RETROSPECTIVE PANEL DATA STUDY OF ENERGY-EFFICIENT RETROFITS: THE RELEVANCE OF SOCIAL CAPITAL AND HOUSING-RELATED LIFESTYLE

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Overview

According to current building standards, a large portion of the building stock in the European Union is energy inefficient. The JRC Technical report (Filippidou & Jimenez Navarro, 2019) on achieving the cost-effective energy transformation of Europe's buildings shows that only 0.4 -1.2% of the building stock in the EU is renovated each year, with slight differences among member states. Keeping in mind the facts that residential energy consumption represented 26.3% of final energy consumption in the EU in 2019 (Eurostat, 2021a), as well as that space heating accounted for 64% of that energy, the area of energy-efficient retrofits surely deserves the attention of the academia and practitioners. Also, private households were responsible for 23.6% of greenhouse gas (GHG) emissions in the EU in the same year, adding to the severity of the issue (Eurostat, 2021b). This indicates that revealing barriers and drivers of energy-efficient retrofits is an important topic. There is already a vast body of literature unveiling various barriers and drivers to energy-efficient household renovations exploring technical factors (building characteristics), financial and economic factors, socio-economic characteristics of households, behavioural factors, information and policy measures (e.g., Achtnicht & Madlener, 2014; Amstalden et al., 2007; Camarasa et al., 2021; Cirman et al., 2013; Dolšak et al., 2020; Felius et al., 2020; Hrovatin & Zorić, 2018 and Trotta, 2018). Our research focuses on determinants that are relatively novel and unexplored in the area of energy-efficient retrofits: social capital and housing-related lifestyle. In doing so, we provide retrospective panel evidence from the EU member country of Slovenia. To the best of our knowledge, these factors have not been substantially studied in the area of energy-efficient retrofits.

Methods

The sample includes 2,537 respondents from Slovenia, economic decision-makers within the household, who are either owners or co-owners of their homes. Both single-family and multiple-family dwellings were included in the sample to analyze possible differences due to individual and collective decision-making and to further explore the impact of social capital on energy-efficient retrofit decisions. The data were collected from an online household survey in August 2020 as part of the EU-funded Care4Climate project. Characteristics of respondents in the sample closely resemble the population with respect to the region, gender and age, with a slight over-representation of individuals with higher education levels. We can divide the explanatory variables into several categories: socio-economic household and individual characteristics, building and location characteristics, social capital, housing-related lifestyle and other variables, including information sources, policy effects and macroeconomic variables. When exploring the impact of social capital, we included three components in our analysis: participation in resident associations, prosocial norms, and a building's formal organization (Cirman et al., 2013; Saegert et al., 2002). We consider the influence of housing-related lifestyle, as operationalized by Thøgersen (Thøgersen, 2017).

We employ the random utility theory and the method of revealed preference, where the revealed preference refers to the decision to perform an energy-efficient retrofit in the respondent's home in the past. According to the random utility theory, a choice to renovate in an energy-efficient way or not can be represented in the following way (Train, 2009):

$$U_{nj} = V_{nj} + \varepsilon_{nj}$$

where U_{nj} is the individual's utility obtained from alternative j, V_{nj} is the component of utility we are attempting to estimate, and the ε_{nj} represents the unknown component. The $V_{nj} = \beta' X_{nj}$ is assumed to be linear in parameters and includes all of the previously discussed explanatory variables (building characteristics, household characteristics, social capital, housing-related lifestyle, etc.) The probability that an individual *n* opts for an energy-efficient retrofit *j* can be modelled through its utility, that is the individual will choose to perform an energy-efficient retrofit only if the choice increases his underlying utility:

$$\text{Prob ('individual opts for an energy-efficient retrofit')} = \text{Prob}\,(U_{nj} \geq U_{ni}) = \text{Prob}\,(V_{nj} + \varepsilon_{nj} \geq V_{ni} + \varepsilon_{ni})$$

Different discrete choice methods are employed to estimate the specified model (e.g., Hoffman & Duncan, 1988; McFadden & Train, 2000 and Train, 2009). We additionally decided to construct a retrospective panel (Mundlak,

1978) in order to capture the time dimension and also the effect of the Slovenian subsidy program, which was introduced in the year 2009 (Eko Sklad, 2022).

Results

Results show that a certain dimension of housing-related lifestyles, such as energy-saving behaviour and proclivity to 'do-it-yourself' (DIY) home maintenance and repairs, as well as variables pertaining to social capital, such as the ease of agreement among residents and the building's formal organization and infrastructure, work as drivers of energy-efficient retrofits. Further, high income levels, age of the respondent and the dwelling, previously performed renovations and availability of subsidies appear significant as drivers of energy-efficient retrofits, while high regional temperatures and negative GDP growth work as barriers to energy-efficient retrofits. Interestingly, attaching more importance to free-of-charge energy counselling negatively impacts energy-efficient retrofits. This may be a result of the fact that households without any experience with energy-efficient retrofits perceive this type of advice as more important due to the greater need to acquire information, implying that lack of information can also work as a barrier to retrofits.

Conclusions

There is still significant room for improvement in the area of residential energy efficiency. With this research, we aimed to build upon the existing literature by asserting the role of social capital and housing-related lifestyle in the energy-efficient retrofit decision-making process. Potential policy recommendations stemming from the results of our research indicate that a policy mix, including subsidies, further educational and informational campaigns on the topics of energy efficiency, as well as interventions and incentives that support the building's formal organization and infrastructure and foster community building are required to tackle different barriers to achieving higher residential energy efficiency.

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