Distributional impacts of long-term climate policies

By Zofia Wetmańska, Karolina Marszał, Aleksander Śniegocki (WiseEuropa)

Introduction

In light of the IPCC report on Global Warming of 1.5°C 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 the identification of suitable approaches to mitigate or minimise 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 drivers of the transition costs as well as available analytical tools and approaches that enable the quantification of the distributional effects of the long-term climate policies.

Transition costs

The low-emission transition requires reallocation of economic resources (such as capital and labour) both within and across sectors. This effort is often perceived as a key barrier for a proactive approach towards climate action. Thus, it is crucial to identify and understand the drivers of the transition costs, as it will enable the design and implementation of better-targeted measures for socially acceptable distribution.

The transition costs can be grouped into three categories, with the first of them being structural drivers, including reallocation of economic activity across regions, sectors and types of occupations. These are direct outcomes of the transition process and as such cannot be significantly mitigated by the policy choices. The second group entails macroeconomic drivers, which include, for example, changes in the cost of factors of production induced by large-scale investments. Final category refers to the impacts of policy design, such as specific rules governing subsidy schemes, environmental taxes or devising public investment priorities. Importantly, policymaking process can affect the distribution of costs arising from two latter categories and thus result in a more socially acceptable low-carbon transition dynamics.

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

European Climate Initiative EUKI

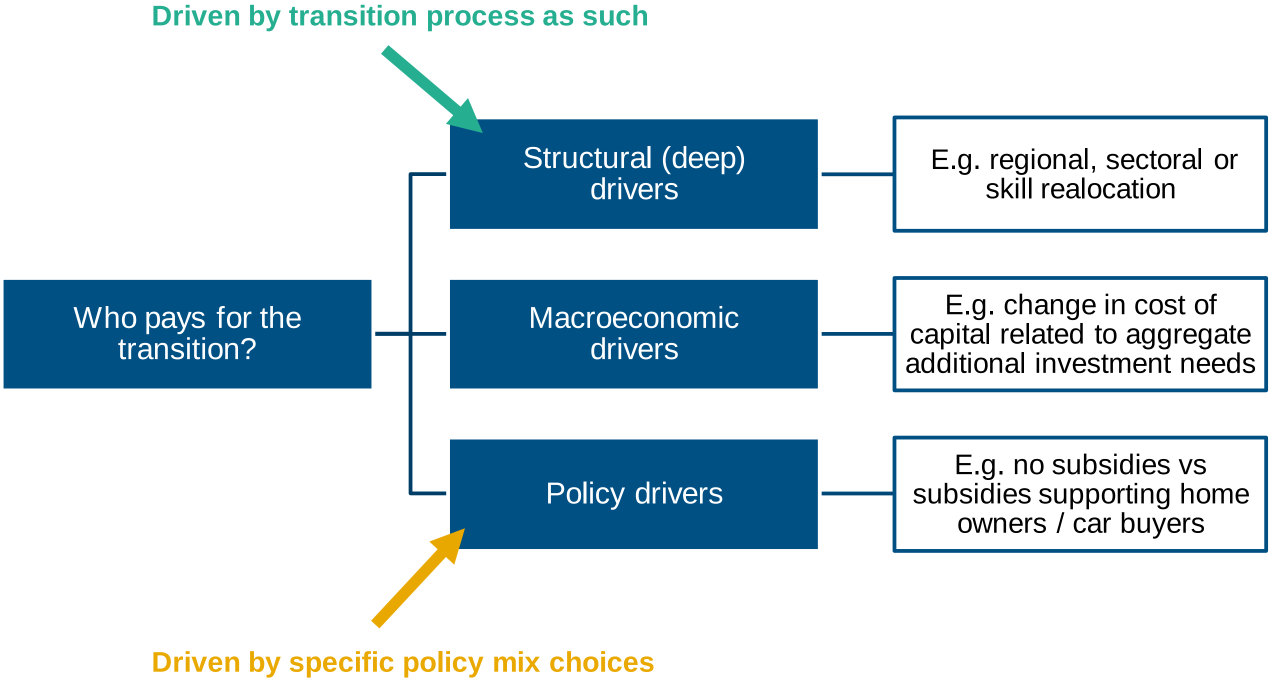
STIFTUNG MERCATOR

Project partners:

ecologic, IDDRI, Fraunhofer ISI, ENERGIAKLUB Climate Policy Institute Applied Communications, WiseEuropa, Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology, Association négaWatt, DTU Technical University of Denmark, ENEA Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile

This project is part of the European Climate Initiative (EUKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

