Assessing the impacts of changing consumer behaviour patterns on our planetary boundaries

Submitted for presentation at the 23. Conference on Global Economic Analysis "*Global Economic Analysis Beyond 2020*" June 17-19, 2020

DRAFT – not suitable for citation

Kirsten Boysen-Urban[1], Emanuele Ferrari[1], Robert M'Barek[1] and George Philippidis[2]

[1] European Commission, Joint Research Centre (JRC), Seville, Spain

[2] Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain

Abstract

With a focus on two of the Sustainable Development Goals - halve global food waste and reduce food losses along the value chain as well as end all forms of hunger by 2030, the objective of this study is to investigate the potential impact of food waste and loss reduction and dietary changes on food security, emissions, land use change as well as water use. For this purpose, this study employs an advanced CGE neoclassical model known as the Modular Applied GeNeral Equilibrium Tool (MAGNET). A biobased variant of the standard GTAP database consisting of numerous additional biobased activities splits (including waste and recycling) is used to enhance to analysis of the circularity of food waste reductions. To control the balance of food nutrients in the diet when changing consumer dietary patterns, we also include a nutrition module in MAGNET. In the case of food loss and waste, worldwide estimates of food waste rates classified into seven regions from the FAO are employed.

In addition to a reference scenario to 2050, we simulate a set of additional scenarios. Comparing with this baseline, the first three scenarios will examine 30%, 40% and 50% reductions in food waste over the period 2020-2050. The second set of three scenarios will examine 30%, 40% and 50% reductions in red meat consumption in all regions, whilst maintaining the protein balance as in the baseline. Results will be presented with a focus on the key economic (output, household incomes), social (employment) and biophysical/environmental (emissions, water and land usage) indicators available in the MAGNET model.

Disclaimer:

The views expressed are purely those of the author and may not in any circumstances be regarded as stating an official position of the European Commission.

Assessing the impacts of changing consumer behaviour patterns on our planetary boundaries

Introduction

With ever more mouths to feed worldwide, policy makers are engaging in ways to develop more sustainable and climate friendly systems of economic development that avoid further increases in harmful greenhouse gas emissions and reduce the burden on our natural biophysical planetary boundaries. One hot topic is the role of changing consumer behaviour and attitudes to food consumption. The FAO (2014) estimates that annually, the economic cost of food waste amounts to 2.6 trillion USD, equivalent to 3.3% of global GDP. Furthermore, non-market biophysical benefits arising from reductions in food waste in terms of land and water savings are to be expected. From an environmental perspective, also reducing activities in emissions intensive activities such as primary agriculture is expected to play a positive role in curbing greenhouse gas emissions. This could be achieved through not only food waste reductions, but also changes in consumers' diets through the sourcing of protein from non-meat activities. Earlier research suggests that economic performance indicators are expected to worsen as a result of food waste (Rutten et al., 2013a; Philippidis et al., 2019), although what perhaps remains less clear is the resulting impacts are the circular impacts arising from changes in available waste as a source of biomass for market goods (e.g., energy).

The current paper therefore employs an advanced variant of a neoclassical computable general equilibrium (CGE) simulation model to examine how changing consumer choice patterns impact on a wealth of economic, social and environmental market indicators and the resulting trade-offs, for a selection of regions across the world. Additional modelling innovations to look at changing diets account for food substitution effects under conditions of unchanged food balances compared with a baseline, whilst the rates of food waste by regions, which are reduced over the 30 year time horizon from 2020 to 2050, are also expected to incur a time related change owing to rising per capita incomes.

Methodology

This study employs an advanced CGE neoclassical model known as the Modular Applied GeNeral Equilibrium Tool (MAGNET) (Woltjer et al., 2014), which is a recursive dynamic variant of the standard GTAP model. As noted, this version of the model is benchmarked to version 9 GTAP database (2011). A biobased variant of the standard GTAP database consisting of numerous additional biobased activities splits (including waste and recycling) (Philippidis et al., 2019) is used to enhance to analysis of the circularity of food waste reductions.

