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Energy efficiency retrofits in the residential sector – analysing tenants' cost burden in a German field study

Ines Weber[a,b,*], Anna Wolff[a]

[a] Ludwig-Maximilians-University Munich, Faculty of Social Sciences, Institute of Sociology, Konradstraße 6, 80801 Munich, Germany
[b] Institut Wohnen und Umwelt (IWU), Rheinstraße 65, 64295 Darmstadt, Germany

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ABSTRACT

With the goal of reducing carbon dioxide emissions and curbing climate change, increasing the energy efficiency of buildings with energy efficiency retrofits is an important task. In Germany a large share of the residential building stock is rented. This comes with barriers to energy efficiency retrofitting due to split incentive problems. Alongside existing government incentive programmes, the German tenancy law allows landlords to add a maximum of 11% of the energy-related modernisation costs onto the annual rent. Studies evaluating the actual outcomes, from an energy as well as a social point of view, are rare. This article compares calculated theoretical heating energy consumption for prior to and after retrofit with actual consumption data after retrofit. Further, the issue of household expenses is addressed by comparing increased rental costs after retrofit with household's energy expenses prior and after retrofit. Despite a reduction in energy consumption of 70%, more than half of the households faced increased costs due to higher rents after retrofit. Even when increases in energy prices are taken into account, still one third of the households faced higher costs. For a fairer and more effective distribution of costs and benefits, this article stresses the importance of alternative financing models.

1. Introduction

In order to reduce greenhouse gas emissions in the residential sector, the German government aims to increase the rate of energy efficient renovations to 2% among other measures in the efficiency first initiative (Presse- und Informationsamt der Bundesregierung, 2011). Due to the lack of a clear definition for modernisation rates (Cischinsky and Diefenbach, 2015), the current rate of modernisation ranges from 0.2% with respect to a minimum of four energy refurbishment measures in a building (Rein, 2016) to 0.8% or 1% without further differentiation (Diefenbach et al., 2010; Presse- und Informationsamt der Bundesregierung, 2011). But energy policy also bears economic and social effects. In the case of retrofitting measures, it is stipulated by § 5 Section 1 in the Energy Conservation Act ("Energieeinsparungsgesetz" (EnEG)), that they have to be economically viable and housing should stay affordable. This is especially important, as a large share of the residential building stock is rented out rather than owner-occupied in Germany – but it is the landlords and housing companies who are the decision-makers when it comes to an energetic retrofit.

While efficiency measures are often considered as the method of choice to prevent energy poverty (Boardman, 1991; Brunner et al., 2012), they are also accompanied by problems such as "energetic gentrification" through an upgrade of neighbourhoods and accompanying increased rents, and thus a displacement of residents (Großmann et al., 2014). In Germany it is often claimed that retrofits should be designed "warmmietenneutral", which means that the increased rent is offset or even outweighed by the energy savings (BMWi, 2014). However, empirical assessment of energy efficiency retrofits from the tenants' point of view, which include the actual reduction in heating consumption, is rare (cf. Section 2). This paper aims to contribute to this field by presenting results from a case study of 10 retrofitted buildings from a social housing company in Germany. The study provided a unique occasion to gather data not only on planned energy reductions, but furthermore, actual consumption data of buildings and households over a period of six years. This data made it possible to compare actual consumption and costs of households prior to and after retrofit.

Deviations between the theoretical heating consumption, i.e. the calculated consumption based on standard assumptions, and the measured heating consumption, have been reported in expansive literature: next to faulty retrofit work or misconceptions in regard to the calculations of theoretical consumption, the heating behaviour of a household is also posited as a possible reason for the observed deviations (Calì et al., 2016; Galvin, 2013; Guerra-Santin et al., 2009; Sunikka-

* Corresponding author at: Ludwig-Maximilians-University Munich, Faculty of Social Sciences, Institute of Sociology, Konradstraße 6, 80801 Munich, Germany.
E-mail addresses: I.Weber@iwu.de (I. Weber), Anna.Wolff@soziologie.uni-muenchen.de (A. Wolff).

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Blank and Galvin, 2012). Therefore, data on the theoretical consumption of households both before and after a retrofit is assessed in order to analyse the extent to which the heating behaviour influences the consumption, and thus the respective heating costs.

The article is structured as follows. Section 2 introduces the energy efficiency policies in the German building sector and provides an overview of studies that assess the socio-economic impact of energy efficiency retrofitting. In order to take the deviation from the actual heating consumption to the theoretical heating consumption into account, we assess flat[1]-specific theoretical consumption. The respective methodological basis for this is explicated. Section 3 provides information on the data collected and the method used for the analyses of households' theoretical heating energy consumption, their actual individual heating consumption and cost burden prior to/after the retrofit. In Section 4 the empirical results of the case study are presented and analysed. Finally, the article concludes with policy implications in Section 5.

