EFFECT OF ENERGY AUDITS ON THE ADOPTION OF ENERGY EFFICIENCY MEASURES

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Overview

Energy audits are typically expected to accelerate the diffusion of energy efficency measures by informing potential adopters about about technology options and related energy costs avings, in particular. Yet the empirical evidence on the effectiveness of energy audit programs is scarce and mixed. Most studies refer to the residential sector (e.g. Hirst and Goeltz 1985; Frondel and Vance, 2013; Murphy 2014) and only few refer to companies (e.g. Hirst et al. 1981). Typically, though only a portion of the measures recommended in audits actually gets implemented (Andersen and Newell 2004, Fleiter et al. 2012). Most evaluations rely on surveys involving respondents' subjective responses. Thus, the estimated effects may suffer from social desirability and other biases. Arguably for lack of data (heterogeneity of measures and companies), no evaluation has so far relied on a comparison with a control group.

In this paper we empirically analyse the impact of an energy audit programm in Germany on the adoption of efficiency measures in small enterprises. Since the EU Energy Efficiency Directive 2012/27/EU requires all Member States to introduce similar audits, our findings should also be of interest to policy-makers in other countries.

Methods

Our evaluation relies on data from two surveys, which were carried out in Germany at about the same time. The treatment group data includes responses from companies participating in an energy audit program. The energy audits are subsidized under the German energy audit program for small and mediuim sized companies. Our control group consists of companies participating in a representative energy use survey in the German tertiary sector, which also includes small companies from the commerce and industry sectors. To allow for comparable data sets, we restrict observations to small companies, i.e. to companies with less than 50 employees. To allow for meaningful comparisons both surveys contain identical questions on the adoption of four generic energy efficiency measures, which are typically recommended in energy audits: lighting replacement (lighting), thermal insulation of the building (insulation), replacing the heating system (heating) and optimization of the heating system (heating optimization).

To estimate the effects of audits on technology adoption in the audit group (i.e. the average treatment effect on the treated ATT) we employ propensity score matching estimators, relying on more than 500 observations in the audit (treatment) group and control group each. The matching estimators assume unconfoundedness, i.e. selection into the audit program relies on observables. Audit participation is modelled via logit model, where the covariates include the energy cost share, the number of employees (size), whether the company has an energy manager, whether the company is a subsidiary, as well as sector dummies reflecting cross-sectoral heterogeneity.

Results

Table 1 first presents the results for the propensity score estimator with one nearest neighbour [nn(1)]. The adjacent column presents the findings when an audit group company is matched with four nearest neighbours [nn(4)]. The third set of results in Table 1 show the results for the Kernel estimator.

Table 1. Audit effects (in percentage points)

		Propensity score estimators				
Measure	Group	N	nn(1)	nn(4)	N	Kernel
lighting	audit	575	20.74 ***	18.61 ***	582	20.73 ***
	control	585			585	
insulation	audit	598	11.18 ***	9.86 ***	601	10.52 ***
	control	589			589	
heating	audit	530	5.94 *	8.00 **	572	9.54 ***
	control	509			509	
heating optimization	audit	564	26.95 ***	27.66 ***	607	28.81 ***
	control	517			517	

Note 1: *** indicates significance at p<0.01, ** indicates significance at p<0.05 and * indicates significance at p<0.1 in an individual two-tailed t-test.

Note 2: Sample sizes for nn(4) are the same as for nn(1).

Conclusions

Based on non-parametric matching analyses we find that the German energy audit program accelerated the adoption of four generic energy efficiency measures in small companies. In absolute percentage terms, the estimates for the ATT are highest for the lower-cost measures considered, i.e. lighting (20 percentage points) and heating optimization (28 percentage points) and lower for the higher cost measures thermal insulation (11 percentage points) and exchange of the heating system (6-10 percentage points). In relative terms, the energy audits roughly double the adoption rates of lighting, thermal insulation and heating replacements, and almost quadruple the rates for heating optimization – a measure that may more likely be overlooked by non-energy experts than the other three generic measures. These findings also suggest that the effectiveness of energy audits vary by technologies. Thus, using program effectiveness indicators like 'the number of additional measures induced by an energy audit' are likely to be misleading. The matching algorithms applied produce fairly robust results, in particular for lighting, insulation and heating optimization. Yet we cannot rule out that the remaining (slight) differences in some covariate means after matching lead to inconsistent propensity score matching estimates of the ATT, in particular for heating.

While we find audits to significantly increase adopton rates of four generic energy efficiency measures, the adoption rates may be below those recommended by the energy audits. Thus, barriers which are not related to lack of information may prevent adoption of these measures (e.g. Anderson and Newell 2004; Schleich and Gruber 2008; Fleiter et al. 2013; Cagno and Trianny 2014). Our estimates are conservative in the sense that we did not include measures that companies had planned to implement prior to the energy audit. However, since audit participation is not random and arguably subject to self selection, unobserved heterogeneity of the propensity to participate in the energy audit may also affect the propensity to adopt the energy efficiency measures. In this case, our findings would overestimate the effectiveness of the energy audits.

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