



## Analysis

# An Environmental Tax Towards More Sustainable Food: Empirical Evidence of the Consumption of Animal Products in France



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## ABSTRACT

Agricultural production is among the industries with the highest impact on the environment in terms of greenhouse gas (GHG) emissions, especially in the production of ruminant meats. Households can change their food consumption habits so as to consume less polluting products such as white meat or vegetable-based food. We analyze whether or not a CO<sub>2</sub> equivalent (CO<sub>2</sub>-eq) tax policy in France can change household habits with respect to animal product purchases, and their environmental impact. Using two levels of a CO<sub>2</sub>-eq tax (€56 and €200 per tonne of CO<sub>2</sub>-eq) applied to the consumption of all animal products, only ruminant meats or only beef, we show that a high level of tax does not allow meeting the 20% objective threshold of GHG emissions reduction for 2020 since it would lead to a 6% decrease in GHG emissions only. Despite the weak effect of such a tax, the most efficient scenario would be to tax the consumption of beef only at a high level. Indeed, this tax policy would allow reaching a 3.2% decrease in GHG emissions, that represents 53% of the variation in GHG emissions when all products are taxed whereas it would only generate 12% of the household welfare damages.

## 1. Introduction

After the energy sector, agricultural production is the industry that has the greatest impact on the environment. In 2010, the net GHG emissions from agriculture, forestry and other land use accounted for 24% of total GHG emissions while 35% were released by the energy sector and 21% by the industry sector (Pachauri et al., 2014). The agricultural sector is a significant contributor in terms of climate change but also in terms of eutrophication, land use, water use, and toxicity. Among agricultural activities, meat and dairy are two of the major polluting sectors, due to a large proportion of crops being indirectly used for the production of meat and dairy, resulting in higher GHG emissions (UNEP, 2010). This is also true for marine products. While overfishing is the most important environmental aspect of seafood production, GHG emissions in this sector are receiving closer attention. Most GHG emissions are due to the use of fuel inputs in fishing as well as feed production for aquaculture. The abundance of stocks and the production methods also contribute to GHG emissions (Ziegler et al., 2013). The environmental impact of food is in large part determined by household diet and consumption habits (cf for instance, Reynolds et al., 2015).

In the future, population and economic growth should lead to an even higher environmental impact if patterns of production and consumption are not changed. Moreover, as the aggregate world meat

consumption, as well as per capita consumption, has increased over time (by 60% and 25% respectively between 1990 and 2009 from Henschion et al., 2014), this trend is predicted to continue in the future. For instance, a study by Fiala (2008) shows that if current consumption patterns continue, total meat consumption will increase by 72% between the years 2000 and 2030, lead mostly by a large increase in chicken and pork consumption. Such a trend is also observed in Europe. For instance, the consumption of meat in Spain increased between 1970 and 2005 with an average annual meat consumption per capita rising from 11.7 kg to 65 kg (Rios-Nunez et al., 2013). This trend in the consumption per capita in the European Union (EU) is expected to be positive for all meats (except sheep meat) between 2013 and 2022, with a decrease in the share of red meat in the total meat consumption in favor of white meat (Henschion et al., 2014).

The EU is one of the largest consumers of animal products per capita in the world. Two thirds of the consumption of animal proteins in the EU comes from five countries (Germany, France, the UK, Italy and Spain), which represents half of the European population (Dumont et al., 2016). France is the second highest European country in terms of population (13% of the EU population) but also in terms of consumed animal proteins (4.5 thousand tonnes), just after Germany. Proteins from animal products account for 60% of total proteins consumed in France; consistent with the average share of the EU15.

Even if the total consumption of meat has decreased in France since

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1998, it still accounts for more than 20% of the total EU consumption in 2014 (in tonnes equivalent carcass) for beef, veal and marine products, 14% for poultry and 11% for pork (FranceAgriMer, 2015).

At the consumption end, some studies have analyzed how changes in consumption habits and diet may mitigate the environmental impact of food consumption. However, as shown in Hedenus et al. (2014), the literature on the mitigation potential through dietary changes under the constraints of household preferences is relatively scant. Hedenus et al. (2014) consider different assumptions on food consumption patterns using FAO projections and two assumptions with respect to household preferences: “75% of ruminant meat and dairy products are replaced by other meat (on kcal basis)”, and “75% of animal food is replaced by pulses and cereals (on kcal basis)”. They conclude that GHG emissions can be mitigated only with dietary changes in which the consumption of animal products is reduced. In the same vein, Tukker et al. (2011) estimate the impact of three simulated diet patterns in Europe (a pattern according to generally accepted dietary recommendations,<sup>1</sup> the same pattern with reduced meat consumption, and a ‘Mediterranean’ pattern with reduced meat consumption) with respect to a status quo scenario. They found a limited impact of 2% in global warming in reduced meat scenarios, and that higher exports will compensate for losses on the domestic meat market. In addition, as emphasized by McMichael et al. (2007) and Horrigan et al. (2002), the growth in meat consumption (and in animal fat in particular), can also increase the risk of chronic diseases, and thus not only exacerbates the environmental problems but also the health risks. Along these lines, using simulations of scenarios representing different variants of meat consumption in Sweden, Hallstrom et al. (2014) show the existence of beneficial synergies in the reduction in meat consumption in Sweden in terms of health, GHG emissions and land use.

