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Analysis

Energy Burden Alleviation and Greenhouse Gas Emissions Reduction: Can We Reach Two Objectives With One Policy?

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ABSTRACT

In this article, we assess French current public policies designed to reduce greenhouse gas (GHG) emissions and abate household energy burden, through a simulation of changes in residential sector characteristics over the long run. We build on an existing partial equilibrium model to take into consideration key determinants of excessive energy burden among vulnerable households. This analysis reveals that current public policies are not sufficient to reach the ambitious objectives for reducing energy consumption and GHG emissions in France. Moreover, the decreases that might occur mask significant social disparities across households. The joint implementation of multiple instruments leads to interactions that diminish overall policy outcomes. Overall, current public policies produce estimated free-riding rates of 75%. Energy efficiency measures are thus insufficient in themselves; the government should focus more on monetary poverty as a cause of low home improvement rates and consider subsidizing renovation costs as a potential solution.

1. Introduction

To address the issues of household energy burden, energy over-consumption, and greenhouse gas (GHG) emissions in the residential sector, European countries, and France particularly, have initiated several policy instruments since the beginning of the 2000s. Most of these tools aim at promoting thermal renovation in the residential sector. Our research objective is to understand the consequences of these public policies for energy burden and GHG emissions, especially among low-income populations. We also hope to provide policy recommendations that allow for a decrease in GHG emissions but would also lead to a decrease in other public expenditures and thus help low-income households in the future.

For about twenty years, the energy burden of vulnerable households has become a social concern in many European countries, demanding as much attention from policy makers as the environmental effects of energy over-consumption (Bouzarovski et al., 2012; Brunner et al., 2012; Dubois, 2012; Moore, 2012). Energy burden is generally measured as the ratio of energy expenditures to household income (Hills, 2011, 2012; Palmer et al., 2008). Among other indicators, excessive energy burden is a proxy of fuel poverty, a situation in which households suffer thermal discomfort (Legendre and Ricci, 2015) due to the inability to sustain an adequate level of warmth and comfort at a reasonable cost (Boardman, 1991, 2004; Lewis, 1982; ONPE, 2014). For this study, we consider that households suffer from energy burden when their energy-income ratio is greater than >10%, as often seen in definitions of fuel poverty (European Fuel Poverty and Energy Efficiency, 2006; Hills, 2011). Recent studies estimate that energy burden affects 150 million people in the European Union alone (Bird et al., 2010). These households often live in poorly insulated housing but are unable to improve the energy efficiency of their homes. The resulting over-consumption of energy, together with insufficient thermal comfort, leads to massive energy waste and significant environmental consequences over times.

Public policies to overcome energy burden are expensive and potentially unsustainable if they fail to tackle the structural problem of poor housing insulation. For example, in 2010 the United Kingdom provided 4.2 billion euros worth of winter fuel and cold weather payments to residents, while the United States offered the equivalent of 1.8 billion euros and Ireland provided 0.3 billion euros (Heffner and Campbell, 2011). To

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achieve more effective energy policies while also determining their effects on populations, governments need to take a closer look at low-income households in particular, to identify how their housing quality, energy use and energy burden differs from that of other segments of the population (Castaneda and Lindert, 2005; Dubois, 2012; Morestin et al., 2009). However, housing policies that support disadvantaged families rarely account for the economic challenges associated with energy use and utility consumption.

In France, between 2005 and 2010, more than 5 million primary residences benefitted from tax credits encouraging energy-saving renovations, at a significant total public cost of 12 billion euros over this five-year period (Clerc et al., 2010). An additional 10 billion euros were allocated to the Energy Transition Law. Despite these efforts to increase energy efficiency, one-fifth of French households still struggled to pay their energy bills in 2014 (ONPE, 2014). Thus, we need to assess existing policies and consider how they might be improved to relieve low-income households of energy burdens in the long term (Hernàndez and Bird, 2010).

The aim of this paper is to assess the effect of several public fiscal policies on energy consumption, GHG emissions and energy burden in France through a simulation model that runs until 2050. We construct a bottom-up model, calibrated with French data, that allows us to determine the type of renovations chosen by a given household among a combination of 35 renovations for a given year, from 2006 to 2050. The decision to renovate is endogenous and depends on the household's profile (notably income quintile) and type of dwelling. The renovation's impact on energy consumption, GHG emissions and energy burden is assessed each year. We also take into account what happened the previous year; the decision in year t has an impact on year $t+1$. We calibrate the model with parameters to study what would have happened without the introduction of a public policy, and to introduce shocks over time. Finally, we consider the evolution of household energy mix, income quintile trends and energy costs through a sensitivity analysis. We find that current public policies encourage households to undertake energy efficiency investments, but (i) they are not sufficient to reach the ambitious objectives for reducing energy consumption and GHG emissions in France and (ii) the policies mask significant social disparities across households.

