FACTORS IMPACTING ENERGY EFFICIENT RENOVATIONS IN THE RESIDENTIAL SECTOR: THE EFFECTIVENESS OF THE SLOVENIAN GRANT PROGRAM

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Overview

The Slovenian residential sector has been regarded as an area holding the greatest potential for energy savings, especially for space heating, which represents more than half of the total household energy consumption. Despite the identified potential for energy efficient improvements, their actual implementations are typically hindered by various barriers such as high initial costs for investment, and a lack of information about the possibilities and benefits of the efficient use of energy. In order to overcome these challenges and to comply with the EU requirements, in 2008 Slovenia adopted the first National Energy Efficiency Action Plan (NEEAP, 2015). As a part of NEEAP, the Slovenian environmental public fund, Eco-Fund, in 2009 introduced a grant program for promoting energy efficient renovations of homes and investments in energy efficient technologies. Many studies have tried to examine the effect of several factors impacting decisions of households to adopt energy efficiency improvements in their homes. Several dwelling characteristics (age of the building, size, the need for the thermal comfort improvement, location), households characteristics (income, education, HH age, structure and size, employment), behavioural and attitudinal factors (daily routines, environmental awareness, and renovation skills) have proven to be important along with economic constraints (lack of funding, high upfront costs) and economic incentives (energy prices, reduction of energy cost). In contrast, the studies on the impact of policy measures and on the appropriateness of their design have been scarcer. Among policy measures the role of information, in particular audits as a means of overcoming the financial barrier and fiscal incentives (grants, tax credits and rebates, lower interest rates) have been most often studied with somehow contentious results (Banfi et al., 2008; Nair et al., 2010; Grösche et al., 2013; Frondel and Vance, 2013; Alberini et al, 2013; Alberini et al., 2014; Achtnicht and Madlener, 2014; Murphy, 2014; Pettifor et al., 2015; Gamtessa, 2012; Nauleau, 2014).

In our study, we draw on findings from the study by Hrovatin and Zorić (2017) where financial constraints were recognised among survey respondents as the most important barrier to conducting energy efficient retrofits of homes, while financial support in terms of grants were reported as one of the most desired drivers for undertaking EE home improvements at the time when no such funds existed. Therefore, the objective of our study is two-fold: first to identify factors that influence decisions of Slovenian households to undertake energy efficient improvements of their homes using revealed preference data. Second, we are interested to see if the aforementioned reported desire for fiscal incentives in fact materialised in their actual use as a stimulus after they were introduced by the Eco Fund in 2009. Finally, it remains to be seen if free-of-charge public funds in fact enable EE home improvements that would not be possible otherwise, or the free-riding effect prevails as has been revealed in some studies (Grösche et al., 2013; Nauleau, 2014). This study could thus provide insights on how to design future energy efficiency policies to enhance energy efficiency (EE) home improvements without wasting public resources.

Methods

The empirical analysis of factors that influence decisions for energy efficient improvements of households is based on the random utility theory, while using actual investment data. To model energy efficient improvement decisions, discrete choice models are employed, namely the logit models with random individual effects (RE). The dependent variable takes the value of 1 if at least one HH EE retrofit was undertaken and 0 otherwise. In order to explain the HH decisions for EE investments the following explanatory variables are included: building characteristics (age, size, and types), household characteristics (number of HH members/residents, number of children, estimated income based on the ownership of appliances and cars), location (urban, rural), and other economic conditions (GDP p.c., index of dwelling sales prices). The data on all variables were taken from the surveys Energy consumption in households in Slovenia conducted by Statistical office of the Republic of Slovenia (SORS) in 2010 and 2014, which assures representativeness of the sample. The final sample, constructed as a retrospective panel data, consists of 6,882 Slovenian households. Since most of individual characteristics except renovation activity and economy indicators do not vary across time in our data, we use the aforementioned Random effects (RE) model.

In order to estimate the effect of Eco Fund grants on the probability of renovating, an estimation in difference is performed using a difference estimator, implemented in the RE logit model. According to the model's assumption, by inclusion of aforementioned explanatory variables we assured that all other factors that may impact on the

probability of investing during the period were included in the model, as otherwise their impact would be attributed to the policy. Finally, the effectiveness of the policy is often measured by the share of free-riders – subsidised households (HH), which would have undertaken the energy efficient renovation even in the absence of the grant. As the data provide information on the grant received by the HH, the share of free riders is then derived from the marginal effects of the significant annual dummies after the launch of grants.

Results

The descriptive statistics show differences in renovation rates over the period 2006-2010 (before the introduction of Eco Fund grants) and 2010-2014 (the Eco Fund period). Overall renovation rate increased from 58% in 2010 to 62% in 2014. Among all renovations in 2014, 62% are declared as EE (façade with isolation (17%), window replacement (38%), and attic isolation (7%)) and can be subsidised, while other 38% renovations not (façade without isolation (6%), and roof replacement (31%)). Twenty-six percent of the EE renovations were subsidised by Eco-Fund financial support. Preliminary results of the regression analysis have identified the potential drivers of EE investments. Among HH characteristics, income has a positive effect on EE renovations, while family size and structure (the number of HH's members, as well as the number of HH's members of age below 18 years) does not significantly impact EE renovations Regarding dwelling characteristics, HH living in older buildings and/or those with larger living area are more prone to invest than those living in more recent and/or smaller buildings. Living in a single family house is also positively correlated with investments in energy efficiency. However, although the larger surface area has a positive effect the corresponding expenditures for heating and electricity are not significant indicators. As expected, living in dwelling constructed in an energy passive way, decreases the likelihood of EE renovating. Regarding the type of the heating system, renovating rates are significantly lower for HH with central heating systems compared to those connected to a district heating system. It may be that HH with a central heating system can opt for the improvement/change of the heating system to achieve energy savings rather than to adopt a building retrofit, while those supplied by the district heating have only the latter option because they are obliged to pay the network charge even if they choose another heating device. Lastly, the probability of investing is also higher in urban and suburban areas.

Results of the regression analysis show a significant and positive effect of Eco Fund grants on HH renovation decisions for the period between 2010 and 2014. After the initial lag of two years, the estimated average marginal effects of grants rose progressively for two consecutive years 2012 and 2013, followed by a slight decrease in 2014. In further research, the model will be augmented by the inclusion of regional variables, (e.g. regional GDP and unemployment rates), and regional climate conditions to detect any differences among regions.

Conclusions

Results of the econometric analysis indicate that introduction of financial incentives may have important impact on future improvements in energy-efficiency of homes. It confirms the findings from the previous research (Hrovatin and Zorić, 2017) that the lack of funding appears to be among the principal barriers to EE HH renovations in Slovenia, so grants became a useful policy instrument to tackle financial constraints. In line with other empirical research, free-riders have also been detected in our study; however their share seems to be lower compared to other studies. Moreover, their share gradually decreases over the period. This analysis therefore provides a better insight to relevant determinants affecting renovation decisions and to the effectiveness of current energy policy instruments.

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