A long run reference scenario transition pathway to 2050 is designed and implemented based on the Global Energy and Climate Outlook (GECO) published by the Joint Research Centre of the European

Commission (Keramidas et al., 2018). To characterise this climate and energy pathway, detailed assumptions are implemented regarding real macroeconomic growth, population change, fossil fuel prices, energy usage and efficiency by types of activity and region, emissions changes and land productivities. Moreover, given agri-food focus, the treatment of primary agriculture captures agricultural factor rigidities, asymptotic land supplies and long run biophysical estimates of land productivities. Furthermore, to avoid the bias relating to excessive income elasticity driven demands for agriculture and food over long terms time horizons in rapidly growing economies with rising per capita incomes, regional income elasticities of household demands are endogenously adjusted downwards in function of rising purchasing power parities.

The study also makes use of a nutrition module in MAGNET (Rutten et al., 2013b, 2014) in order to control the balance of food nutrients in the diet when changing consumer dietary patterns (i.e., red meat reductions). In the case of food waste, worldwide estimates of food waste rates classified into seven regions from the FAO (2011) are employed, whilst econometric estimates of changing food waste rates as a function of rising per capita incomes (under the assumptions of current consumer attitudes) are also computed to improve the food waste cuts imposed in our simulations.

Scenarios

In addition to a reference scenario to 2050, up to six additional scenarios will be considered. Comparing with this baseline, the first three scenarios will examine 30%, 40% and 50% reductions in food waste over the period 2020-2050 assuming time linear reductions. As mentioned in the previous section, the initial rates of food waste are based on FAO estimates whilst assuming unchanged attitudes to food waste, we econometrically calculate revised food waste rates by region with changes in their per capita incomes. The second set of three scenarios will examine 30%, 40% and 50% reductions in red meat consumption in all regions, whilst maintaining the protein balance as in the baseline. In this way, it will be possible to model more faithfully food substitution effects in favour of other protein sources.

Results will be presented with a focus on the key economic (output, household incomes), social (employment) and biophysical/environmental (emissions, water and land usage) indicators available in the MAGNET model.

References

FAO (2011). Global food losses and food waste, Extent Cause and Prevention. Rome 2011, http://www.fao.org/3/a-i2697e.pdf.

FAO (2014). Food wastage footprint: Impacts on natural resources. Final Report. Rome: FAO. www.fao.org/nr/sustainability/food-loss-and-waste.

Keramidas, K., Tchung-Ming, S., Diaz-Vazquez, A. R., Weitzel, M., Vandyck, T., Després, J., Schmitz, A., Rey Los Santos, L., Wojtowicz, K., Schade, B., Saveyn, B., and Soria-Ramirez, A. (2018): *Global Energy and Climate Outlook 2018: Sectoral mitigation options towards a low-emissions economy – Global context to the EU strategy for long-term greenhouse gas emissions reduction*, EUR 29462 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97462-5, doi:10.2760/67475, JRC113446.

Philippidis, G., Sartori, M., Ferrari, E. and M'barek, R. (2019) Waste not, want not: A bioeconomic assessment of household food waste reductions in the EU, *Resources, Conservation & Recycling*, 146, pp514-522.

Philippidis, G., Bartelings, H., Helming, J., M'Barek, R., Ronzon, T., Smeets, E., van Meijl, H., Shutes, L. (2018)The MAGNET Model Framework for Assessing Policy Coherence and SDGs: Application to the Bioeconomy; JRC Technical Reports, European Commission; EUR 29188 EN; Publications Office of the European Union: Luxembourg, 2018; ISBN 978-92-79-81792-2.

Rutten, M. M., Tabeau, A. A., & Godeschalk, F. E. (2014). We are what we eat: An economic tool for tracing the origins of nutrients with entry points for action. (FOODSECURE technical paper; No. 28). The Hague: FOODSECURE project office LEI Wageningen UR (University & Research centre). http://edepot.wur.nl/342014.

Rutten M., Nowicki P., Bogaardt M.-J., Aramyan L., (2013a). Reducing Food Waste by Household and in Retail in the EU: a Prioritisation Using Economic, Land Use and Food Security Impacts. LEI Wagenigen UR. https://edepot.wur.nl/290135.

Rutten M. M., Tabeau A. A., Godeshalk F. E. (2013b) A New Methodology for Incorporating Nutrition Indicators in Economy-Wide Scenario Analyses. (FOODSECURE technical paper; No. 1). The Hague: FOODSECURE project office LEI Wageningen UR (University & Research centre). http://edepot.wur.nl/292724.

Woltjer G., Kuiper M., Kavallari, A., van Meijl, H., Powell, J., Rutten, M., Shutes, L., & Tabeau, A. (2014). The MAGNET model - Module description. LEI Report 14-057. The Hague, Netherlands.