In Section 2, we present how the article aligns with and adds to the existing literature. In Section 3, we describe current French residential energy policies to address the questions of energy burden, energy consumption and GHG emissions. In Section 4, we build on an existing partial equilibrium model (Charlier and Risch, 2012) to assess the effectiveness of these public policies in the long run. In Section 5, we outline the results, before we conclude and give some policy recommendations in Section 6.

2. Literature Review

The issue of fuel poverty in France has been the subject of recent studies, including an article suggesting that fuel poverty affects between 9% and 20% of French households (Legendre and Ricci, 2015). This situation cannot be attributed solely to insufficient household income. High energy costs and the poor energy efficiency of a significant portion of available residences increase the prevalence of fuel poverty and excessive energy burden (Brunner et al., 2012; Santin, 2011). The situation is thus suboptimal, both socially and environmentally.

There is a substantial body of literature on the effect of various residential energy policies on French household energy consumption and GHG emissions (Charlier and Risch, 2012; Giraudet et al., 2011; Mauroux, 2012; Nauleau, 2014); this literature finds that some households make energy-saving investments, but others free-ride on those efforts. Most studies find that the joint implementation of multiple instruments can lead to interactions that augment or diminish overall policy outcomes (Bennear and Stavins, 2007). Vona and Patriarca (2011) use a dynamic model to show that excessive inequality among households hinders the development of environmental technologies, especially in rich countries. Finally, Büchs and Schnepf (2013) examine whether the association between emissions and household characteristics varies for different types of emissions. They show that the distributional implications of mitigation policies that aim to create financial (dis)incentives are likely to differ across income groups. We therefore explore what policy instruments might be the most effective for simultaneously achieving both social and environmental objectives, as mentioned, for example, by Druckman and Jackson (2010). In their study, they develop a Reduced Consumption Scenario for the UK, constructed by assuming that all households achieve a specific 'minimum income standard' deemed to provide a decent life and thus argue that significant reductions in GHG emissions could be achieved without jeopardizing social well-being.

Other studies focus specifically on the impact of public policy on GHG emissions in France. Crassous et al. (2006) and then Sassi et al. (2010) present a recursive dynamic framework in which they postulate that endogenous technical change is a result of the interplay between the driver of economic growth, consumption, technology, and localization patterns. Their model (IMACLIM-R) stresses that (i) induced technical change triggers induction of energy demand and (ii) the increased energy bills hamper sector profitability and constrain household budgets. Finally, Giraudet et al. (2011) develop a hybrid framework (Res-IRF coupled to IMACLIM-R) to assess future residential energy demand in France using a bottom-up module of energy consumption for space heating. In addition, they distinguish investment in energy efficiency from changes in the utilization of energy-consuming goods. They obtain a 37% reduction in final energy demand achievable with business as usual in existing dwellings and demonstrate that an additional reduction of 14% could be reached if barriers to investment were overcome. Although Giraudet et al. (2012) consider heterogeneity between consumers in their study, they consider neither energy burden nor household capacity constraints.

A thorough assessment of residential energy policies on both energy-efficiency investments and energy burden using a simulation model must ideally be based on data encompassing a broad scope of variables. They would include a set of predetermined variables (regardless of the type of investment option) reflecting the socioeconomic characteristics of households, housing tenure, income quintile, dwelling type, energy-relevant equipment features and quality, as well as energy expenditures. Another set of variables would concern potential energy-efficiency (EE) investment options: the list of technical options and, for each option, the cost, equipment quality, energy savings in physical units and expected energy prices to compute expected savings on energy expenditures. Finally, there should be a set of financial variables, including the capacity constraints on investing, the amount spent and access to capital. Very few simulation models provide the means to perform an assessment including all these parameters.

In this paper, we extend an existing simulation model (Charlier and Risch, 2012), diverging from the initial model by distinguishing households by income quintile in order to take into account all the parameters mentioned above by household income level. The model thus now considers energy burden and its key determinants in order to simulate the effect of public policies aiming specifically at households with a high energy-income ratio (e.g., social energy tariffs and vouchers). In this new version of the model, we can run simulations by type of dwelling as well as household profile. It is now also possible to analyze the decision to invest in each type of energy-saving renovation (35 possible combinations) according to housing tenure, debt ratio and borrowing power according to household income quintile. This extension affects all the model's equations (obsolescence of housing stock, renovation decisions and housing stock dynamics).

This extension of the model allows us to study which kind of public policy is most effective in decreasing energy consumption, GHG emissions and disparities across households in terms of energy burden: environmental measures that aim to induce energy-saving household