Distributional impacts of long-term climate policies

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Introduction

In light of the recently published IPCC report (1.5C) and using the targets of the Paris Agreement as a common point of reference, there is a clear need to accelerate policy efforts leading to reduction of greenhouse gas emissions. Their successful implementation, however, requires social acceptance, which, in turn, is dependent on distributional impacts that climate action may have on different types of economic actors, sectors and geographies. Thus, assessment of long-term low-emission strategies should cover not only the impacts of transition on sectoral indicators and macroeconomic aggregates, but also address the question how the costs and benefits of climate action are distributed throughout the economy and society. Such assessment should also support identification of suitable approaches to mitigate or minimize the negative consequences that could translate into increased social inequalities and poverty.

The choice of policy tool in a given sectoral and national context together with appropriately designed revenue recycling scheme determine the scale and type of associated distributional effects. The recently published meta-analysis of 53 national evaluations of climate policy impacts concluded that more than a third of the assessed effects are progressive or proportional – i.e. the burdens associated with a given policy instrument are either greater for wealthier actors or distributed equally across the income distributions (Ohlendorf et al. 2018).

However, among the available studies, there is currently very little focus on the evaluation of the distributional effects of climate policies in the long-term perspective. These are rarely included in the analysis of the macroeconomic consequences of the changes in prices and assets productivity that are being covered by the global models that address the interactions between the socio-economic and environmental realms.

The aim of this note is to present the review of available analytical tools and approaches that enable the quantification of the distributional effects of the long-term climate policies on households taking into account their heterogenous nature. Given that the acceptability and the net economic effect of climate policies depends on the effectiveness of the compensatory schemes, the note also takes into account the issue of the revenue recycling.

Available methodologies and their comparison

There are four main types of models (differing in terms of aggregation level and sectoral coverage) that enable analysis of distributional effects.

Computable general equilibrium (CGE) models enable to estimate the impact of changes in policy and other external factors upon the whole economy, including interdependencies between different economic sectors via markets for goods and production factors (OECD 2014). They have been used extensively to analyse international trade and economic effects of measures to reduce greenhouse gas emissions. While all CGE models are able to assess policy impacts of price-based mechanisms (or their equivalents) on the economy as a whole and specific sectors, specific versions may also be used to capture broader set of factors, such as technological change or developments on financial markets (e.g. Paroussos et. al 2017). However, CGE models have a strong macroeconomic focus, as they typically have a single representative household and cannot provide detailed results with regard to its behaviour. Therefore, as they are mostly

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focus on macroeconomic and sectoral indicators, they allow to assess the distributional effects of climate policies in the form of shifts in economic activity between the countries as well as across the sectors.

To include distributional impacts in the CGE models, several modifications have been introduced to the standard assumptions. One of them is the replacement of single household with the representation of multiple household types, differentiated by their income levels and expenditure structure. This approach considers interactions between households, changes in their composition and macroeconomic developments to predict future shifts in income distribution resulting from the introduction of a given policy. For example, Rausch et al. (2011) use survey data to incorporate household heterogeneity into analysis of the distributional impact of carbon pricing in the US. Their results show that there are significant variations not only across broad socio-economic groups, but also within them, and that this individual-level variation in vulnerability to climate policies outweighs differences between groups. Other examples of CGE models applications to the assessment of distributional impacts of climate and energy policies include studies focused on China, Mexico, Indonesia, South Africa, Philippines. In most cases, the modelling indicates that carbon pricing has regressive effects on households. It can be neutralised, however, by using revenue recycling measures (OECD 2014). For the EU countries, one example is the assessment of climate and energy package on Finland, which found that its costs are distributed rather equally, i.e. distributional effects are mostly neutral (Honkatukia et al. 2009).

Microsimulation (MS) models, unlike the CGE models, allow a comprehensive analysis of distributional effects at the micro level, for multiple household types. On the basis of a large amount of detailed household data such as income, taxes, savings or expenditures, they enable assessment of households behaviour with regard to labour market participation and consumption patterns. These models are also characterised by high flexibility and diversity of approaches, which can be tailored to assess specific types of policies and capture various impacts among different households. Despite these advantages, MS models also have limitations, in particular inability to account for indirect, cross-sectoral and macroeconomic impacts of a given policy. Moreover, it requires high quality microdata sets, which might not be available in a given country.

