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Article

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CESifo Forum

Provided in Cooperation with:
Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Fredriksson, Gustav; Zachmann, Georg (2021) : Assessing the Distributional Effects of the European Green Deal, CESifo Forum, ISSN 2190-717X, ifo Institut - Leibniz-Institut für Wirtschaftsforschung an der Universität München, München, Vol. 22, Iss. 05, pp. 03-09

This Version is available at:
https://hdl.handle.net/10419/250934

Winners and Losers of Energy and Climate Policy – How Can the Costs Be Redistributed?

Achieving climate policy goals requires comprehensive measures to reduce greenhouse gas emissions, particularly in the energy and transport sectors. There are different ways to achieve the goals. Depending on which one policymakers choose, countries, industries or population groups will have to shoulder costs of the realignment. Who should bear more and who less of the burden? This edition of the CESifo Forum examines this critical and complex issue in the EU, the US, and in the low- and middle-income economies of the world. The authors also discuss ways how more socially-balanced and better politically-feasible energy and climate policies can be developed and implemented.

Gustav Fredriksson and Georg Zachmann

Assessing the Distributional Effects of the European Green Deal*

The European Green Deal marks an important step in the EU's combat against climate change. The Deal increased the EU's 2030 greenhouse gas emissions reduction target from 40 percent to at least 55 percent below 1990 levels and established a goal of climate neutrality by the mid-century (European Commission 2019). In July 2021, the European Commission presented its "Fit for 55" package which contains a series of policy proposals for meeting the higher 2030 target.[1] The proposals include a reduction in the allowances in the existing emissions trading system (i.e., for industry and power sector emissions), the introduction of a new trading system for building and road transport emissions, and more ambitious national targets for sectors covered by the Effort Sharing Regulation (ESR). They also entail the introduction of a carbon border adjustment mechanism (CBAM).

Countries and households will be unevenly impacted by such policies and, more generally, by accelerating decarbonization until and beyond 2030. There is consequently a risk that the costs of the Green Deal fall disproportionately on poorer countries and poorer households. This is important to avoid, since EU climate policy is intended to reflect the principle of a fair burden sharing across and within countries (European Commission 2019). Moreover, the political acceptance of climate policies within countries risks being jeopardized if the burden falls disproportionately on poorer households (Büchs et al. 2011).

The impact on countries and households will vary across the policy instruments of the Green Deal. This article focuses on the distributional effects of carbon pricing, as it will be a key policy instrument in coming decades. We examine two issues. First, we consider the between- and within-country distributional implications of more stringent carbon pricing policies in the context of the Green Deal. This includes a within-country assessment of the CBAM. Second, we discuss remedies for any adverse distributional

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* The authors are grateful to Florian Landis for his helpful comments and to Victor Vorsatz for his valuable research assistance. The authors bear the sole responsibility for all conclusions and possible errors.

[1] The proposals can be found here: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en#documents.

effects that might arise from the carbon pricing in the Green Deal.

To examine how countries and households are impacted by the carbon pricing mechanisms, we use a conceptual framework that decomposes the distributional effects from a carbon price into what we call a "supply-side" and a "demand-side".

On the *supply-side,* the cost of meeting comparable emission targets through carbon pricing will vary significantly between *countries*. Some countries will find it easier to reduce emissions due to, for instance, being able to scrap old polluting installations that were likely to close anyway. Similarly, the emissions profiles of countries differ, as some have more emissions in sectors that are relatively cheap to decarbonize. *Households*, meanwhile, are affected on the supply-side by nominal changes in labor, transfer, and capital income arising from carbon pricing, and these changes will affect household groups differently.

On the *demand-side,* some *countries* have poorer populations than others, and will therefore find a given carbon price more burdensome relative to national consumption expenditure. *Households*, on the other hand, are unevenly impacted by carbon price-induced changes in consumption prices.

We use this conceptual framework in the following section to characterize the distributional effects from more carbon pricing in the context of the Green Deal. We thereafter discuss remedies for mitigating any adverse distributional outcomes that might arise from the carbon pricing schemes.

WHAT ARE THE DISTRIBUTIONAL EFFECTS FROM MORE CARBON-PRICING IN THE GREEN DEAL?

