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The distributional effects of carbon-based food taxes

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ABSTRACT

Mitigation policies have focused mainly on the energy and transport sectors, but recent studies suggest that food related measures can also deliver cost-effective emission reductions. This paper evaluates the implications of levying consumption taxes on food products in Spain based on their carbon footprint. Specific elasticities are estimated for the food demand system based on a dataset of around 20,000 households, using a demand system model. The results show that this policy can reduce emissions and, at the same time, help to change consumption patterns towards healthier diets. For the first time in the related literature, this paper also explores the distributional implications. The results show that carbon-based food taxation tends to be slightly regressive and can have more effect on specific social groups. However, that effect can be ameliorated if exemptions on some basic food products are introduced.

1. Introduction

The recent Paris Agreement at the 21st Conference of Parties COP21 shows that greenhouse gas (GHG) mitigation has been put increasingly on the political agenda. Traditionally, mitigation options for achieving targets have been focused more on the energy and transport sectors, and less attention has been paid to agricultural and food-related sectors. Although energy and transport sectors are the largest contributors, agriculture accounts for 10–12% of global direct GHG emissions. If other indirect emissions are considered, such as those from fertiliser production and land use change, that fraction rises to 20–24% (IPPC, 2014). Moreover, when a full life-cycle analysis of emissions is performed according to the EIPRO study (EC, 2006), food consumption may account for as much as 31% of the EU-25's total GHG emissions. According to the EIPRO study, 80% of the emissions from food originate from the consumption of meat and dairy products, but these only represent about one-third of the total energy intake (McMichael et al., 2007). Therefore, any policy aimed at mitigating emissions should also consider options that impact on the food system, especially in relation to livestock production and meat consumption.

Many papers have explored the mitigation options, potential and costs throughout the food production chain (see Garnett, 2011). The options can be classified as supply-side measures, such as increasing land productivity via technological or managerial approaches (Webb et al., 2014), and demand-side measures, such as reducing losses in the food supply chain (Godfray et al., 2010) or changing diets (Hedenus et al., 2014; Hallström et al., 2015). Although demand-driven measures have seldom been considered, yield improvements may not be sufficient to deliver emission reductions and maintain food security without significant expansion of crop or pasture areas (Bajželj et al., 2014). Stehfest et al. (2009) shows that a global food transition to a scenario with less meat in the diet can reduce remarkably[1] the mitigation cost in a 2 °C stabilisation scenario. Promoting changes in diet composition may therefore not only play a role in future mitigation policies but also prove to be a cost-effective measure.

Furthermore, dietary changes may be attractive not only from a climate perspective but also from a public health perspective (Mytton et al., 2012). Excess consumption of red meat, sugar and

[1] According to Stehfest et al. (2009), a global transition to a low meat-diet as recommended for health reasons would reduce the mitigation costs to achieve a 450 ppm CO2-eq. stabilisation target by about 50% in 2050 compared to the reference case.

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saturated fats increases the risk of various diseases (WHO, 2003). On top of this, according to the WHO more than 1.4 billion adults[2] globally are overweight and more than a half a billion are obese. Therefore, recent literature and policies have focused on the health benefits of reducing energy intake and the consumption of meat and dairy products, especially in Northern European Countries (Härkänen et al., 2014). Denmark, for example, introduced[3] a "fat tax" (Jensen and Smed, 2013; Gustavsen and Rickertsen, 2013), Hungary applied a "junk food tax" and France tried to introduce a tax on sweetened drinks (Villanueva, 2011). However, health related food taxation has also been criticised in terms of effectiveness, distributional impacts and acceptability (McColl, 2009). Evidence suggests that it can be effective in improving health conditions if taxes are sufficiently high, but changes in nutrients should be considered carefully (Green et al., 2015). Most studies also find that health-related food taxation is regressive (Leicester and Windmeijer, 2004); that is, poorer income groups pay a greater proportion of their income in tax than richer income groups. But it is not clear whether health gains might be progressive (Nnoaham et al., 2009), in which case they would offset the negative effect on income distribution. Although acceptability is generally low and varies widely, support increases when the health benefits are explained and emphasised (MRC, 2011). Finally, most studies agree that all these barriers could be ameliorated if taxes on less-healthy foods are combined with subsidies or tax exemptions on fruit and vegetables (Nnoaham et al., 2009; Smed et al., 2007; Mytton et al., 2012). In any case, these results suggest that there are potential gains in terms of health and climate change if the consumption of meat and dairy products is reduced.

