SPLIT INCENTIVES, IMPERFECT INFORMATION AND ENERGY EFFICIENCY SUBSIDIES

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Overview

Market failures such as externalities and information problems are important causes of underinvestment in energy efficient technologies by economic agents (Gerarden et al., 2017). Governmental subsidy programs target the market failure caused by externalities and measuring the cost-effectiveness of these programs is already studied in previous papers (Gillingham et al., 2018). However, it is not yet clear how information problems such as split incentives and asymmetric information impact the effectiveness of these programs. This is nevertheless an important consideration, as the statutory incidence of energy efficiency subsidies for buildings falls on the end user instead of the investor in case a building is built by a developer. This does not matter in case both parties are fully informed. Yet, when information is asymmetric statutory incidence does matter and this could significantly affect investment decisions.

In this paper we therefore examine whether and to what extent split incentives affect the cost-effectiveness of a tax reduction for residential energy efficiency investments in Belgium. Homeowners received a reduction in the property tax of 20% to 40% for ten years if the energy efficiency level of their dwelling reached a specific threshold. Both owner and developer-built dwellings were eligible, but the tax reduction was passed down to the buyer for the latter group.

We exploit the discrete jump that this reduction creates to credibly identify the number of bunched dwellings and the average reduction in their energy efficiency level. We compare results between owner and developer-built dwellings to examine how information problems affect the subsidy program. The results in this paper show that split incentives and asymmetric information can significantly reduce the cost-effectiveness of such programs.

More specifically, we find that 89% of the dwellings are inframarginal in the full sample. This means that only 11% of the dwellings obtained a more performant energy efficiency level than they would've gotten in the counterfactual scenario without energy efficiency subsidies. Assuming an average lifespan of 15 years for the investments, this means that the tax reduction reduced energy use at a cost of 0.46 euro per kilowatt-hour. However, the results for the full sample hide a stark difference between the owner and developer-built sample. The cost per kWh is equal to 2.71 euro in the latter sample, seven times larger than the cost of 0.37 euro found in the sample of owner-built dwellings.

Methods

We use a dataset that contains the universe of energy efficiency declarations for buildings in Belgium. The energy efficiency level is denoted in E-levels with a lower E-level corresponding to a building with a higher energy efficiency. The subsidy program is only applicable for residential dwellings and we restrict the dataset accordingly to 87,108 observations.

Furthermore, we obtained access to the addresses related to each declaration. We use the addresses to make a distinction between owner and developer-built dwellings. We consider two or more dwellings as a development project if the dwellings are located in the same street and the construction permit applications are filed the same day. For 54,684 dwellings or 63% we found this to be the case.

We need to credibly estimate the number of dwellings of which the energy efficiency level has been improved due to the tax reduction and by how much the energy efficiency increased. We follow the bunching approach developed by Kleven and Waseem (2013) to estimate the counterfactual distribution of energy efficiency levels as follows:

$$n_j = \sum_{i=0}^{p} \beta_i (E_j)^i + \sum_{k=L}^{U} \gamma_k \mathbb{1}(E_k = E_j) + \epsilon_j$$

The dependent variable n_j is the number of dwellings at each E-level. The first term on the right-hand side denotes a p-th degree polynomial in E-level, while the second term is a set of dummy variables for each unique E-level in the excluded region.

First, the number of dwellings that bunch below the threshold is equal to the difference between the observed and counterfactual number of dwellings at each E-level in the excluded region at and to the left of the threshold:

$$\hat{B} = \sum_{j=L}^{T} (n_j - \hat{n}_j) = \sum_{j=L}^{T} \hat{\gamma}_j$$

Second, we can compute the average reduction in the E-level of dwellings that bunch below the threshold as follows:

$$\Delta\hat{\hat{E}} = \frac{1}{\hat{B}} \left[\sum_{j=L}^{T} \hat{\gamma}_j (E_T - E_j) + \sum_{j>T}^{U} \hat{\gamma}_j (E_j - E_T) \right]$$

Where the first term between brackets at the right hand side is the total decrease in E-points beyond the threshold and the second term is the total decrease in E-points up to the threshold.

Results

We find that 2,105 additional dwellings bunched at the threshold. This is only a small fraction of dwellings below the threshold, which results in 89% of dwellings being inframarginal. These units would have had the same energy efficiency level if the tax reduction had not been introduced. The E-level of the dwellings that did bunch below the threshold was reduced with 5.50 E-points on average. This constitutes a decrease in expected annual energy use of approximately 9% for these units. The program led to a reduction in the expected annual energy use of approximately 5,4 million kilowatt-hour for a total cost of 31 million euro. The cost per kilowatt-hour saved ranges from 0.65 to 0.36 euro, depending on whether the lifespan of the energy efficiency investments is 10 or 20 years.

The results for the full sample, however, hide a stark difference in the response of developers and owners that built their dwelling without a developer intervening. The share of inframarginal dwellings is ten percentage points higher in the former group (97% vs. 86%), while the average reduction in the E-level is about half the size (2.23 vs. 5.12 E-points). The much higher inframarginal use and smaller reduction in the E-level results in a cost per kWh saved that is seven times larger for developers (2.71 vs 0.37 euro).

Conclusions

These findings indicate that, contrary to owners, developers did not respond to the property tax reduction. We attribute this difference in the response to a principal agent problem caused by imperfect information at the buyer side. Households were not aware of the property tax reduction. Demand for dwellings that were eligible for the tax reduction did not increase as a result and developers therefore did not increase supply. The findings in this paper show that this mechanism can reduce the cost-effectiveness of subsidy programs significantly. A back-of-the-envelope calculation shows that the program's cost per kWh saved would have been one-third lower if the share of inframarginal dwellings would be as low in the developer-built as in the owner-built sample.

References

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