Between Countries

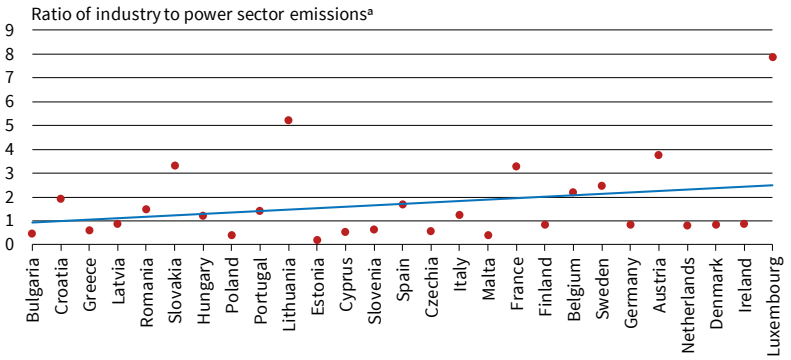
The Green Deal requires member states to increase their pace of decarbonization by 2030 and until 2050. In the following, we consider the between-country distributional effects of meeting the higher abatement through carbon pricing. To simplify the analysis, we assume a single uniform carbon price, covering all sectors and countries in the EU, initially exists and is increased as a result of the Green Deal.[2]

The higher carbon price will induce abatement by countries. On the supply-side, some countries will find it cheaper than others to reduce emissions. Part of the reason is that abatement opportunities differ *within* a given sector. Some member states can, for instance, still close polluting installations that have exceeded their economic lifetime, while others will have to conduct significant additional investments to reduce emissions within a given sector. But there are also differences in abatement opportunities *across* sectors. This can be seen by comparing countries' EU ETS emissions profiles. The EU ETS (currently) covers emissions from the power sector and industry. Richer member states typically have a high share of industrial emissions, which are costly to abate. Poorer member states, in contrast, typically emit relatively more in their power sectors, and these emissions are often cheaper to reduce.[3] Figure 1 portrays the different EU ETS emissions profiles by plotting the ratio of industry emissions to power sector emissions in 2019 by member state. Countries are ordered from left to right in terms of ascending GDP per capita adjusted for purchasing power. The blue trend line indicates that the share of industry in total EU ETS emissions is lower on average for poorer countries. The nine poorest countries have, on average,[4] a ratio of 0.67 industry to power sector emissions, while this ratio increases to 1.45 for the next nine richest countries, and to 1.02 for the nine richest countries.[5]

Figure 2 provides a stylized depiction of how heterogeneous emissions profiles can lead to uneven changes in abatement costs. The figure assumes there exists two countries A and B that partake in a joint carbon market like the EU ETS. The total abatement is determined by an emissions cap. Each country can reduce one unit of emissions at a cost corresponding

Figure 1

Ratio of Industry to Power Sector Emissions in 2019 by Country



[a] Industry emissions refer to the categories "Fuel combustion in manufacturing industries and construction (CRF1A2)" and "Industrial processes and product use (CRF2)" in EEA (2021) while "Fuel combustion in public electricity and heat production (CRF1A1A)" is used as a proxy for power sector emissions. The blue line is a linear trend line that best fits the data.
Source: Authors' compilation based on data from EEA (2021) and Eurostat (2021a).

[2] While this allows us to more clearly identify the supply- and demand-side considerations, we note that the distributional effects also depend on the scope of the carbon pricing scheme. For instance, the creation of a separate emissions trading system for road transport and building emissions, as proposed in the "Fit for 55" package, will impact countries unevenly. We return to this point in the next section, where we discuss ways of mitigating adverse distributional effects across countries for different scopes of carbon pricing schemes.

[3] The cheaper abatement in the power sector vis-à-vis industry is corroborated by a number of studies. The European Commission's Impact Assessment accompanying the 2030 Climate Target Plan, for instance, shows that power sector emissions decrease by a larger extent than industrial emissions in all scenarios (see Table 6 in European Commission 2020). Enerdata (2014) similarly finds that emissions from the power sector are comparatively easy to mitigate and account for most of the EU ETS abatement by 2030 in its scenarios.

[4] A weighted average was taken by country group.

[5] As a robustness test, we repeated the exercise using data from the EU ETS data viewer of the European Environment Agency, available here: https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1. We used the category "21-99 All industrial installations (excl. combustion)" as a proxy for industry emissions and "20 Combustion of fuels" as a proxy for power sector emissions. The country orderings did not change, as the industry to power sector emissions ratios for the three country groups were 0.42, 0.77, and 0.64, respectively.

to its marginal abatement cost (MAC). Panel (a) of Figure 2 shows the MAC curves for both countries and for the joint market (i.e., the sum of both countries' curves). The MACs are increasing in the level of abatement as it gets increasingly costly to reduce emissions. It is assumed that country B's emissions are easier to reduce, meaning it can abate comparatively cheaply (as reflected by its flatter MAC curve). The CO_2 allowance price is determined in the joint market by the MAC of meeting the cap. The price equalizes the MACs across countries and leads to abatement costs for each country corresponding to the shaded triangles in Panel (a).

