Modeling carbon consequences of pro-environmental behaviors of consumers in Spain

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Extended abstract:

Consumption is the purpose of production. Household demands decide what goods and services are going to be produced. This consumption has direct and indirect requirements that have their impact on the environment. Direct requirements include resources needed and emissions emitted by households from heating, cooking, car use and so on, while indirect requirements consider resources needed to satisfy consumer demand via the numerous firms located in the countries in which the goods and services demanded by the consumers are produced, see Munksgaard et al. (2005).

In this context, pro-environmental behaviors of consumers aimed at reducing emissions are one of the main challenges of any environmental policy. Modal shifts from private cars to public transport, healthier vegetarian based diets and responsible use of electricity (using efficient electrical appliances) are principal goals to reduce emissions. However, how people consider their environmental awareness is the result of a personal decision-making process with strong interference from an individual's attitude and values, prevailing social norms and assessment of personal costs (Blake, 1999; Stern, 2000). Citizen awareness depends on multiple variables: socio-demographical (gender, age, household size, income, education) and structural (type of house, energy efficiency, car ownership, free time travel) (Tabi, 2013).

With this in mind, in order to shed light and clarify what is the current environmental awareness and the real behavior of consumers, a recent social and environmental survey in Spanish households (INE, 2008) aims to establish to what extent households and the economy are ready for sustainable use and to explore consumers' behaviors regarding environment. Therefore, based on these survey results and the current awareness of the environment in Spain, this work simultaneously addresses two objectives: the effects of pro-environmental

behaviors to evaluate policy strategies vis a vis a carbon tax, and the compatibility of socio-economic benefits with environmental goals.

With these objectives, we are interested in answering the following questions: Are houses equipped with regards to the environment? Do consumers act in accordance with the environment? What could be the effects of achieving greater environmental awareness in line with official recommendations and the most environmentally conscious countries? Are pro-environmental objectives compatible with socio-economic benefits, such as increases in income and employment? How do household characteristics like income distribution influence economic and environmental impacts? Which types of public policies are more effective to reduce carbon emissions: a carbon tax or promotion and advertising control policies? In short, this work attempts to go further into the analysis of environmental impacts associated with households' behavior, evaluating pro-environmental behaviors depending on income distribution and starting from a current awareness of the environment.

For this purpose, we design representative scenarios to evaluate the effects of improvements in the current environmental awareness of households according to income level. These scenarios consider higher shares of efficient electric appliances with a rating of more than of $A+$, healthier vegetarian based diets and the promotion of sustainable means of urban transport through the transfer of passenger vehicle traffic to collective modes (bus, train and underground). Specifically, our first scenario consists of considering the guidelines, recommendations and levels of the most environmentally conscious countries compared to the current behaviors in Spain. Then, in a second scenario, we classify households by environmental taxonomies to analyze the effects of changes in behaviors and lifestyles. Finally, in a third scenario, we compare the previous results obtained with a carbon tax based on embodied emissions to influence consumption and behavior of households in relation to electricity expenditure, healthier diets and public transport use. Specifically, we consider the new energy taxation rule (European Commission, 2011) that proposes a tax based on CO_2 emissions at 20€ per tonne of CO_2.

The methodology follows input–output theory to quantify the direct and indirect effects of scenarios simulated (see Ferng, 2002; Resosudarmo, 2003; McDonald and Patterson, 2004). In particular, we develop a Computable General Equilibrium (CGE) model calibrated on the 2008 Spanish data. A high level of disaggregation is considered for the agricultural, energy, agri-food industry and transport services sectors. Final demand by households also differentiates four groups of income level. Our analysis focuses on the impact on greenhouse

gases (GHG), methane (CH_4) and sulphur dioxide (SO_2). This paper also studies the economy-wide effects of these alternative scenarios to observe the compatibility with increases in income and employment.

We treat emissions generated from heating, cooking, car use and so on as direct household emissions, depending on the amount and kind of energy used (fuel, gas, coal, etc.). Moreover, we treat emissions generated in the production processes to satisfy consumer demand as indirect emissions by linking the emissions of economic activities to different components of final demand (i.e. households, exports, public expenditure and investment). More interestingly, we consider all the emissions (domestic and foreign) embodied in goods consumed by Spanish households using information from Timmer (2012).

In addition, in our analysis we take into account the 'rebound' effects (Jevons, 1985). Given that alternative improvements imply savings in household spending, increasing consumers' real income and expanding firms' production and export possibilities, the prices will undergo numerous and complex adjustments throughout the whole economy. General equilibrium analyses seem suitable for predicting the ultimate result of these changes due to the fact that these models allow us to capture changes in prices, consumption, production, and technology. While partial equilibrium analysis focuses on the sector affected by a policy assuming the rest of the economy is not affected, CGE models consider other sectors and regions and incorporate constraints and feedbacks between different economic sectors allowing for a more complete assessment. Therefore, CGE models have increasingly been used in empirical analyses of changes in efficiency improvements and their rebound effects (e.g. Hanley et al. (2006) in Scotland; Barker et al. (2007) for the UK economy; and Barker et al. (2009) for the world economy).

The results suggest that reductions in greenhouse gas, methane and sulphur dioxide emissions might be compatible with increases in income and reductions in unemployment with public policies stimulating environmental awareness (e.g. promotion and advertising). However, we notice the relevance of potential rebound effects that may reduce these positive impacts and increase emissions as a consequence of greater expenditures in other products. Influencing environmental behaviors through higher taxes on final consumption may have larger impact to reduce emissions but socio-economic benefits are missing. This work shows that analyzing household consumption patterns and their sensitivity to environmental initiatives in comparison with fiscal measures may shed light on the design of guidelines for policymakers.

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