Credit Constraints, Energy Management Practices, and Investments in Energy Saving Technologies: German Manufacturing in Close-up

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Overview

One of the main targets of current energy and climate policies is the increase of energy efficiency. Increasing efficiency of fossil fuel use offers potential economic and societal benefits through the reduction of costs, environmental damage, and import dependencies. Germany aims to nearly double its annual improvements in economy-wide energy productivity[1] to 2.1 percent. However, the German economy is currently not on the trajectory to reach this ambitious energy efficiency target. Official statistics show that energy productivity only increased by about 1.3 percent per year in the period from 2008 to 2015 (BMWi, 2016; Löschel et al., 2016). Consequently, the drivers of and the barriers to energy efficiency improvements have to be identified to increase overall energy efficiency.

This is especially true for the manufacturing sector, a large user of energy and an important cornerstone of the German economy. In 2014 it accounted for 30 percent of total final energy use and 22 percent of gross value added (BMWi, 2015). However, little is known about the underlying firms' investment behavior regarding energy saving technologies and the reasons for trailing the energy efficiency targets. In this context the economic literature shows that energy saving technologies, which promise considerable reductions in financial costs and environmental damage associated with energy use, may not be adopted by firms to the extent that might be justified, even on a purely financial basis (Gerarden et al. 2017). In Germany a portfolio of policy instruments has been implemented in order to incentivize the adoption of energy saving technologies. However, the effectiveness of these measures fell short of expectations. This shortcoming can be explained by the so-called energy efficiency gap. This gap arises as market failures or behavioral obstacles hinder firms from achieving their individual profitable levels of investments in energy efficiency (Gerarden et al., 2017; DeCanio, 1993).

The objective of our study is to shed light on the drivers and the barriers that influence investments in energy saving technologies by German manufacturing firms and to provide insights for the design of energy efficiency policies. More specifically, we analyze the relationship between financial barriers (e. g. credit constraints), information and knowledge (e. g. energy management practices), salience of energy-related topics, and investments in energy saving technologies.

Data & Econometric Model

We conduct a correlation analysis to investigate the decision to invest in energy saving technologies at the firm level by employing different linear and nonlinear regression models. Our empirical analysis utilizes two main data sources. First, we use data from structured telephone interviews that we conducted with managers from 701 randomly selected German manufacturing firms. This unique survey data contains information about the investments in energy saving technologies in production processes or buildings. Furthermore, it includes information on energy management practices and internal investment-related decision-making processes. Second, we merge this data with commercial microdata, which includes general firm characteristics from official sources as well as firm-level credit ratings from Germany's largest credit rating agency.

Utilizing this detailed data set, we are able to analyze two different investment categories of energy-saving technologies separately and jointly, i. e. for production processes and for buildings. The investment frameworks for both the categories differ from each other due to technological factors or the policy framework. Therefore, we conclude that the drivers and the barriers for each investment category are different. However, we can identify this heterogeneity utilizing the aforementioned data set. Furthermore, we contribute to the literature by using external credit rating data instead of self-reported information to determine the role of financial barriers. Thus, by applying objective data provided by Germany's largest credit rating agency, we can identify whether or not the financial barriers are important for the investment decision. Additionally, we provide a more up-to-date analysis of the energy efficiency gap analyzing German firms and also provide insights from the current policy framework for policy makers. Our analysis relies on representative survey data amongst German manufacturing firms. The discrete investment decision is analyzed using a probit model.[2]

Results & Conclusion

We find that credit constraints are barriers to investments in energy saving technologies which

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See footnotes at the end of text.

increase the energy efficiency of the firms' production processes and that energy management practices increase the probability of investing in energy efficiency of their production processes. The most important management practice is the implementation of energy consumption targets by firms. However, as our analysis shows, the probability of investing in energy efficiency is higher if there are two or more energy management practices implemented. In Figure 1, the relationship between the predicted probabilities of investing in energy saving technologies and the firm's credit rating is shown.

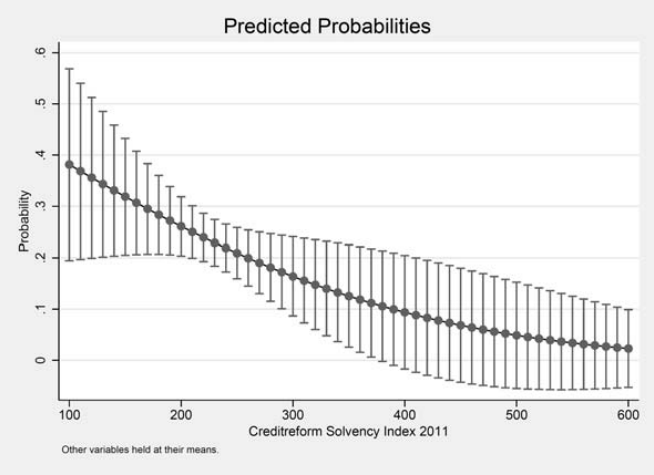

Figure 1: Credit constraints
Notes: A Credit Solvency Index of 100 indicates very good solvency; an index of 600 indicates very high risk.

Furthermore, investments in the energy efficiency of buildings are also positively influenced by the implementation of energy management practices. For buildings, the important management practices are the assessment of the energy efficiency potential and energy management systems. Again, two or more practices significantly increase the probability of investing as compared to just one or no implemented management practices. The higher the energy cost shares of heating or cooling and the energy intensity of firms, the higher is the propensity to invest in energy efficiency. In addition, energy self-generation by firms as well as structured internal decision-making processes positively influence the investments in energy efficiency. The investments in energy saving technologies increasing the energy efficiency of buildings are not correlated with the firms' credit ratings.

An overview over our results can be found in Table 1. The heterogeneity in our results for the different investment categories (production processes and buildings) calls for a targeted analysis of investments in energy saving technologies and the implementation of tailored policy instruments for different investment categories.

Footnotes

[1] Energy productivity is defined as price adjusted gross domestic product divided by total final energy consumption.

[2] Additional analyses can be found in the discussion paper version: Löschel, Lutz, and Massier (2017). These include the combined estimation of the investment decision and the investment volume, applying two-part and Heckman selection models.

References

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Category	Factor	Influence on propensity to invest in energy saving technologies	
		production process	buildings
Financial barriers	Credit rating	-	.
	Investment subsidies	.	.
Information & knowledge	Energy management practices	+	+
	Decision-making processes	.	+
Salience & awareness	Energy intensity	.	.
	Share of heating or cooling in energy costs	-	+
	Buildings' ownership		.
	Energy self-generation	+	+

Table 1: Influencing factors for firms' investment decision on energy saving technologies
Notes: A positive (+) (negative (–)) sign indicates that the factor has a positive (negative) statistically significant correlation with the probability of investing. (.) indicates no statistically significant result.