Panel (b) shows the impact of tightening the cap.[6] This increases the CO_2 allowance price and both countries' abatement. Abatement costs increase to a larger extent for country A since its MAC curve is steeper. The figure therefore suggests how countries might be unevenly impacted by more stringent climate targets. In practice, some countries will face higher total abatement cost relative to their current emissions than other countries. This implies that, if the allocation of emission rights is solely based on current emissions ("grandfathering"), they might be worse off.

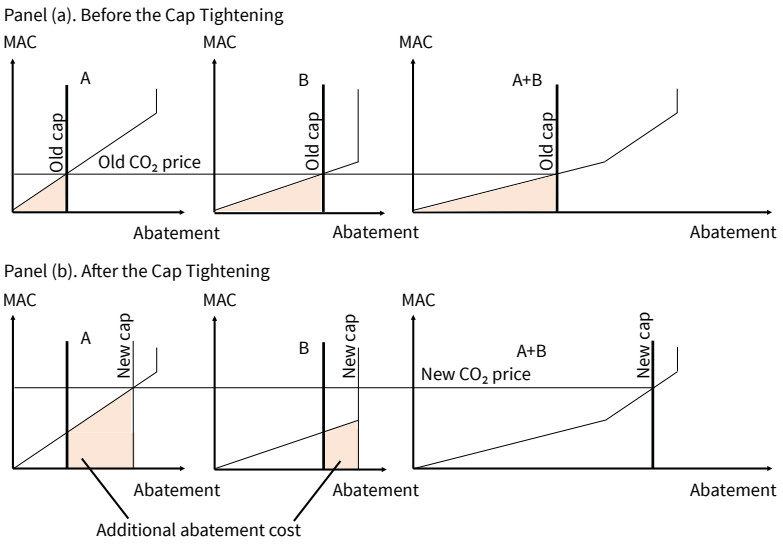
We now consider the demand-side argument. Some countries will find a given carbon price more intrusive than others as the carbon cost will constitute a higher share of their national consumption expenditure. Households in Poland (per-capita emissions of 10.4 tonnes), for instance, will on average find a carbon price of 60 EUR more burdensome than German households (per-capita emissions of 10.1 tonnes) relative to their consumption expenditure (actual individual consumption per-capita in Poland in 2020 was less than EUR 9,000 and almost EUR 23,000 in Germany).[7] Correspondingly, a carbon price of 60 EUR/tonnes would impact consumption by around EUR 500 in both countries (without recycling), but represent six percent of Polish actual individual consumption and only two percent of German actual individual consumption. These percentage values, on the one hand, exaggerate the effect as some of the per-capita emissions can be abated at a lower cost than the carbon price. On the other hand, in poorer countries, consumers might have a higher share of carbon-intensive products in their overall consumption basket (fuels, goods) than consumers in richer countries (services). On aggregate, based on such demand-side considerations, poorer countries might therefore be more affected by decarbonization if allowances are distributed based on historical emissions.

[6] We assume for simplicity that the allowance allocation after the cap tightening does not create any rents from allowance exports.

[7] The per-capita emissions statistics were retrieved from Eurostat (2021b) and the actual individual consumption statistics from Central Statistics Office Ireland (2021) who sourced them in turn from Eurostat.

Figure 2

Stylized Impact of Tightening an Emissions Cap on Abatement Costs[a]



[a] The figure is not drawn to scale. "A" and "B" refer to two hypothetical countries, while "A+B" is the joint market for allowances.
Source: Authors' compilation.

Within Countries

The additional abatement from the Green Deal will also have distributional implications within countries. We focus our attention on how households might be unevenly impacted if the abatement is met through higher carbon prices. The overall impact can be decomposed into an expenditure-side effect and an income-side effect.[8] The former can be considered demand-side in nature while the latter relates more to the supply-side. We elaborate on both effects below.

