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DISCUSSION PAPER SERIES

IZA DP No. 17898

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ABSTRACT

Understanding Distributional Impacts of Carbon Pricing – Insights from Comparative Analysis

Carbon pricing is becoming increasingly common but raises equity concerns and is frequently perceived as putting higher burdens on the poor than the rich. This chapter discusses the reasons for unequal carbon price burdens across countries and population groups, through the lens of a comparative analysis for two countries with comparable climates but different income levels, Lithuania and Finland. The simulations consider multiple revenue recycling options, and they account for both the direct burdens from households' fuel consumption and indirect burdens associated with the impact of carbon charges on the prices of other goods. With no compensation to affected households, average burdens are larger and also more regressive in Lithuania than in Finland, largely because of cross-country differences in energy expenditure patterns. Net distributional outcomes depend crucially on how carbon tax revenues are used, however, and carefully designed compensation can prevent regressive impacts of carbon-price packages.

JEL Classification: C8, D12, D31, H23, Q52

Keywords: carbon taxation, carbon tax burden, distributional impact, energy budget share, environmental tax reform, revenue recycling

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Understanding distributional impacts of carbon pricing – insights from comparative analysis[1].

A widely adopted and growing form of environmental taxation relates to the pricing of CO_2 emissions. Currently, some 40 national and 25 sub-national jurisdictions explicitly price carbon to curb emissions and around a quarter of global emissions are covered by a carbon price, up from just 5% in 2010[2]. Measures including carbon taxes, cap-and-trade systems and phase-outs of fossil-fuel subsidies to incentivise a reduction in emissions and the substitution from dirtier to cleaner fuels and technologies. In addition, governments have long taxed fossil fuels through specific excise taxes, which are economically related to explicit carbon prices. For each fuel type, their base (fuel use) is proportional to associated CO_2 emissions, although the tax rates are not directly determined by the carbon content of the fuels[3]. Carbon pricing is regarded as environmentally effective, economically efficient, and simple to administer, without being technologically prescriptive[4]. Carbon pricing also raises significant government revenues that can be used to support a just energy transition, or to pursue other government objectives. Nonetheless, current prices often fall short of the levels needed to meet national and international reduction targets, with the Intergovernmental Panel on Climate Change (IPCC) warning that "coverage and prices have been insufficient to achieve deep reductions"[5]. Numerous governments are therefore considering reforms to increase effective carbon rates, by increasing prices in existing measures, by broadening the share of covered emissions, or by introducing new carbon-pricing instruments.

A key challenge for carbon-pricing initiatives relates to their impact on the cost of living, and its distribution across different population groups. By charging producers and consumers for emissions, carbon pricing

[1] This research was supported by the Luxembourg Fond National de la Recherche (AFR individual, project id: 14614512) and the Erasmus+ Programme of the European Union (ecoMOD Project, project number: 2023-1-LI01-KA220-HED-000157594). The opinions expressed and arguments employed herein are solely those of the authors. In particular, they ~~and~~ do not necessarily reflect the official views of the OECD or of its member countries.

[2] UNFCCC. About Carbon Pricing. Accessed 10/30/2024. https://unfccc.int/about-us/regional-collaboration-centres/the-ciaca/about-carbon-pricing#What-is-the-current-status-of-carbon-pricing-in-th

[3] Effective Carbon Rates 2023. OECD Series on Carbon Pricing and Energy Taxation, 2023. https://doi.org/10.1787/b84d5b36-en.

[4] Stiglitz, Joseph, et al. "Report of the high-level commission on carbon prices." (2017): 1-61.

[5] Lee, Hoesung, et al. "Synthesis report of the IPCC Sixth Assessment Report (AR6), Longer report. IPCC." (2023).

results in potentially sizable burdens for households, and these can vary significantly across and within countries[6]. There is a risk that burdens are regressive[7], creating obstacles for a just energy transition. The distributional impacts also affect public support and the public discourse, shaping the political economy of carbon pricing schemes[8].

While the literature on distributional impacts of carbon pricing is growing, there is a lack of in-depth comparative analysis that accounts for both direct impacts on household budgets (due to emission associated with domestic heating and transport fuel) and indirect impacts (due to emissions associated with the production of non-fuel goods and services). Household burdens are the result of complex interactions of numerous factors[7], leading to substantially different impacts across population groups and across countries. It remains difficult to anticipate household burdens in countries that may have broadly similar abatement commitments and climates but differ in other respects, including stage of development and population characteristics.

