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The distributional effects of a carbon tax and its impact on fuel poverty: A microsimulation study in the French context

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ABSTRACT

This paper studies the distributional effects of France's recently introduced carbon tax. Using a microsimulation model built on a representative sample of the French population from 2012, it simulates the taxes levied on each household's consumption of energy for housing and transport. Without revenue recycling, the carbon tax is regressive and increases fuel poverty. From a policy perspective, this finding indicates that the question of fuel poverty cannot be ignored in the quest for a fair ecological transition. It proposes that some of the revenues from the carbon tax should be redistributed to households. Different designs of cash transfer to support households are then compared. The results show that the inequities of the carbon tax could be offset at reasonable cost relative to total carbon tax revenues. However, adjusting the design of cash transfers to criteria other than income level does not diminish the cost of compensating households. The benefits of finely adjusting cash transfers may therefore be somewhat limited. Most notably, the results show that targeting revenue recycling at low-income households would help to reduce fuel poverty substantially. This study therefore indicates that carbon taxation actually provides an opportunity to finance ambitious policies to fight fuel poverty.

1. Introduction

This paper aims to explore the distributional effects of the recently introduced French carbon tax and to design compensatory measures that restore social equity across households. The level of the carbon tax increased from €7/tCO_2 in 2014 to €30.5/tCO_2 in 2017, and the energy transition law (2015) provides for the carbon tax to rise to €56/tCO_2 in 2020 and €100/tCO_2 in 2030 in order to meet our climate objectives.[1] In the long-term, the carbon tax should lead to a fall in energy consumption and spending, but during the transition to a low-carbon economy, its consequence for households will be to raise costs for heating and mobility. Taxing carbon increases the cost of fossil fuels, an increase that firms are likely to pass on to consumers in the form of higher prices. This produces a decline in purchasing power that is likely to affect households in their day-to-day practices. Moreover the burden it places on household budgets is expected to be greater for low-income households and those with limited choices (Parry et al., 2005; Fullerton, 2008), for example households with poorly insulated homes or with no alternative to car use. Because they may not have the capacity to adjust their energy consumption, sections of the population are likely to face difficulties in meeting their energy needs. This phenomenon – called fuel poverty – is gaining momentum in France (Charlier et al., 2016; Legendre and Ricci, 2015), and more broadly in Europe (Derdevet, 2013; Bouzarovski et al., 2012; Thomson and Snell, 2013; Guyet, 2014). In France, the Grenelle 2 Act (2010) defines people as living in fuel poverty if they "*experience particular difficulties in obtaining the supply of energy in their homes required to meet their basic needs because of the inadequacy of their resources or of their living conditions*".[2] The number of households in fuel poverty in France rose by 17% between 2006 and 2013, and it now affects more than 20% of households, according to the French National Fuel Poverty Observatory (ONPE, 2016). In light of this, it is essential to ensure that the carbon tax will not further exacerbate the problem of fuel poverty.

Microsimulation modelling is particularly relevant to the analysis of the distributional impacts of certain public policies and tax reforms (Merz, 1991; Spadaro, 2007; Bourguignon and Spadaro, 2006). It is a popular tool for evaluating the distributive impacts of energy/carbon taxation. Most energy/carbon taxes appear to be regressive, as low-income households generally spend a larger share of their income on energy. Yet some studies qualify this result (Parry et al., 2005;

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[1] For comparison, in 2016, about 19 countries had implemented a carbon tax or scheduled one for implementation. Their amount varied between US$137/t$CO_2$e (€118/t$CO_2$) for Sweden to less than US$1/t$CO_2$e (€0.9/t$CO_2$) for Mexico.

[2] https://www.legifrance.gouv.fr/eli/loi/2010/7/12/2010–788/jo/texte.

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Table 1
Review of existing micro-level studied on French data.

Authors	Year of study	Country	Income measurement	Scope of the tax	Behavioural responses	Revenue recycling
Nichèle and Robin	1995	France	Total consumption	"Heat and lighting" and "Purchase and use of vehicles"	Yes (uniform)	No
Ruiz and Trannoy	2008	France	Disposable income	Total consumption affected by VAT and excise duties, including on fuels (TIPP)	Yes (uniform)	Yes
Berri et al.	2014	France	Total consumption	"Private transport" and "Public transport"	No	No
Clerc and Marcus	2009	France	Disposable income	Domestic energy, Fuels	Yes (differentiated)	No
Bureau	2011	France	Disposable income	Gasoline, Diesel	Yes (differentiated)	Yes
CGDD	2016	France	Disposable income	Network gas, Heating oil, Gasoline, Diesel	No	No