The expenditure-side effect refers to how households are affected by changes in the prices of goods and services. Carbon pricing will make emissions-intensive goods and services, such as petrol and heating fuels, more expensive compared to goods and services with a lower carbon content. This has an uneven impact across households since their expenditure patterns differ. Poorer households typically spend a larger share of their income on energy goods, meaning their consumption becomes relatively more costly. A carbon price therefore falls more heavily on the consumption expenditure of poorer households, which hurts them more on the expenditure-side (Burtraw et al. 2009; Goulder et al. 2019; Landis 2019; Hasset et al. 2009; Mathur and Morris 2014).

Rising consumption prices are only part of the overall effect of a carbon price, however. Households are also impacted on the supply-side, through the income-side effect. This incidence channel has until fairly recently been ignored in the literature. The income-side effect denotes how households are impacted by changes in nominal capital rents, wages,

[8] The expenditure-side effect and income-side effect are commonly referred to as the "uses-side effect" and "sources-side effect," respectively.

Table 1

Overview of the Demand- and Supply-side Distributional Effects between and within Countries from a Carbon Price (before Revenue Redistribution within Countries)

	Demand-side	Supply-side
Between countries	Carbon pricing especially hurts poorer countries, since a given carbon price reduces consumers' expenditure budgets there by a higher percentage	Richer countries are hurt more by a carbon price as their abatement opportunities are typically costlier
Within countries	Poorer households, whose consumption is typically more emissions-intensive, are particularly hurt by a carbon price	Richer households, who generally derive more income from capital and labor, are hurt more by a carbon price

Note: Red (blue) denotes low-income households or low-income countries being relatively worse (better) off. The "demand-side" and "supply-side" within countries are proxies for the expenditure-side effect and income-side effect, respectively.

Source: Authors' compilation.

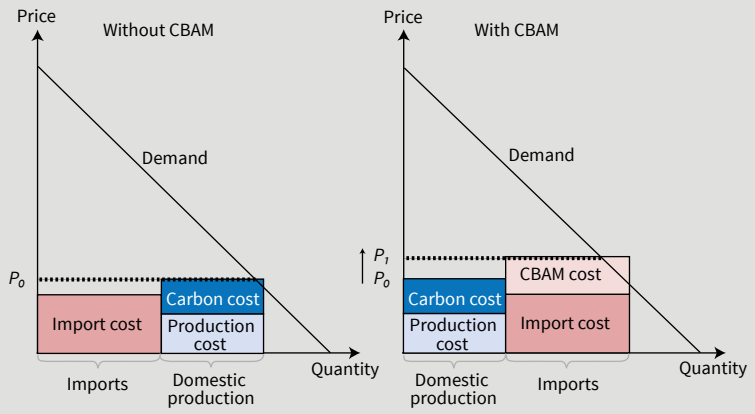
and transfer income. Richer households are typically hurt more on the income-side because they derive larger income shares from capital and labor, whose returns decrease as a result of carbon pricing. Poorer households, in contrast, earn relatively more transfer income, which is less affected by carbon pricing, especially if the transfers are indexed to inflation (Fullerton et al. 2011; Cronin et al. 2019). Poorer households are

WITHIN-COUNTRY DISTRIBUTIONAL EFFECTS OF THE CARBON BORDER ADJUSTMENT MECHANISM

The carbon border adjustment mechanism, proposed by the European Commission in the "Fit for 55" package (see European Commission 2021a), will have complex distributional implications. The CBAM is intended to prevent carbon leakage by requiring EU importers of certain carbon-intensive products to buy an amount of allowances proportional to the products' carbon content. The CBAM is meant to ultimately replace the free allowance allocation in the EU ETS, which has been used to prevent carbon leakage to date. The CBAM would apply to sectors currently in the EU ETS, and the price of the CBAM allowances would mirror the EU ETS price. By requiring importers to pay for the carbon content, the CBAM will likely increase the prices of covered goods. This is shown stylistically in Figure 3. Prior to the CBAM introduction, the market price equals P_0 and imports are cheaper than domestically produced goods (left figure). The CBAM increases the cost of imports, making them more expensive than domestic substitutes in the figure. The market price consequently rises to P_1 (right figure).

Figure 3

Stylized Depiction of the Effect of CBAM on Market Prices[a]



[a] The height of the red (blue) bars corresponds to the marginal cost of producing imported (domestic) varieties.