2. Background and literature review

2.1. Energy efficiency policies in the German building sector

Along with policy instruments from Denmark and the UK, the German CO_2 Building Rehabilitation Programme (CO_2-Gebäudesanierungsprogramm) is internationally recognised as a front-runner in the field (Murphy et al., 2012). Based on European guidelines from the European Parliament and Council Directive on the energy performance of Buildings (2010/31/EU), the legal framework in Germany to promote energy transition in the building sector is the Energy Conservation Act (EnEG). It serves to implement Federal Government decisions and also provides the legal basis for the amendment to the Energy Savings Ordinance (EnEV) (Federal Ministry for Economic Affairs and Energy, 2018). § 5 Section 1 in the Energy Conservation Act stipulates that energy efficiency retrofitting has to be economically viable and housing should stay affordable. The federal development bank (Kreditanstalt für Wiederaufbau (KfW)) operates the dominant policy instrument of the economic incentive programme. KfW loans and grants are coordinated with EnEV and are supposed to increase energy efficiency in existing dwellings. Funding is only granted by the KfW if the refurbished building consumes no more than 115% compared to the legal maximum primary energy demand for space and water heating of a new built EnEV reference building. Since the EnEV 2009, energy efficiency retrofitting is obliged to meet the existing mandatory minimum thermal standards for the renovation of existing homes whenever more than 10% of the building is repaired or replaced (e.g. work on the façade or windows) (§ 9 Section 3 EnEV). With regard to a retrofit of existing dwellings the programme comprises five different levels of loans –"KfW Efficiency House" 55, 70, 85, 100, 115 – as well as providing a loan for heritage buildings and loans for individual measures, such as a window replacement. The different levels correspond to the ambitiousness of the refurbishment: KfW Efficiency House 55 represents 55% of the maximum primary energy requirement, 115 represents the minimum standard to obtain funding (KfW, 2017).

Despite the funding programmes, the issue of who bears the costs and who benefits from energy efficiency retrofitting is recurrent. This is crucial in Germany as more than half of the residential buildings are rental units (Statistische Ämter des Bundes und der Länder, 2015). The issue of barriers to finance energy efficiency retrofits in rental units is discussed under keywords such as the agency problem, split incentive problem or principal-agent problem (Bird and Hernández, 2012; Gillingham et al., 2012; März, 2017; Renz and Hacke, 2017; Wood et al., 2012). These keywords refer to the situation in which the person making the investment to increase energy efficiency (landlord) is not the same person who benefits from it by the reduced energy costs (tenant). In order to facilitate and foster energy efficiency retrofitting, the German tenancy law allows landlords to allocate 11% of the modernisation costs onto the annual rent (§ 559 German Civil Code (BGB)). After landlords have allocated the maximum of 11% onto the rent, they are obliged to wait until the local rent level is reached. Once the rent is equal to the local rent index,[2] the landlord has no additional revenues to redeem the retrofit costs. In residential regions where the housing market is not as tense in comparison to many cities in Germany, this can lead to a situation in which landlords have no incentive to carry out costly energetic retrofits at all – as fewer tenants will be willing to pay the high rent in the first place (DENA, 2010).

2.2. Assessing the socio-economic impact of energy efficiency retrofitting

An energy efficiency retrofit can have beneficial effects on the indoor climate and health of all occupants, as indoor temperatures in the summer do not rise as high and the presence of draughts as well as cold surfaces are minimised due to the better insulation. Beyond these per se positive arguments when it comes to energy efficiency retrofitting, the issues of affordability and distribution of costs and benefits laid out in the previous section persist. Within this context the trends in fuel prices need to be taken into consideration. Compared to 1999, the price of heating oil, natural gas, electricity and district heating approximately doubled by the year 2017 (BMWi, 2018). As energy services have the perception of a necessary good (Schulte and Heindl, 2017), this increase puts households with low incomes and/or households living in homes with high heating energy consumption under financial pressure. Consequently, more attention is paid to the issue of fuel poverty. Fuel or energy poverty is associated with income poverty, bad housing conditions, a lack of thermal insulation of dwellings and consecutive problems such as health problems due to cold temperatures in the winter or high temperatures in the summer as well as restricted behaviour due to high energy bills (Dubois and Meier, 2016; Healy and Clinch, 2002; Hills, 2011).[3] Energy efficiency retrofits are often presented as one approach to reduce fuel poverty, as heating consumption, related CO_2 emissions and heating costs are reduced while independence from the effects of price fluctuations increases (Discher et al., 2010; Hills, 2011).

The economic viability of an energy efficiency retrofit is predominately analysed from an investors' point of view – i.e. for the house-owner living in the house, private landlords or housing associations. In this context the net present value (NPV) is the prevailing methodology for a cost-benefit analysis, in which the cost of the retrofit is compared with the long-term savings from the decrease in fuel consumption. Other parameters usually included are the technical life-time of the measures implemented, future maintenance costs, the expected annual energy price development, discount rate and inflation (Galvin and Sunikka-Blank, 2012; Henger and Voigtländer, 2012). The costs of energy-related modernisations vary tremendously and depend on the method of calculation as well as on the extent of measures taken (Henger and Voigtländer, 2012).

In the case of a tenancy, both the tenant and the landlord can benefit from the energy efficiency retrofit: by making the property

[1] The term flat in the context of this paper refers to a self-contained housing unit in an apartment building and is synonymous to the term apartment (American English).

[2] A local rent index („Mietspiegel") provides an orientation on the local rent level in the privately financed housing sector in Germany. The local rent index differentiates between municipalities, year of construction, equipment of dwelling etc. There is no obligation for a community to issue such a local rent index, thus not every community has one.

[3] There is an ongoing discussion about measures of energy poverty, for a detailed analysis see (Heindl and Schuessler, 2015).