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Which factors determine the extent of house owners' energy-related refurbishment projects? A Motivation-Opportunity-Ability Approach

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ABSTRACT

Increasing the energy efficiency of the buildings in the European Union to reduce their high share of the final energy consumption could have various societal benefits. A special focus in this regard lies on residential buildings. However, in Germany, the energy efficiency increase associated with residential refurbishment projects is commonly low. For a better understanding of this problem, we investigate factors influencing the extent of energy-related refurbishment projects of owner-occupiers of single and two-family houses. For this purpose, we use online survey data, the Motivation-Opportunity-Ability framework and general factors influencing the adoption of energy-related refurbishment projects. These factors' effects on the refurbishment extent of owner-occupiers in the process of such projects are analyzed with structural equation analysis. Our results show that the intention to embellish the house, need for building maintenance or having related know-how foster the realization of more comprehensive energy-related refurbishment projects. A supporting social environment and willingness to take out a loan were also identified to have this effect. Based on our results, we inter alia suggest that having subsidized regional consultation initiatives, which allow for a potential multiplier-effect amongst house owners, could increase the extent of energy-related refurbishment projects. Finally, ideas for ongoing research are provided.

1. Introduction

The building sector in the European Union (EU) causes 36% of the greenhouse gases (GHG)[1] and is responsible for 40% of the EU's final energy consumption. One reason for these high rates is that about 35% of the EU's buildings are more than 50 years old (European Commission, 2017). Improving the energy efficiency of the EU's building stock in combination with a high use of renewable energy could potentially lead to a 75% reduction in final energy use in the EU by 2050 (compared to 2010) and to a 90% reduction of GHG emissions (compared to 1990) (Artola, Rademaekers, Williams, & Yearwood, 2016). In order to exploit these potentials, the EU has implemented two relevant directives, namely the 2010 Energy Performance of Buildings Directive and the 2012 Energy Efficiency Directive. These directives, which apply to new as well as existing buildings, are not only supposed to enable the achievement of the EU's goals, such as a 40 % reduction of GHG emissions by 2030 (compared to 1990),[2] but could also lead to other benefits such as increased employment in the construction sector and decreased dependency on energy imports. There is also the potential for household energy bills to decrease and indoor comfort in refurbished houses to increase (Bukarica, Lončarević, Pešut, & Zidar, 2017). Owing to these potential social and economic benefits, energy efficiency in the building sector is of particular interest to politicians. However, in Germany, there is reluctance among house owners to take up energy efficient refurbishment measures (EERM). A general indicator for this reluctance is the amount of financial investments made in the context of EERMs in the German residential sector. These investments reached EUR 40.9 billion in 2010, but a decline of EUR 6 billion was observed in 2014 (Rein & Schmidt, 2016). Another more specific figure expressing this reluctance of house owners and triggering our approach is the refurbishment efficiency associated with energy-related refurbishment projects in the residential sector. Although comprehensive energy-related refurbishment projects in residential buildings could lead in theory to average energy efficiency increases of up to 35 %, this number amounts to only 7.7 % in reality (Walberg, Gniechwitz, Neitzel, Austrup, & Gottschalk, 2016). With regard to an almost carbon-neutral building stock by 2050, a goal stated in the German Climate Action Plan (BMUB, 2014), it is important to identify

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[1] GHG: Greenhouse gas(es), EERM: Energy efficient refurbishment measures.
[2] https://ec.europa.eu/clima/policies/strategies/2030_de.

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factors that can help to increase the extent of energy-related refurbishment projects of already willing house owners. Thereby, owner-occupiers of single and two-family houses play an important role. Firstly, these owner-occupiers have much more independence in terms of making decisions about refurbishments when compared to owners of apartments in apartment buildings, in which decisions generally involve a number of people (BPIE, 2011). Secondly, owner-occupiers of single and two-family houses, at 11 %, account for a significant share of the overall final energy consumption in Germany (Walberg et al., 2016). This study has a particular focus on these owner-occupiers and the mentioned refurbishment efficiency, i.e. the achieved individual energy efficiency increase caused by the extent of EERMs. Specifically, we analyze owner-occupiers of single and two-family houses in Germany who are in the process of planning or conducting energy-related refurbishment projects.

