

# ***HEATING ENERGY CONSUMPTION, ITS INTERDISCIPLINARY COMPOSITION WITH A FOCUS ON THE TIME DEPENDENCY OF THE PRICE ELASTICITY OF DEMAND***

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## **Overview**

A mix of influences that fall under different research disciplines determines private households' heating energy consumption (HEC). Because every discipline has its own tradition and terminology, combined approaches are scarce. This paper offers new insights into the mechanisms that determine HEC. The proposed theoretical model (see Figure 1) is based on the household production theory and integrates economic, engineering and behavioral aspects. Comparative statics enable an interdisciplinary integration of price- and income functions as an economic influence, the production function as a technical influence, and the utility-based choice architecture as a behavioral influence. Based on a functional derivation of this theoretical rationale, in the empirical part a panel data model of heating energy consumption is estimated. The empirical analysis is based on field experiment data from 60 apartments in South-West Germany monitored from 2011 to 2015.

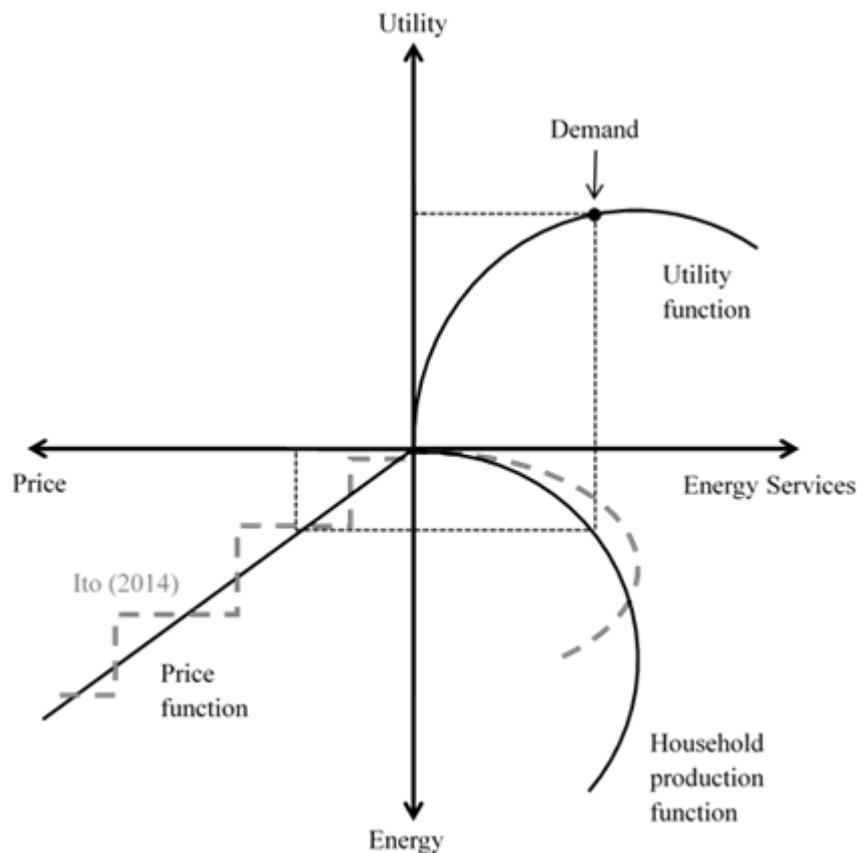


Figure 1: The theoretical HEC model.

The paper is organized as follows. In section 2, a literature review identifies developments to date of the academic discussion on the economics of HEC. In section 3, the theoretical HEC model applying the interdisciplinary rationale is described. Section 4 transforms the theoretical HEC model from section 3 to a mathematical representation of a utility-maximizing household. The results of an empirical panel regression

analysis of the price elasticity of HEC demand are presented in section 5. Section 6 discusses the results and combines the results obtained from the theoretical and empirical parts. Section 7 concludes.

## **Methods**

In the theoretical part of the paper, theoretic reasoning is used to develop the HEC model. Comparative statics give insights on the three different cause-effect relationships incorporated in the model. The empirical investigation of the field experiment data makes use of panel regression to address the research question on the time dependency of the demand of HEC.

## **Results**

Based on the theoretical rationale the interdisciplinary dependencies affecting private households' HEC behavior are mapped. Latest findings from the literature on household's price elasticity of demand are joined with the physiological properties of the human body, the physical determinants of the indoor environment and the psychological impacts affecting the household choice architecture. The model suggests a clear optimum in the household's choice of the indoor air and climatic conditions. The HEC model derived also enables to compare the empirically investigated households to other, differently situated empirical evaluations of households' HEC behavior.

Moreover, we find empirical evidence that the price elasticity of demand is only significant in yearly aggregated data.

Third, in relation to the other influences on HEC, the price impact is less pronounced than the impact of e.g. comfort conditions.

## **Conclusions**

The applied household production theory suits the research aim of describing households' HEC behavior well and establishes a framework to integrate and analyze different impacts from different research disciplines. The derived HEC model incorporates impacts from economics, engineering and psychology. The model enables a general overview on and interdependencies of the underlying mechanism driving HEC. Furthermore, empirical observations reviewed in accordance with the HEC model become comparable to differently situated empirical findings. Thus, the derived theoretical model delivers a universal framework to HEC.

The empirical results provide evidence that occupants do not act upon energy price signals following their daily heating routine. In less frequent considerations, occupants adjust their HEC with respect to the price influence. Based on the results, policy measures aimed at reducing HEC are advised to take the respective impact of the variables into account.

## **References**

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