This chapter quantifies and discusses household burdens arising from a hypothetical (additional) carbon tax of €30 per ton of CO2 in Finland and Lithuania. The stylised tax is levied on CO2 emissions resulting from the combustion of fossil fuels (coal, natural gas, heating oil, petrol, and diesel) and biomass (firewood) by households, as well as those purchased by firms in each country, including for district heating and electricity generation[9]. Lithuania and Finland have comparable climates, especially in the most populous regions, but average income levels differ, as do experiences with environmental taxation. A comparison between those two countries therefore provides an instructive case study to discuss key drivers of the distributional impact of carbon pricing. The simulations consider multiple revenue recycling options and account for direct

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[6] OECD. OECD Employment Outlook, 2024. https://doi.org/10.1787/ac8b3538-en, 2024.
[7] Linden, Jules, Cathal O'Donoghue, and Denisa M. Sologon. "The many faces of carbon tax regressivity—Why carbon taxes are not always regressive for the same reason." Energy Policy 192 (2024): 114210.
[8] Dechezleprêtre, Antoine, Adrien Fabre, Tobias Kruse, Bluebery Planterose, Ana Sanchez Chico, and Stefanie Stantcheva. Fighting climate change: International attitudes toward climate policies. NBER Working Paper No. w30265. National Bureau of Economic Research, 2022.
[9] In our modelling, a carbon tax is imposed on the energy industries in relation to the carbon content of their output. We assume that the tax is forward shifted by the energy industries to producers of goods and services, which in turn forward shift the tax to the final consumer (i.e. the household). This implies that in our modelling, the entire carbon tax is forward shifted and borne by households.

burdens from households' energy consumption, as well as indirect burdens associated with the impact of carbon charges on the prices of non-energy goods.

Consumption patterns and distributional impacts differ markedly across the two countries. In Lithuania, energy budget shares follow an inverted U-shape across income groups, but poorer households consume more carbon-intensive energy than high-income ones. In Finland, energy budget shares increase with income and wealthier households consume more carbon-intensive energy. As a result, a uniform carbon price is more regressive in Lithuania than in Finland (but it remains slightly regressive in Finland because poorer households spent larger shares of their income). Average impacts are also larger in Lithuania. Using revenues to compensate households can lead to progressive impacts in both countries, but the distributional impact depends strongly on the type of revenue recycling (e.g. per capita transfers, indirect tax reductions, etc.), and even simple reforms lead to different outcomes across the two countries.

The chapter first highlights country-specific driving factors that shape household burdens from carbon pricing. It then discusses the role of carbon-price coverage and design. Next, it illustrates the distributional mechanics using Lithuania and Finland as case studies, and explores options for using carbon-pricing revenues to compensate households. A final section concludes with a short discussion and considerations for future work.

Carbon pricing across countries

Energy consumption and associated carbon footprints are unequal across countries. A key insight from the cross-country comparative literature is that they vary by average income and development level[10]. Carbon footprints are much higher in high-income countries, but in some middle-income countries, households spend a larger share of their income on energy. Within countries, the distribution of energy expenditures is

[10] Dorband, Ira Irina, Michael Jakob, Matthias Kalkuhl, and Jan Christoph Steckel. "Poverty and distributional effects of carbon pricing in low-and middle-income countries–A global comparative analysis." World Development 115 (2019): 246-257.

also related to the stage of development. This relationship between environmental footprints (in this case due to energy consumption) and income is commonly referred to as Environmental Engel curves[11].

A large 2019 study covering 87 low and middle-income countries identified a threshold of $US 15 000 per year (PPP-adjusted) below which a carbon tax is likely to be progressive[10]. This is explained by an inverse U-shaped relationship between average energy expenditure shares and average income, where average energy expenditure first increases faster than expenditure on other goods as countries, and households within countries, become wealthier, and then shrinks beyond a certain income level, as households start to priorities other consumption. Average energy budget shares are therefore low in poor countries, increase as households transition to middle-income levels, and fall again as countries' national income rise further.

A related pattern also finds support in studies across high-income European Union (EU) countries, with EU-wide carbon pricing found to be regressive across countries, putting a higher burden on comparatively poorer (and primarily Eastern) EU countries[12]. Key driving factors behind this pattern include higher energy budget shares in poorer countries, along with more carbon intensive production and consumption.

Country and region-specific characteristics other than income also shape household carbon footprints and the resulting incidence of a carbon tax. Relevant factors include average household size, climate, the energy mix, population density and car ownership, resource availability and access to infrastructure, the carbon-intensity of value chains, income inequality, and the housing stock[13]. Carbon price burdens are therefore highly context-dependent, with income levels an important determinant of energy use.

[11] Sager, Lutz. "Income inequality and carbon consumption: Evidence from Environmental Engel curves." Energy Economics 84 (2019): 104507.
[12] Feindt, Simon, Ulrike Kornek, José M. Labeaga, Thomas Sterner, and Hauke Ward. "Understanding regressivity: Challenges and opportunities of European carbon pricing." *Energy Economics* 103 (2021): 105550.
[13] Ivanova, Diana, Gibran Vita, Kjartan Steen-Olsen, Konstantin Stadler, Patricia C. Melo, Richard Wood, and Edgar G. Hertwich. "Mapping the carbon footprint of EU regions." *Environmental Research Letters* 12, no. 5 (2017): 054013.