For a better understanding of the extent of these owner-occupiers' refurbishment projects and to increase the refurbishment efficiency, we utilize factors that commonly influence the actual uptake of energy-related refurbishment projects. The so called Motivation-Opportunity-Ability (MOA) framework serves as a theoretical basis and structural equation analysis as an empirical research method. Applying the mentioned framework, which is often used to analyze individuals' performances, allows us to test hypotheses in the context of the framework predictors. By this we mean the influence of Motivation, Opportunity and Ability on the pursued extent of EERMs of owner-occupiers of single and two-family houses (research target 1). Additionally, by using formative operationalized constructs, this also allows for an evaluation of the effect of different influencing factors related to refurbishments on the three predictors of the MOA framework and thus also on the extent of EERMs (research target 2). The extent of EERMs in this study, which has direct implications on the energy efficiency increase, is measured via the number of EERMs. In doing so, our approach distinguishes from the majority of existing empirical studies in the context of residential energy-related refurbishment projects and understanding house owners' decisions and behavior. Analyzing the relevant literature shows that studies in this field generally look towards numerous factors that influence the adoption of e.g. specific EERMs such as innovative heating systems (Michelsen & Madlener, 2013; Sopha, Klöckner, & Hertwich, 2011) or insulation activities (Friege, 2016). Other studies analyze the general uptake of energy-related refurbishment projects including different EERMs (Klöckner, 2014; Stieß & Dunkelberg, 2013) or conduct choice experiments to investigate preferences for different EERMs and related projects (Achtnicht & Madlener 2014; Alberini, Banfi, & Ramseier, 2011). Moreover, there are also studies analyzing house owners' willingness to pay for certain EERMs (e.g. Banfi, Farsi, Filippini, & Jakob, 2008) or the overall investment levels associated with residential energy saving projects (e.g. Nair, Gustavsson, & Mahapatra, 2010). However, specific analysis that considers the extent of different energy-related refurbishment activities is rare what is also emphasized by Collins & Curtis (2016) who state "The literature in this field is dominated by analysis of the propensity of households to engage in energy efficiency retrofitting of the home. These studies generally look at whether a household makes a decision to engage in any retrofit measures, regardless of intensity". Those studies who are focused on the extent of energy-related refurbishment projects (e.g Collins & Curtis, 2016; Gamtessa, 2013; Long, 1993), in turn, mostly analyze the effect of economic factors and e.g. household characteristics. In Collins and Curtis (2016) and Gamtessa (2013), for example, the effect of incentive schemes and household characteristics on the extent of Canadian and Irish refurbishment projects are analyzed. Long (1993) also considers mainly household characteristics and economic aspects and underlines i.a. the importance of energy price increases or income tax credits for increasing US house owners individual residential spending on energy conservation. Even though e.g. the study of Mortensen, Heiselberg, & Knudstrup, 2014 considers some non-economic benefits and suggests utilizing the desire of Danish house owners for improvements in comfort and architecture to increase the total budget for energy-related refurbishment projects, profound analysis of non-economic aspects in this regard is lacking. The identification of such factors, for example, those related to individuals' know-how, beliefs or situational aspects, could be used by policy makers as well as energy assessors, architects or other relevant business actors. With the help of such factors, those actors could fine tune their respective programs and change their approach towards house owners who are already willing to engage in energy-related refurbishment projects. This could, on the one hand, allow for an increase in the extent of energy-related refurbishment projects and, consequently, the achieved energy savings of house owners. On the other hand, this could also allow for the achievement of the prior mentioned benefits including a reduction of the environmental impact of cities and municipalities.

Besides these practically relevant contributions, a further scientifically relevant contribution is intended with the present study. By this we mean the consideration of a so far widely neglected perspective when empirically analyzing households' energy-related decision-making. Specifically – and in contrast to the common experimental and retrospective perspectives outlined in the review of Kastner and Stern (2015) – we mean the perspective of house owners in the process of an energy-related refurbishment project. The consideration of this perspective but also of the extent of energy-related refurbishment projects is finally supposed to respond to the review of Friege and Chappin (2014). These authors conclude that the research on understanding house owners' decisions in the context of residential energy efficiency measures is in its infancy due to limited underpinning research.

The remaining part of the present paper is organized as follows: The hypotheses we are investigating and the methodology used are provided in the following section after an introduction of the MOA framework. Our results are presented in Section 3. The discussion of our results and our conclusions can be found in Section 4.

2. Methodology

In this section, we describe the methodology used in this study. This includes details regarding the MOA framework and the operationalization of the framework predictors as well as information on data acquisition and the statistical procedure used for the data analysis.

2.1. The Motivation-Opportunity-Ability framework

An early use of the Motivation-Opportunity-Ability framework, which serves as the theoretical base for this study, can be found in the field of job performance analysis. It was developed because previous theories had failed to provide a strong and consistent prediction of individual job performance. Blumberg and Pringle (1982) added the so far neglected dimension, 'the opportunity to perform,' to the known correlates of performance. Later, the determinants Motivation, Opportunity and Ability were also proposed by Ölander and ThØgersen (1995) but in the context of environmental issues and consumer lifestyles. However, in accordance with both Ölander and ThØgersen (1995) and Blumberg and Pringle (1982), *Motivation* is e.g. determined by the desirability of the outcome of a certain behavior. *Opportunity* is influenced by external factors that make the performance of relevance easier or more difficult. One's *Ability* to perform the respective behavior depends on individual aspects e.g. one's knowledge (Blumberg & Pringle, 1982; Ölander & ThØgersen, 1995).

As the MOA framework is characterized as being a meta-theory (Gregor, 2006), it has been adopted and used in various fields of research. As examples for the utilization in the field of energy issues, the studies of Karatas, Stoiko and Menassa (2016), Chai and Baudelaire (2015) or Li, Menassa and Karatas (2017) can be mentioned. Karatas et al. (2016) utilized the MOA framework for selecting occupancy-