Fullerton, 2008). A review of existing literature shows that the observed differences can in part be explained by the modelling choices. Before the recycling of tax revenues and on the basis of annual income, most environmental taxes appear regressive. However, when the use of permanent income, the impact of the price of goods for which energy is an input, the impact of income factors and the recycling of tax revenues are taken into account, the level of regressivity is found to be mitigated (Poterba, 1991; Hassett et al., 2007) Behavioural modelling leads to more mixed results depending on the sensitivity to energy prices of poor households relative to rich households (Grainger and Kolstad, 2010) (Beck et al., 2015; Rausch and Schwarz, 2016; West and Williams, 2004). An increasing number of studies also discuss in more detail the relative impact of different revenue recycling options: lowering pre-existing taxes, increasing pre-existing social transfers, or introducing differentiated and/or targeted cash transfers (Labandeira et al., 2006; Brännlund and Nordström, 2004; Wadud et al., 2009; Callan et al., 2009). Results tend to differ according to the precise design of the taxes and/or transfers considered for recycling.

To my knowledge, at the time of writing, there exist six published micro-level studies based on French data (Table 1) (West and Williams, 2004; Brännlund and Nordström, 2004; Cronin et al., 2017; Clerc and Marcus, 2009; Bureau, 2011; CGDD, 2016). Analysis of these studies confirms the regressive nature of an energy or carbon tax in the French context, in the absence of any revenue recycling. This review raises three points on which there is no consensus or which have not been dealt with in France, which this paper will address. First, transport fuel consumption has spread across income deciles in recent decades, and it may be that there have been changes in the relative regressivity of taxing carbon on transport fuels and on domestic energy. Second, to date, these studies have focused on regressivity and may neglect losers among households with similar incomes. In particular, none has addressed the impact of an energy/carbon tax on fuel poverty, and one can ask to what extent the carbon tax could push households into this condition. Third, there is still debate in France over the use of carbon tax revenues, and there are questions to be asked about how much revenue recycling is needed to compensate households for the negative impacts of the carbon tax.

The objective of this paper is twofold. Firstly, I measure the distributional impacts of taxing carbon on households' direct energy use for housing and transport. In particular, I quantify the regressivity of the carbon tax and the increase in fuel poverty associated with it. To do this, I developed a microsimulation model to evaluate fiscal policies that affect energy taxes in France, including the carbon tax. It simulates the impact of the carbon tax at the individual household level and enables its distributional consequences to be accurately assessed. The model is built on the Phebus survey (2012), which provides the most recent and detailed data available in France on energy consumption both for housing and transport. Secondly, I look at how households can be compensated by redistributing carbon tax revenues through cash transfers. I design several alternative scenarios in order to assess which are the most effective in correcting the inequities found and, in particular, in offsetting the regressivity of the carbon tax and in reducing its impact on fuel poverty. I quantify the cost of these measures in terms of the carbon tax revenues collected. One of the originalities of this paper is therefore to analyse the link between carbon taxation and fuel poverty. By increasing the cost of using carbon-intensive energy, the carbon tax heavily affects household budgets and exposes part of the population to the risk of fuel poverty. Nevertheless, I will show that the revenue generated by the carbon tax provides an opportunity to finance ambitious public policies to combat fuel poverty. This study therefore sheds new light on the potential use of the carbon tax to tackle the issue of fuel poverty and offers an empirical application in the French context.

The rest of the paper is organised as follows. The second section describes the microsimulation model, the data, and the indicators used to evaluate the distributional impacts of the carbon tax. The third section presents the distributive impacts of the carbon tax. The fourth section explores alternative scenarios of redistribution to compensate households for the negative impacts of the carbon tax. The fifth section sums up and concludes the paper.

2. Methods

This study is based on a microsimulation model that simulates the taxes levied on the energy consumption of households for a representative sample of the French population. It assesses the aggregate and distributive impacts of reforms in energy taxation and compensatory measures already implemented or under review. Though the model is static and fails to account for general equilibrium consequences, it offers a good approximation of the short-term impacts of a given policy. There were four elements to the design of the microsimulation model, described in the following subsections:

- a database containing a sample of representative households, with the relevant variables for the problem studied;
- a modelling of the energy tax system – to derive household energy expenditure;
- a modelling of households behaviour;
- the indicators to measure the distributional impacts.

2.1. The database

The model is built on the Phebus 2012 survey, which provides the most recent data on energy consumption available in France. The Phebus survey was conducted for the French government with the objective of informing public policies on household energy consumption and on housing renovation. A sample of 5405 households, representative of the principal residencies in Metropolitan France, were interviewed about their energy consumption for both housing and transport, as well about the characteristics of their dwellings, including energy performance. The survey also contains detailed information on their energy habits and the socio-demographic characteristics of each occupant. The survey unit was the household.

For the purpose of this paper, households with disposable income, domestic energy consumption and fuel consumption in the top 0.5% as well as those with disposable income and domestic energy consumption