 0.676 |
| | (0.302) | (0.463) | (0.635) |
| MIGRATION | −0.255 | 0.009 | −2.092*** |
| | (0.229) | (0.256) | (0.414) |
| EMPLOYMENT | −0.212*** | −0.206*** | −0.522*** |
| | (0.059) | (0.074) | (0.168) |
| OWNERSHIP | −0.197* | −0.163* | −0.764*** |
| | (0.109) | (0.101) | (0.220) |

Note: significance levels are $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$; Driscoll and Kraay standard errors in parenthesis

Within the third HA proxy (Table 5) net–migration becomes a statistically significant variable, which negatively impacts the housing cost overburden rate of all households, along with the employment rate and ownership percentage. Contrary to the first two model specifications, the number of building permits for residential buildings, as well as the degree of urbanization, no longer affects housing affordability (Kikerec, 2024). Again, statistics of Hausman and Pesaran CD favor FE two–ways model. However, significant Wooldridge statistics across all models indicate that there is autocorrelation present, which can affect the reliability of standard errors and significance testing. This suggests that corrections for serial correlation might be necessary to ensure valid inference. Thus, a Driscoll and Kraay robust standard errors are applied to FE two–ways models for each dependent variable. Best fit estimates with robust standard errors are summarized in Table 6 (goodness–of–fit measures and diagnostic test statistics are omitted as already reported in previous tables).

## 4. Conclusion

This paper comprehensively examines the multifaceted issue of housing affordability within 27 EU countries over 13 years. By analyzing the socio–economic and demographic factors, the research has shed light on the intricate dynamics that influence housing affordability across different member states. The empirical analysis revealed significant insights into how variables such as building permits, urbanization, net–migration, home–ownership rates, and employment rates interact to shape housing affordability (Kikerec, 2024). These results underscore the complexity of the housing market and suggest that housing affordability cannot be fully explained by traditional economic or demographic variables alone. Effective housing policies should not only address the supply side by encouraging new construction and reducing regulatory barriers but also consider demand side measures such as financial assistance for low income households (Kikerec, 2024). However, demand side interventions must be carefully designed to avoid unintended consequences, such as inflationary pressures on housing prices.

Furthermore, it highlights the role of demographic trends, particularly urbanization and migration, in influencing housing markets. Policymakers need to account for these trends when designing strategies to ensure that housing supply meets the evolving needs of the population. The study also pointed out the necessity for continuous monitoring and adaptation of housing policies to respond to changing economic and demographic conditions. This paper contributes to the body of knowledge on housing economics and provides valuable insights for policymakers, urban planners, and stakeholders involved in addressing the housing affordability crisis in the EU. Ensuring that all households have access to affordable housing is not only a matter of economic stability but also a fundamental aspect of social well–being. Limitation of this paper is not using other explanatory variables, such as mortgage rate, because such data are not available for all EU members and all observed years. Although standard requirements are fulfilled, having the number of cross–sections greater than the number of time periods, this paper deals with small panel (351 observations in total) and therefore panel data should be balanced and complete, at least to compensate for that deficiency. Another limitation is regarding the use of static panels, while the use of dynamic panels (accommodating not only serial correlation but also cross–sectional dependence) will be considered in future research.

**Attribution**

This article originated from the final thesis of the undergraduate BDiB study program at University of Zagreb, Faculty of Economics and Business.

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# Trendovi i pokretači priuštivog stanovanja u EU: uvidi iz analize panel podataka

**SAŽETAK**

Priuštivo stanovanje ključan je problem koji utječe na dobrobit pojedinaca, ali i društva. Priuštivo stanovanje omogućuje kućanstvima da zadovolje svoje osnovne životne potrebe bez nepotrebnog financijskog opterećenja. Ono utječe na mobilnost radne snage, potrošnju, gospodarski rast i ekonomsku otpornost. Priuštivo stanovanje obično se mjeri udjelom dohotka kućanstva potrebnim za pokriće troškova stanovanja, uključujući najamninu ili otplatu stambenog kredita, režije i održavanje. Međutim, ne postoji univerzalno prihvaćena mjera stambene priuštivosti (poput omjera troškova stanovanja i dohotka, pristupa preostalog dohotka ili subjektivnih mjera kojima se procjenjuje percepcija kućanstava o priuštivosti njihovog stanovanja). Ovi različiti indikatori odražavaju složenost priuštivog stanjavanja i naglašavaju potrebu za sveobuhvatnom analizom koja koristi više mjera, što je i svrha ovog rada. Panel analiza socio-ekonomskih i demografskih pokretača, kako na strani potražnje tako i na strani ponude, koji utječu na priuštivo stanovanja, ključna je za razvoj učinkovitih politika koje osiguravaju pristup adekvatnom i priuštivom stanovanju za sve građane, jer su se mnoge zemlje Europske unije suočile s krizom priuštivog stanovanja obilježenom rastom cijena nekretnina, troškova stanovanja i nedostatnom ponudom stambenih jedinica.

**KLJUČNE RIJEČI**

*EU članice, priuštivo stanovanje, stambeni troškovi, panel podaci*

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