Source: Authors' compilation. © ifo Institute

The European Commission analyzed the distributional effects of the CBAM in the Impact Assessment accompanying the CBAM proposal (see European Commission 2021b). The analysis was conducted using a computable general equilibrium framework for various CBAM scenarios. The overall finding was that the CBAM is regressive, although the distributional effects are likely small in magnitude owing to a limited impact of the CBAM on consumption prices and household incomes.

The Impact Assessment decomposed the overall effect into the expenditure- and income-side. The expenditure-side effect was typically regressive, as the consumption of poorer households became disproportionately expensive in most countries. On the income-side, the CBAM was also generally regressive. The CBAM increased capital returns and wages, which benefited richer households in particular as they derive relatively more income from capital and labor. It should, however, be noted that part of the regressive income-side effect likely stemmed from the recycling mechanism (a reduction in labor income taxes) especially benefiting richer households.

therefore better shielded from factor income losses, which hurts them less on the income-side.

Another important component of the income-side is the way in which carbon revenue is redistributed to households (Goulder et al. 2019). It is well-recognized in the literature that the choice of revenue recycling mechanism matters considerably for the overall incidence of a carbon pricing policy. Landis and Heindl (2019) have found, for instance, that recycling carbon revenues in a progressive manner can help fully offset the regressive expenditure-side of carbon pricing schemes for many EU member states.[9] The importance of revenue recycling for distributional outcomes within countries is also shown for Belgium in particular by Vandyck and van Regemorter (2014) and for the United States by Burtraw et al. (2009) and Bento et al. (2009).

Even in the absence of revenue recycling, however, the income-side can fully offset the regressive expenditure-side. Rausch et al. (2010) and Rausch et al. (2011) were two of the first studies to take the income-side into account by analyzing the impact of carbon pricing on households in the United States using a computable general equilibrium framework. They found that the income-side offsets the expenditure-side even when ignoring revenue recycling, making the overall impact of the carbon pricing policy proportional to slightly progressive.[10] Rausch and Schwarz (2016) similarly show that the incidence from carbon pricing, in the absence of revenue recycling, is not necessarily regressive and is influenced by production and household characteristics. These studies highlight the importance of taking the income-side into account when assessing the distributional impact of carbon pricing policies within countries.

Summarizing the Distributional Effects

Table 1 summarizes the channels through which countries and households are unevenly impacted by more stringent carbon pricing in the Green Deal. The demand-side tends to disproportionately hurt lower-income countries and households, while the supply-side falls more heavily on richer countries and households.

HOW CAN THE POTENTIAL ADVERSE DISTRIBUTIONAL EFFECTS FROM THE GREEN DEAL BE ADDRESSED?

Between Countries

The distribution of cost from carbon pricing between countries can be shaped by (1) the way carbon markets are segmented, (2) the way allowances are allocated across countries, and/or (3) financial transfers.

Segmenting carbon markets allows having different carbon prices across countries and/or sectors. This is currently the case within the non-ETS sector, where Germany has an explicit carbon price of 25 EUR/tonne while Poland has none. And sectoral segmentation will likely continue under the Green Deal, as transport emissions will have a different carbon price than power sector emissions. The way in which politics allocates targets across countries and sectors will have distributional impacts.

Economists do not like segmenting markets, as this reduces efficiency, and the same allocation of cost can in principle be achieved by allocating fully fungible emission rights between countries. Such allocation is today conducted based on two principles: historical emissions and GDP. While different and more targeted allocations might be possible, opening up a zero-sum discussion on allocation of allowances between 27 member states is politically not easy.

Finally, a targeted allocation of cost between countries can also be achieved by financial transfers. While this is in principle equivalent to allocating fungible emission allowances, such financial transfers can in political practice be combined with conditionalities. The EU itself currently sells a number of emission allowances to finance special funds that are then used for specific purposes. By their design, the just transition, the innovation, and the modernization fund quite clearly focus on specific countries.

Overall, there will be a need to weigh the demand- and supply-side considerations to ensure an equitable and politically acceptable burden sharing. If the demand-side is prioritized, the abatement costs of poorer countries can be alleviated through compensatory measures. These can come in the form of generous allowance allocation in the EU ETS or lower non-ETS targets. Measures of the sort have already been implemented. The Phase IV rules of the EU ETS, for instance, allocate a disproportionately high share of auctioning revenue to lower-income member states (relative to their baseline emissions). Moreover, the non-ETS targets under the ESR are largely based on countries' economic capacity, which resulted in low targets for poorer member states. Such a demand-side emphasis would allow the EU to compensate poorer countries for part of their abatement costs. This is evidenced by Babonneau et al. (2018) for the non-ETS, who show that extending the non-ETS burden sharing rules under the original ESR to 2050 would benefit low-income countries relative to richer ones.

