Renovation of multi-family houses in Switzerland: What are the reasons for the slow adoption of new energy-efficient technologies?

Master thesis - Nina Boogen, CEPE, ETH Zürich, nboogen@ethz.ch

Overview
The heating requirement of buildings makes up to 33% of the final energy consumption in Switzerland (Jakob 2006). Only 1-2% of the houses are renovated every year, of which only 30-50% carry out an energy-efficiency improving renovation of the building envelope (Banfi et al. 2008). In addition, in multi-family houses, mostly the owner is not the inhabitant himself. Therefore, the incentive for an energy-efficiency renovation is expected to be even smaller than in an owner occupied house, as the owner does not benefit directly from the investment himself. This phenomenon is called Principal-Agent (PA) problem. Besides this problem, there are several market failures in the market of energy-efficient technologies: missing or asymmetric information, positive and negative externalities, bounded rationality and public goods are involved (Brown 2001; Clinch & Healy 2000; Linares & Labandeira 2010; Sorrell 2004). The gap between the actual level of energy-efficiency improving renovations and the level of economically attractive energy-efficient renovations is called the energy efficiency gap (IEA 2007; Jaffe & Stavins 1994). In the building sector this gap could be significant: The heating energy demand could be reduced at least by 33% for the existing building stock (Jakob 2006). Many studies suggest that energy efficient renovations are economical attractive (Friedrich et al. 2007; Uihlein & Eder 2010), still the adoption rate is very low.

Method
The goal of this thesis is to identify barriers, which influence the decision for an energy efficiency renovation of the building envelope instead of merely doing maintenance work. Thus, two analyses were applied to data from Swiss multi-family-house owners; a descriptive analysis and an econometric analysis. The questionnaire was designed and carried out within the framework of the project “Advanced Energy-Efficient Renovation of Buildings” (Workpackage C2) by the Centre for Energy Policy and Economics (CEPE) and TEP GmbH (Banfi, Farsi & Jakob 2011).

With the econometric analysis six hypotheses were to be tested:

1. **Information failure**: A professional consultancy by an architect or an engineer increases the choice probability for an energy efficiency improving renovation.
2. **Principal Agent Problem**: Multi-family houses where the administration is done externally and the owner does not live in the house at the same time are less likely to undergo an energy efficiency renovation.
3. **Scale effect**: Houses with more flats are more likely to undergo an energy efficiency improving renovation. As the investment costs per flat are less in a house with more flats.
4. **Discounting**:  
   a. Multi-family houses owned by a highly educated person are more likely to undergo an energy efficiency improving renovation as the discount rates for highly educated people are smaller.
b. Multi-family houses with an older owner are less likely to undergo an energy efficiency improving renovation as the discount rate rises with the age.

5. Risk-aversion:
   a. Multi-family houses with a male owner are more likely to undergo an energy efficiency improving renovation, as women are more averse to risk.
   b. Multi-family houses owned by highly educated persons are less likely to undergo an energy efficiency improving renovation, as highly educated people are more averse to risks.

6. Location: Multi-family houses in different cantons have different probabilities to undergo an energy efficiency improving renovation, as cantons might have different energy policies and regulations.

For this, a binary logit model with single equation regression for each part of the building envelope (window, roof and façade) was applied. As dependent variable the binary choice of the decision for an energy-efficiency renovation or simple maintenance work was taken into account:

\[
y = \begin{cases} 
0 & \text{if overhauling} \\
1 & \text{if EE renovation} 
\end{cases}
\]

Consequently, the model will only include the subsample of people who have gone in for a renovation. The independent variables consisted of housing characteristics (e.g. age of the building, building type, the location of the building), socio-economic characteristic of the owner (e.g. age, education) and additional variables explaining the principal-agent problem and the market barriers. Thus, conclusions can be drawn about the factors that are inhibiting the full utilization of the efficiency potential.

Results

As main results in the descriptive analysis, yearly renovation rates for energy efficiency renovation between 1996 and 2010 were estimated at 3.9% for window, 1.01% for façade and 1.8% for roof. Whereas about 90% of the window renovations are energy efficient, for façades this share is only about 50% and for roofs about three quarter (see Figure 1).

![Figure 1: Type of renovation, multiple answers possible.](image-url)
Furthermore, the most important information sources were identified: Most of the respondents used a handyman or building contractor (46.8%), an architect or engineering office (36.1%) or a specialist planner (31.5%) as their primary information source. Only 7.7% of the owners used a public information centre or public utility as information source. This fact emphasises the importance of adequate education for professionals in this area in energy efficiency matters.

From the econometric analysis five findings follow:

1. (Filippini et al. 2011) reported that a professional consultancy by an architect, engineer, energy consultant or a public information centre could be an important factor to heighten the rate of energy efficiency renovations of single-family houses. The present econometric analysis suggests that this conclusion could also be valid for multi-family houses for all three parts of the building envelope. The positive association can be demonstrated through positive and significant coefficients of the consultancy by an architect or engineer. The question of whether or to what extent the estimated effect is biased by selection needs further research that is beyond the scope of this study.

2. For multi-family houses with an external administration and where the owner does not live in the house himself, the econometric analysis showed that such owners are less likely to choose an energy efficiency renovation. The façades of buildings with this combination are less likely to be renovated in an energy efficient way by 18.6% on average. This is suggestive evidence that the Principal Agent problem does exist, in the sense that the tenants might fail to reward, with higher rents, the owners who opt for an energy efficient renovation.

3. The more flats a building has, the lower are the costs of an energy efficient renovation per flat, and the more likely a decision for an energy efficient renovation becomes. This is supposed by the scale-effect. However, the number of flats is not significant in the three regression models. Therefore, the scale-effect could not be verified clearly.

4. Discounting rates and risk perception might be driving forces if an owner decides for an energy efficiency renovation. The socio-economic variables age, education and gender are thought to have an effect on personal discounting rates and risk perception. However, the socio-economic variables showed no clear sign and were barely significant.

5. Location seems to have an influence on façade renovations. Homeowners in Bern, Basel-Land and Thurgau seem to choose significantly more energy efficiency renovations of their façades than homeowners in Zurich. For roof and window no such effect could be observed. Whether this effect is caused by different regulations or funding policies, is not possible to say. Further research in this direction would be necessary.

Conclusions

In general two main obstacles for energy-efficiency renovations can be found: 1. Information and 2. Financing. If an owner is not sufficiently informed about economic attractiveness of an energy efficient renovation, the chances for this owner to conduct such a renovation are very low. To decrease this effect of a lack of information, public information centres and professional consultancy need to be promoted and all other sources of information should be increasingly sensitized on this topic.
Investments in energy-efficiency improving measures can be passed on to tenants by 50-70% according to the Swiss rental law (VMWG), whereas maintenance work can not be passed on to tenants, as it should be financed through rent incomes. However, in practice owners may not be sure whether they can fully recover their investments: The willingness to pay of the tenants must be high enough. This uncertainty of recovering the investment hinders the homeowners of taking action. And even if they can regain their expenses, an energy efficiency renovation needs high upfront investment, which may not always be affordable for an owner. Lacking investment is an important reason for both, not doing a renovation at all and just doing maintenance work instead of an energy efficiency renovation. In order to exploit the large reduction potential for energy demand in the building sector, both of these obstacles are important issues and should be tackled with corresponding policy measures. In doing so, particular attention should be paid to the Principal-Agent Problem.

References