Carbon pricing for a just transition: Design options for policymakers

Regressive carbon prices, with disproportional burdens on the poor and other low-income groups, can be due to multiple factors. First, energy consumption as a share of total expenditure (energy budget shares), may be higher at lower income levels (making energy a 'necessity' as defined by economists[14]). In addition, the coverage of a carbon price affects its distributional impact[15]. When tax-exempt commodities are heavily consumed by low-income households, a carbon tax will tend to be less regressive. In practice, some products or commodities are exempt under carbon pricing schemes[16], sometimes to protect households' living standards, and sometimes to protect industries from foreign competition. Here, we focus on the impacts on households' living standards.

Carbon prices on domestic fuel and electricity are generally more regressive than for motor fuel[17], as low-income households spend larger parts of their resources on heating and electricity. Levying carbon prices on motor fuels can in fact be progressive[18]. Taxing electricity and domestic fuels at different rates can have various distributional impacts depending on the energy mix and technology used to produce electricity. For instance, in China, the poorest spend a larger share of income on coal-based electricity while the wealthy spend more on heating fuel[19], making taxation of electricity more regressive than of heating fuels.

More granular differentiation of carbon prices by fuel type, across different types of heating or transport fuels, also affects distributional outcomes. For instance, in Ghana, the poorest predominantly use kerosene

[14] In economics, 'necessities' are defined as goods and services that have an income elasticity of less than one, i.e. the income share spent on the good or service declines with income. Conversely, goods and services are defined as 'luxuries' if they have an income elasticity greater than one.
[15] The empirical analysis of this chapter does not study the distributional impacts of various carbon tax designs.
[16] Sumner, Jenny, Lori Bird, and Hillary Dobos. "Carbon taxes: a review of experience and policy design considerations." *Climate Policy* 11, no. 2 (2011): 922-943.
[17] Flues, Florens, and Alastair Thomas. "The distributional effects of energy taxes." (2015).
[18] Vandyck, Toon, and Denise Van Regemorter. "Distributional and regional economic impact of energy taxes in Belgium." *Energy Policy* 72 (2014): 190-203.
[19] Jiang, Zhujun, Xiaoling Ouyang, and Guangxiao Huang. "The distributional impacts of removing energy subsidies in China." *China Economic Review* 33 (2015): 111-122.

for transportation, and firewood and charcoal for heating[20]. In Germany, charges on diesel were found to be more progressive than on petrol as wealthier households more heavily consume diesel[21].

In practice, carbon pricing schemes are indeed frequently designed to mitigate regressive impacts. For example, Mexico exempts natural gas from its (currently small) carbon tax to reduce its regressivity[22]. In the EU, a separate emission trading scheme was established covering the residential and transportation sectors, as higher carbon prices in these sectors have an immediate effect on households. Exempting 'dirtier' fuels used by the poor however compromises abatement objectives, as it weakens incentives to switch to less carbon-intensive alternatives.

The majority of household spending is on non-fuel items. Embedded (indirect or upstream) emissions associated to the production of goods and services can therefore make up large shares of households' total emissions[6]. Because non-fuel spending also tends to be "flatter" across income groups than fuel spending, accounting for the indirect burdens can render carbon pricing significantly less regressive[23]. Pricing emissions associated to the production of imported goods (through a Carbon Border Adjustment mechanism, CBAM) can also make carbon pricing less regressive[12]. Carbon pricing schemes sometimes feature different rates for household level or industrial emissions (for example in Denmark). In Europe, the EU Emission trading scheme (EU-ETS) first covered carbon intensive sectors, exempting the transportation and residential sectors. At the same time, however, substantial free allocations enable industries to gradually transition to low-carbon energy sources and can make EU-ETS effectively more regressive[24].

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[20] Cooke, Edgar FA, Sarah Hague, Luca Tiberti, John Cockburn, and Abdel-Rahmen El Lahga. "Estimating the impact on poverty of Ghana's fuel subsidy reform and a mitigating response." *Journal of Development Effectiveness* 8, no. 1 (2016): 105-128.
[21] Jacobs, Leif, Lara Quack, and Mario Mechtel. "Distributional effects of carbon pricing by transport fuel taxation." *Energy Economics* 114 (2022): 106290.
[22] Renner, Sebastian. "Poverty and distributional effects of a carbon tax in Mexico." *Energy Policy* 112 (2018): 98-110.
[23] Ohlendorf, Nils, Michael Jakob, Jan Christoph Minx, Carsten Schröder, and Jan Christoph Steckel. "Distributional impacts of carbon pricing: A meta-analysis." *Environmental and Resource Economics* 78 (2021): 1-42.
[24] Vandyck, Toon, Matthias Weitzel, Krzysztof Wojtowicz, Luis Rey Los Santos, Anamaria Maftei, and Sara Riscado. "Climate policy design, competitiveness and income distribution: A macro-micro assessment for 11 EU countries." *Energy Economics* 103 (2021): 105538.