There is, however, a need to balance the demand-side considerations with the supply-side. Allocating too much of the additional non-ETS abatement to richer countries, who typically already have higher targets, would increase their costs considerably. Sartor et al. (2015) caution that failing to take into account abatement cost differences when design-

[9] Carbon pricing policies that leave low-income households better off relative to high-income households are called "progressive"; policies that make low-income households comparatively worse off are said to be "regressive"; while policies with a neutral impact are called "proportional."

[10] Specifically, Rausch et al. (2010) found that the impact is proportional to slightly progressive, while Rausch et al. (2011) found evidence of a roughly proportional impact.

ing burden-sharing rules in the non-ETS means that some countries might be unable to meet their targets. Moreover, the overall cost to the EU would increase if more abatement is undertaken in richer countries where emissions reductions are generally costlier. It can also be argued that poorer member states are already largely compensated for their carbon cost (e.g., through the overallocation of EU ETS auctioning allowances), meaning additional compensation might be too costly in terms of sacrificed cost effectiveness.

Integrating carbon markets could make it easier to increase the burden for low-income countries (to enhance cost-effectiveness) while ensuring they remain compensated. Vielle (2020) found that poorer member states would reap the largest gains from linking non-ETS markets. Market integration allows countries to trade allowances which, in theory, can equalize MACs across polluters, thereby improving cost-effectiveness (Böhringer 2014; Goulder and Parry 2008; Böhringer et al. 2006). Richer countries, who typically have higher MACs, benefit from lower total abatement costs, while poorer countries, whose MACs tend to be lower, gain revenue from exporting allowances. In practice, large overall cost savings could likely be achieved from non-ETS market integration (Sartor et al. 2015; Vielle 2020; Tol 2009) or from linking ETS with non-ETS markets (Böhringer et al. 2009; Babonneau et al. 2016).

One final point merits consideration. As highlighted by Sartor et al. (2015), increased flexibility, through for instance non-ETS market integration, will on its own not deliver the necessary financing and abatement required for low-income countries' low-carbon transition. It is therefore important that policies specifically aimed at supporting the decarbonization of low-income countries' non-ETS sectors are also implemented.

Within Countries

We have already seen that carbon pricing does not necessarily result in regressive within-country outcomes, even in the absence of revenue recycling. In the event that low-income households are disproportionately hurt, however, revenue recycling is an effective tool for making the incidence less regressive. The recycling can come in various forms, including per-capita lump sum transfers (Williams III et al. 2015; Burtraw et al. 2009) and the reduction of other regressive taxes. The carbon revenue could also be invested in projects that especially benefit low-income households. These include measures that improve energy efficiency in low-income housing, promote skill formation for vulnerable occupation groups during the energy transition, or make public transport more accessible for rural low-income households (Zachmann et al. 2018; European Commission 2021c).

There is furthermore evidence that transfer indexation can shield poorer households on the income-side. Fullerton et al. (2011), Cronin et al. (2019), and Goulder et al. (2019) show that indexing transfers to inflation can help compensate low-income households for higher consumption prices created by carbon pricing. These households benefit in particular from the indexation since they typically derive higher income shares from transfers.

CONCLUSION

The European Green Deal will affect different countries and different households unevenly. Moreover, distributional impacts can be decomposed into a supply- and demand-side.

On the supply-side, some poorer countries might benefit from cheap abatement opportunities, while on the demand-side carbon price-induced increases in final prices will represent a lower fraction of consumption expenditures for richer countries. Within countries, poorer households might be less affected by changes in nominal factor returns and transfers (supply-side), while they might feel increases in consumption prices more (demand-side). To properly address distributional effects, all major channels need to be fairly assessed.

The cost distribution across countries can be influenced by segmenting carbon markets, allocating allowances, and using financial transfers across countries. Revenue redistribution will become increasingly important if carbon markets are further integrated.

Within countries, progressively recycling carbon revenue and indexing transfers to inflation can lower costs for poorer households.

This article has two major caveats. First, we restrict our attention to carbon pricing, and therefore do not address the distributional effects of other climate policy instruments in the Green Deal (e.g., standards). Second, and relatedly, we do not consider how outcomes are impacted by the use of overlapping instruments for decarbonization in coming decades.

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