Figure 1. Different types of drivers related to the transition costs



Source: WiseEuropa

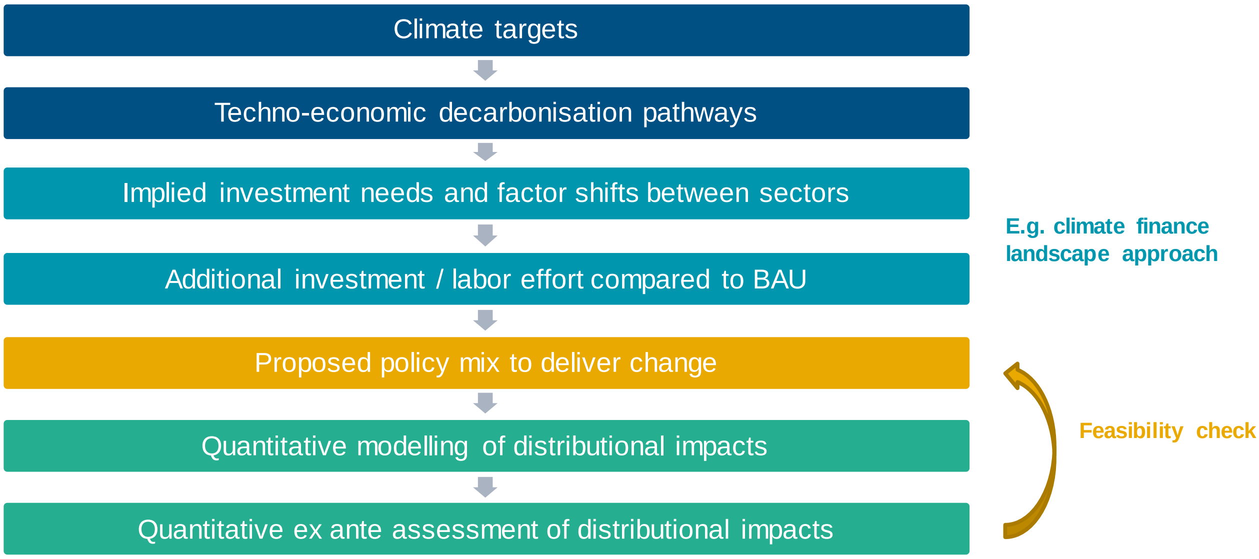
Linking assessment of investment needs and distributional impacts

The 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 options (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 climate finance flows (Rademaekers et al. 2017). Often, the mapping exercise is being combined with results of techno-economic modelling of decarbonisation pathways, what enables to determine the sectoral investment needs, and thus to quantify necessary, additional investments required to reach long-term climate targets (Hainaut et al. 2018). This, in turn, allows to specify various policy scenarios which allow closing the identified gaps, both directly, e.g. through subsidies, and indirectly, e.g. through the introduction of standards which redirect private investments to low-carbon solutions. Such detailed policy mixes may then 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 a better alignment of the modelling work with the specific domestic policy challenges, allowing modellers to provide more precise and nuanced answers to the policymakers' question “Who pays for the transition?”.

Figure 2. Systemic assessment of investment needs and associated distributional impacts of the long-term decarbonisation pathways



Source: WiseEuropa

From the modelling perspective, this creates an additional challenge of linking bottom-up and top-down assessment tools, i.e. implementation of the analytical approach throughout the whole policy-making process. 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 the implications of low-emission transition for Poland (Bukowski et al. 2013). The feedback loop in the modelling of the linkages between investment needs, policy choice and distributional impacts, can be described as a three-step process: 1) cost-effective decarbonisation pathways are determined by identification of the investment needs and shifts of production factors (capital, labour) between sectors compared to BAU, using, for example, the climate finance landscape approach; 2) as necessary investments require significant expenditures, their financing should be regulated by implementing specific policy mix, supported by assessment of distributive effects and financial perspective in long-term strategies modelling, and finally 3) the quantitative ex-ante estimation allows for a feasibility check and therefore increases the credibility and reliability of the introduced policy measures.

Methodologies for quantitative ex ante assessment of distributional impacts

There are two most frequently used methodological approaches (differing in terms of aggregation level and sectoral coverage) that enable an analysis of distributional effects.

Computable general equilibrium (CGE) models enable estimation of the impact of changes in policy and other external factors on 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 designed 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, different versions may also be used to capture broader sets of factors, such as technological change or developments on financial markets (e.g. Paroussos et al. 2017). Traditionally, CGE models have a strong macroeconomic focus, and they typically operate on a single representative household, thus are unsuitable for a detailed analysis of the behaviour of heterogenous groups and individuals. Therefore, they allow for assessment of the distributional effects of climate policies in the form of shifts in economic activity between the countries as well as across sectors.