Additionally, a Mediterranean-style diet has been extensively reported to be associated with a favourable health outcome, with a better quality of life (Sofi et al., 2008) and with low carbon emissions (Vidal et al., 2015; Pairotti et al., 2015). The Mediterranean diet comprises eating habits traditionally followed by people in the different countries bordering the Mediterranean Sea, such as Italy and Spain, characterised by a high level of consumption of fruit, vegetables and legumes, moderate consumption of fish and the consumption of olive oil as the main source of fats. However, this diet has evolved since the early 1960s towards a more animal-protein-rich diet similar to those of Northern Europe and America (Lassaletta et al., 2013). In fact, in Spain about 17% of the population are obese and around 53% are overweight, so food taxation could also be an important tool for recovering the traditional Mediterranean diet there.

This paper sets out to evaluate the implications of implementing consumption taxes in Spain on food items depending on their GHG footprint. This route is quite novel and, as far as we know, there are only two studies of this type (Edjabou and Smed, 2013; Abadie et al., n.d.). These studies show that carbon based food taxation can be effective in reducing GHG emissions and explore the optimal design of different taxation schemes on food. This paper goes a step further and also evaluates the distributional implications of the policy. The welfare impacts are explored for different income, age and social groups for 14 different food categories, including tax exemptions. The elasticities are estimated with 2002–2013 data from household expenditure surveys, which contain information on around 20,000 households, with the use of a demand system model (AIDS). Finally, it is explored the indirect impacts in terms of nutrients in order to test whether the tax scenarios could also help to move towards a healthier diet.

The paper is structured as follows. Section 2 describes the model and the data used in the analysis. Section 3 shows the tax scenarios considered, and Section 4 discusses the results of the simulations conducted. Finally, Section 5 concludes.

2. Methods and data

This section describes the model, the elasticities and the data used in the analysis. Subsection 2.1 describes the demand model used to estimate the elasticities of the goods analysed. Subsection 2.2 describes the data used in the estimation and simulation stages. Finally, Subsection 2.3 analyses the price and expenditure elasticities estimated.

2.1. Demand model

A two-step approach is followed to assess the welfare effects generated by different tax scenarios. Firstly, a demand model is estimated to provide a set of estimates of the substitution, own-price and expenditure elasticities of the goods analysed. These elasticities are then used in Section 4 to simulate distributional and welfare effects generated by tax rates charged on food. For the first stage, it is used the well-known Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer (1980). This model has been widely used in scientific literature to analyse food demand (see Smed et al., 2007; Bouamra-Mechemache et al., 2007; Mergenthaler et al., 2009; Bilgic and Yen, 2013 among others). Its main advantage is that it enables a first-order approximation to be made to an unknown demand system. In addition, the model satisfies the economic consumption theory axioms and does not impose constraints on the utility function. The log-linear approximation (LAIDS) used in this paper follows an n-good system equation as follows:

$$W_{it} = \alpha_i + \sum_{J=1}^{n} \gamma_{ij} ln\, p_j + \beta_i ln\left(Y_{it}/_{\tilde{p}_t}\right) + t + \sum_{i=1}^{3} d_i + e_{it} \tag{1}$$

where W_{it} represents the share associated with good i in period t for each household, α_i is the constant, p_j is the price of commodity j, $\tilde{p}$ stands for the Stone price index, Y is household income (hence, $Y/\tilde{p}$ represents real income), t is a trend variable that captures the role of the time, which takes values equal to 1 in 2002 and 11 in 2013, d_i is a set of dummy variables that controls for the household type,[4] the region where the household is located in terms of NUTS1[5] and whether the household is rural or urban, measured through the population density. Finally e_{it} is the idiosyncratic error term. The adding up and homogeneity restrictions of Equation (1) are the following:

$$\sum_{i=1}^{n} \alpha_i = 1 \tag{2}$$

$$\sum_{j=1}^{n} \gamma_{ij} = 0 \tag{3}$$

[2] It is also noteworthy that 40 million preschool children are also overweight: http://www.who.int/features/factfiles/obesity/facts/en/index4.html.

[3] The tax on saturated fat (which was accompanied by increased taxes on sugar products, soft drinks and cigarettes) was introduced in 2010 and repealed in 2013.

[4] The household categories used are: adults alone; couple without children; couple with children; single-parent households and other households.

[5] The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU. The NUTS 1 level represents groups of autonomous communities.

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