Changing consumption habits towards a more sustainable direction and achieving a reduction in meat consumption may be a difficult task even if it is part of the sustainability public policy objectives (Austgulen, 2014). In this paper, we propose to analyze the impact of environmental price policies that specifically target the consumption of animal products based on the analysis of French households' purchasing behaviors. This analysis requires a precise knowledge of household demand for animal products. In the literature focusing on the demand for animal products, most studies use data aggregated at the country or regional level, with only a few studies conducted at the individual household level. Moreover, most of the literature deals with the demand for meat in North America (Gallet, 2010). The only exception is the analysis of Caillavet et al. (2016), who use a cohort of French households, differentiated by income, age of the head and region, in order to evaluate household substitution patterns among 21 food categories. They find that an environmental tax which corresponds to a 20% increase in the price of animal-based food products may reduce GHG emissions by 7%. In this paper, we develop a demand model of animal product consumption in France using a random coefficient logit model and individual data from a French household panel that gives detailed information on food purchases. This discrete choice model allows for the analysis of household preferences for all purchase alternatives available in the market. Then, we estimate consumption patterns between the different animal products but also with an alternative food product aggregate composed only of vegetable-based food. As far as we know, the proposed demand model is one of the most disaggregated ones with 29 possible animal product alternatives proposed to households, contrary to the analysis of Caillavet et al. (2016) which distinguishes only eight animal product alternatives. This disaggregated model allows us to consider the substitution pattern at a very precise product level. Given the demand patterns for the different animal product categories, we analyze whether or not public policy tools can

be used to encourage more sustainable food consumption habits. We focus on environment taxes and, in particular, on a GHG tax based on a CO<sub>2</sub> equivalent (CO<sub>2</sub>-eq), and examine if such a tool can efficiently guide households' choice of food consumption (cf. Vinnari and Tapio, 2012, Wirsenius et al., 2011 and Edjabou and Smed, 2013). We investigate the impact of different carbon tax policies.<sup>2</sup> In 2007, the European Union committed to halve global emissions by 2050 in order to limit global warming to 2 °C. In order to achieve these objectives, GHG emissions must be reduced by 20% by 2020 below the 1990 level and by 60% by 2050, and the recommended carbon price should be set at €56 per tonne of CO<sub>2</sub>-eq in 2020 and €200 per tonne of CO<sub>2</sub>-eq in 2050 (Quinet, 2009). We use these levels of carbon prices to simulate the impact of a CO<sub>2</sub>-eq tax policy on the consumption of animal products. We compare the following: first, the effects of taxing the consumption of all animal products given their contribution to climate change; second, only the consumption of ruminant meats (beef, veal, lamb); and third, only the consumption of beef products, all of which have the highest environmental impact. We compare the results according to their environmental impact as well as their effect on household welfare. Finally, we infer the nutritional impact of such policies in order to evaluate whether or not a carbon taxation policy could be consistent with an improvement in nutritional recommendations.

Our results on household purchase behavior suggest that the own-price elasticities for aggregate animal products is low (−0.31). As a result, we show that a tax of €56 on the consumption of all animal products leads to a very small change in GHG emissions and that even with a high level of tax (€200 per tonne of CO<sub>2</sub>-eq), it is not possible to meet the 20% objective threshold of GHG emissions reduction for 2020 since it would only lead to a 6% decrease in GHG emissions embedded in all 30 food products. Despite the weak effect of such a tax, the most efficient scenario would be to tax the consumption of beef only at a high level. Indeed, this tax policy would allow reaching a 3.2% decrease in GHG emissions, that represents 53% of the variation in GHG emissions when all products are taxed whereas it would only generate 12% of the household welfare damages (−0.39% when only beef is taxed at 200€/tonne of CO<sub>2</sub>-eq, and −3.22% when all products are taxed at this same rate).

The following section motivates the use of taxes based on GHG emissions to mitigate environmental impact. Section 2 presents the motivation of this paper and its related literature. Section 3 discusses the market for animal products in France. In Section 4, we present our methodology to estimate the demand for the different categories of animal products. Section 5 discusses the demand estimation results that drive the demand substitution patterns for these products in France. Section 6 presents the different CO<sub>2</sub>-eq tax policy simulations and analyzes their impact on different environmental and nutritional indicators. Section 7 concludes.

## 2. Motivation and Literature Review

Market failures that lead households to make suboptimal decisions are one of the main reasons to justify public intervention. Suboptimal food choices result from households' lack of information about the environmental impact of food products, but also by the externalities of such choices on wildlife, global pollution and on human health.

In order to change consumption patterns, different policy tools can be used including tax policies, information intervention programs or subsidies. Informational measures have been analyzed in the literature mainly under the form of dietary recommendations, promotions via social marketing campaigns, labeling regulation, and/or educational measures. While such tools clearly modify attitudes and behaviors

<sup>1</sup> Recommendations “include minimum levels of fruits, vegetables and fish intake and limits on saturated and trans fat intake” (Tukker et al., 2011).

<sup>2</sup> The term “carbon” in this paper will refer to GHG emissions measured in tonnes of CO<sub>2</sub>-eq.

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