Combining a detailed analysis of household-level impacts from a microsimulation model with results provided by CGE modelling framework may be useful for capturing long-term distributional effects of economywide low-emission transition. CGE model is able to indicate the range of macroeconomic impacts of the individual policy, while the MS model enables estimation of these translate into specific social outcomes in terms of inequality and poverty. MS models can be applied sequentially, considering results from a macro model to simulate heterogeneous outcomes, or in iteration with CGE until the two models converge to a common solution (Van Ruijven et al. 2015). Such MS-CGE model combinations were applied to calculate distributional effects of transportation fuels taxation in Belgium and Italy, showing that distributional impacts are determined by revenue redistribution as well by the wealth of the country (Vandyck and Regemorter 2014, Tiezzi 2005). Another example is study on the long-term impact of an emissions trading scheme in Australia, which was assessed as progressive in the case of lump-sum revenue recycling to households (Buddelmeyer et al. 2012). MS model on its own can be applied to assess the effects of policy instruments such as increased energy prices, existing direct taxes on energy or to compare of revenue recycling types (OECD 2014).

Input-Output (IO) models represent the interdependencies between sectors of the economy and are used for assessment of the direct and indirect impacts of sectoral policies and other types of shocks affecting on value added, production and employment through supply chains and multiplier effects. In these models, households' expenditures are determined by aggregate consumption patterns. IO framework produces detailed outputs at the sectoral level, including demand for imported goods, allowing to assess distributional impacts across sectors and countries. However, it cannot capture households' response to changing policy and economic conditions nor their heterogeneity. It also does not model potential supply-side constraints in the economy. The biggest advantage of this method consists in its relative simplicity and limited data needs, which may be covered by official national and European statistics (e.g. Eurostat provides supply, use and input-output tables) as well as by available outputs of international research projects (e.g. World Input-Output Database). Application of input-output models can be combined with both MS and CGE models.

IO models have been used for estimation of the economic impact of environmental taxes, in particular taxes on transport fuels, energy and registration duties for cars, which was analysed on the example of Denmark (Wier et al. 2005). Bach et al. (2002) examined the impact of environmental fiscal reform introduced in Germany in 1999 using a combination of MS-CGE-IO models, concluding that this policy measure had a moderate regressive effect even after revenue recycling.

Direct modelling of income distribution estimates a comparative income distribution based on household survey data or other distribution data. The range of use of this type of model is extensive - it can be applied to the single representative household or multiple household types. It focuses just on income volume, regardless of the expenditures and differences in sources of incomes between households. From a climate policy assessment perspective, it can predict the number of people or households in poverty, depending on the implemented policy. Despite the fact that this model depends on a limited number of datasets, its main weakness is the strong dependence on the quality and availability of income data.

As the income distribution does not influence the results of CGE analysis, direct modelling of income distribution can be applied ex-post to CGE-based modelling outputs (Van Ruijven et al. 2015). This approach can be used to evaluate the distributional impacts of economic restructuring (De Janvry et al. 1991, Morrisson 1991). Even broader framework combining CGE, MS models and direct modelling of income distribution enables calculation of distributional effects for a large number of households and for different income levels (e.g. Decaluwé et al. 1991). Direct modelling of income distribution may be also used as a first step for further qualitative assessment of distributional impacts. This is especially relevant for long-term strategies analysis, which requires assumptions on the multidecade evolution on key economic variables. For example, such approach can be applied to Shared Socio-economic pathways used for global climate policy assessments (Van der Mensbrugghe 2015).

Linking assessment of investment needs and distributional impacts

Long-term low-emission transition requires a broad and diverse set of climate policy measures which will redirect financial flows across the economy away from emission-intensive and towards low-carbon activities. However, these are often not modelled in detail, especially within long-term decarbonisation pathways assessments. While analysis of broadly defined policy scenarios (e.g. carbon fee and dividend schemes) may help to determine broad principles of inclusive climate policy design, it has limited applicability to specific dilemmas faced by policymakers working on domestic long-term low-emission frameworks.

In recent years, an increasing number of projects and initiatives have focused on mapping financial flows towards low-carbon economy (Rademaekers et al. 2017). These may be combined with results of techno-economic modelling of decarbonisation pathways, which provide sectoral investment needs, to quantify necessary additional shifts in financial flows required to reach long-term climate targets (Hainaut et al. 2017). Such in-depth assessment of financing gaps to be addressed by climate policies (both directly, e.g. through subsidies, and indirectly, e.g. through introduction of standards and bans to redirect private investors to low-carbon solutions) allows to specify detailed policy mixes to be assessed by modelling tools presented in this note. Furthermore, based on the results of such assessment, the policy mixes may be further refined to ensure social acceptability of the envisioned low-emission transition pathways. Thus, linking assessment of investment needs and distributional impacts may ensure better alignment between modelling work and specific domestic policy challenges, allowing modellers to provide more precise and nuanced answers to the policymakers' question "Who pays for the transition?". From the modelling perspective, this creates an additional challenge of linking bottom-up and top-down assessment tools. This can be achieved by translating outputs from sectoral bottom-up assessments into exogenous shocks affecting top-down models. Examples of such linkages include modelling of RES policies' impact on the EU labour market (Duscha et al. 2014) and implications of low-emission transition for Poland (Bukowski et al. 2013).

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