RESIDENTIAL ENERGY EFFICIENCY AND EUROPEAN CARBON POLICIES: A CGE-ANALYSIS WITH BOTTOM-UP INFORMATION ON ENERGY EFFICIENCY TECHNOLOGIES

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Overview

Ambitious energy efficiency goals constitute an important part of the EU's road to a low carbon economy. While the introduction and reformation of energy policy instruments take place rapidly, the knowledge of how several energy policy instruments and goals interact lags behind. Recent studies have revealed that the targets and policy instruments are partly overlapping and contradicting (Böhringer and Rosendahl, 2010; Huntington and Smith, 2011; Aune et al., 2012; Flues et al., 2014). The main lessons learned from these studies are that carbon taxation is much more efficient to curb carbon emissions than energy efficiency policies, while the reduction in energy use is larger with energy efficiency measures compared to carbon taxation. With carbon taxation the possibility of substitution between fuels gives less reduction in energy use, but larger reduction in carbon emissions. However, the knowledge of energy efficiency policies interact with other instruments is still scarce.

In this paper we analyse two issues: what is the effect of energy efficiency targets for residential energy use and how do these targets interact with carbon policies. Our example economy is Norway, a small open energy-producing economy with ambitious energy efficiency and climate policy goals as the EU. We scrutinise two different interpretations of the 2030 energy efficiency ambitions: a cap on residential energy use and a cap on residential energy intensity. The main focus in our analysis (Bye et al., 2015) is the so-called rebound effect, i.e., counteracting effects on energy use caused by energy efficiency efforts. Saunders (2015) recommends computable general equilibrium (CGE) models as the most suitable tool for studying rebound effects of energy efficiency policies, as they are able to take into account general productivity growth as well as various market interactions and rebound effects. By means of CGE analysis we consider rebound effects, economic welfare costs, as well as the effects on economy-wide CO_2 emissions.

Methods

We combine an economy-wide perspective, as captured by a CGE model for Norway, with bottom-up information on costs and potentials for investing in energy efficiency technologies in residential buildings. The latter is based on detailed information of energy investment possibilities derived from the bottom-up model TIMES-Norway (Lind and Rosenberg, 2013; Rosenberg and Espegren, 2014).

Results

First, the analysis confirms that instruments designed to save energy are ineffective in abating CO_2. The results are even more pessimistic: Energy efficiency policies increase the CO_2 emissions and when applied simultaneously with carbon pricing, the problem is aggravated. The main explanation is the high share of electricity in total energy use. As households reduce electricity use, energy-intensive trade-exposed (EITE) industries expand. Even if the energy use in the EITE industries is also primarily electricity, they have substantial process emissions. As opposed to most CGE studies, we account for such CO_2 emissions.

Second, the energy restrictions posed on households are costly: the shadow price corresponds to an equivalent electricity tax of around 200%, depending on the policy design. In addition, welfare costs are reinforced as the expanding EITE industries are relatively unproductive. This arises from the relatively low carbon prices faced by the EU ETS emission sources compared to non-EU ETS emission sources, and also from other concessional terms enjoyed by the EITE industries.

Third, a cap on residential energy intensity is a more stringent regulation than a cap on residential energy use, with higher welfare costs.

Conclusions

The study finds that energy efficiency policies increase CO_2 emissions, and simultaneously introducing carbon pricing only aggravates the problem. The main explanation is the high share of electricity in total energy use in Norway. Energy use in dwellings is almost entirely based on electricity. As households reduce electricity demand, energy-intensive and trade-exposed industries (the EITE industries) can access electricity and other resources at lower prices. Rebound effects within households are small, but economy-wide, indirect rebound is significant because the EITE industries expand. The economy-wide rebound effect is in the middle of previous findings (Gillingham et al., 2013).

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