To include distributional impacts in the CGE models, several modifications have been introduced in the standard assumptions. One of them is the replacement of the 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 the 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 the application of the CGE models for the assessment of distributional impacts of climate and energy policies include studies focused on China, Mexico, Indonesia, South Africa and Philippines. In most cases, the modelling indicates that carbon pricing has regressive effects on households. However, it can be neutralised by using revenue recycling measures (OECD 2014). For the EU countries, CGE model has been applied for the assessment of climate and energy package in Finland. Unlike the global examples, the results showed that costs are distributed rather equally, i.e. distributional effects are mostly neutral (Honkatukia et al. 2009).

Microsimulation (MS) models, on the other hand, allow for a comprehensive analysis of distributional effects at the micro-level, for multiple household types. Using 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 numerous advantages, MS models also have limitations as they do not offer the macroeconomic perspective of the CGE modelling, in particular they are characterised by the inability to account for indirect, cross-sectoral and macroeconomic impacts of a given policy. Moreover, they require high-quality microdata, 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. The CGE model is able to indicate the range of macroeconomic impacts of the individual policy, while the MS model enables these estimations to 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 a 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 revenue recycling types (OECD 2014).

When the data or resource limitations make it impossible to apply general equilibrium and microsimulation models, alternative methodologies may be used to provide an evidence base on the distributional impacts of climate policies. One of them is **Input-Output (IO) analysis**, a simpler version of the CGE modelling, which captures the interdependencies between sectors of the economy. IO framework is mainly used for assessment of the direct and indirect impacts of sectoral policies and other types of shocks affecting value added, production and employment through supply chains and multiplier effects. This approach produces detailed outputs at the sectoral level, including demand for imported goods, allowing to assess distributional impacts across sectors and countries. The biggest advantage of this method is its relative simplicity and limited data needs, however, it is also possible to use more developed models based on the IO framework but not classic CGE, addressing macroeconomic phenomena to the larger extent, both on the demand and supply side and linking with sectoral policies. Similarly, instead of using detailed microdata, the distributional impacts of the climate policies may be approximated based on the aggregated figures from the **household budget surveys**. These may include structure of household expenditures across income deciles or quintiles. Such analysis may indicate, for example, that 20% households with lowest incomes spend significantly higher share of their available budget on electricity than 20% of households on the opposite side of the income distribution. This approach, however, does not account for the internal differences within each income group.

Assessment of investment needs and distributional impacts in national strategies – examples

The analysis of investment needs and distributional impacts has been applied in the process of development and assessment of selected national strategies. For instance, the German long-term transition scenario has been assessed by linking the macroeconomic model ASTRA-D with sectoral bottom-up models which provide information on the level of investment needs and their detailed structure (Öko-Institut and Fraunhofer ISI 2016). The models indicate that total additional investment needs in low-emission scenario will surpass EUR 30 bn by 2030 and EUR 50 bn after 2040. These will be concentrated mainly in buildings, transport and energy sectors. In the long run, results show a decrease in operating costs, allowing for redirection of savings to other sectors. Moreover, macroeconomic modelling predicts an increase in total employment by half a million jobs in 2050, higher GDP and productivity-related to deployment of new technologies. The analysis also discusses various sources of financing, including governmental subsidies, retaining profits, borrowing, cost pass-through and foreign capital transfers. For the government budget, the modelling finds that the transition leads to net positive impact, as additional revenues from the higher national income outweigh subsidies required to support sectoral shifts.

Investment needs and distributional issues have been also addressed in the economic assessment of the impact of the National Low-carbon Strategy in France (Ministére de L'écologie, du Développement Durable et de L'énergie 2015). In this case, apart from a bottom-up assessment of investment needs and top-down macroeconomic modelling, a separate modelling exercise has been carried out to assess distributional impacts of transition in the residential buildings sector. The analysis was carried out with Prométhéus microsimulation model based on data on distribution of households among types of buildings, energy use, and income deciles, as well as detailed assumptions on the costs of renovation. This provided results not only for average households but also information on how the investment needs and energy expenditures will evolve in the future for households on the whole spectrum of income distribution.

The abovementioned examples show that so far, there is a strong preference of the modelling choices that enable an analysis of specific, well-defined narrow aspects of the transition over the use of more complex approaches which require e.g. extensive data collection of use of hybrid modelling strategies. Looking forward, the increased interest in distributional impacts among policymakers, as well as scale of transition challenge and the interdependency of their macro and micro impacts are likely to induce shift towards more advanced and comprehensive analytical approaches.

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