While the discussion above focused on CO2 emissions, the coverage of other Greenhouse Gas (GHG) emissions, notably Methane emissions (CH4) and Nitrogen dioxide (N2O), also shape distributional impacts of pricing measures. At the household level, CO2 emissions result primarily from energy use, while a large part of CH4 and N2O emissions result from agricultural production. A study of the Netherlands found that a broader coverage of emissions beyond CO2 reduced the regressivity of a carbon tax[25] (due to more equal food spending shares than energy spending shares across income groups), while studies in Mexico[22] and 16 Latin American and Caribbean countries[26] found that including CH4 and N2O emissions makes carbon pricing more regressive (due to particularly high food spending shares among the poor).

The existing literature therefore highlights the likely impacts of specific design choices. As incomes, energy consumption and other expenditure patterns differ substantially across countries. Results are, however, difficult to generalise or to extrapolate from one country context to another[27].

Results I: When are carbon prices regressive?

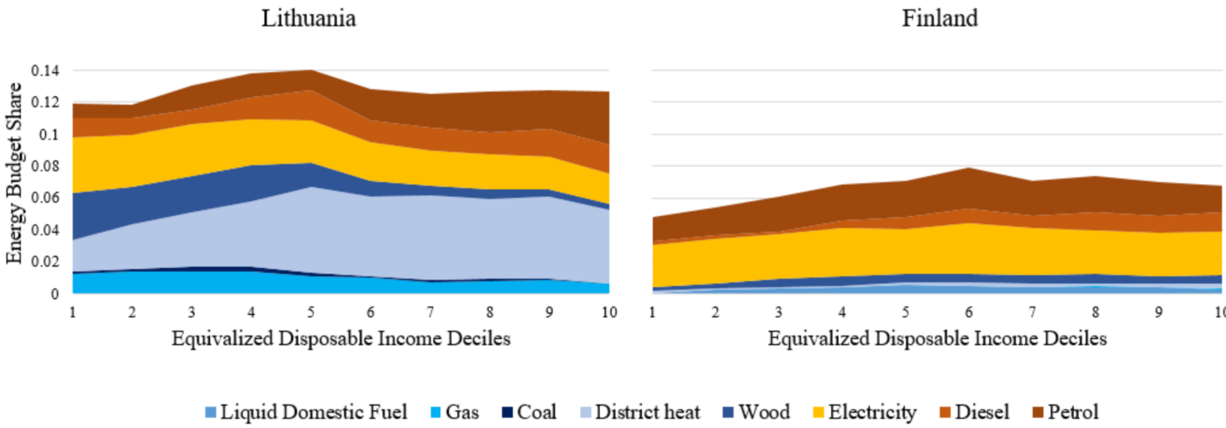
Comparisons between Finland and Lithuania illustrate that, even across countries in close proximity, energy budget shares can vary substantially, increasing with income for some types of energy, while declining with income for others. Overall, Figure 1 shows that, in Lithuania, the share of household income devoted to energy consumption is almost twice as high as in Finland. Average energy consumption increases with income in Finland, while it follows an inverted U-shape in Lithuania. Motor fuel budget shares (diesel plus petrol) increase with income in both countries, but diesel expenditure is concentrated among wealthier households in Finland, while wealthier households in Lithuania spend significantly more on petrol.

[25] Kerkhof, Annemarie C., Henri C. Moll, Eric Drissen, and Harry C. Wilting. "Taxation of multiple greenhouse gases and the effects on income distribution: A case study of the Netherlands." *Ecological Economics* 67, no. 2 (2008): 318-326.

[26] Vogt-Schilb, Adrien, Brian Walsh, Kuishuang Feng, Laura Di Capua, Yu Liu, Daniela Zuluaga, Marcos Robles, and Klaus Hubaceck. "Cash transfers for pro-poor carbon taxes in Latin America and the Caribbean." *Nature Sustainability* 2, no. 10 (2019): 941-948.

[27] Steckel, Jan C., Ira I. Dorband, Lorenzo Montrone, Hauke Ward, Leonard Missbach, Fabian Hafner, Michael Jakob, and Sebastian Renner. "Distributional impacts of carbon pricing in developing Asia." *Nature Sustainability* 4, no. 11 (2021): 1005-1014.

Figure 1. The average energy expenditure as share of the household budget by income group



Source: Authors' own calculations. Based on 2015 EU-Household Budget survey data.

The carbon content of energy varies markedly across fuel type and, for electricity, it also varies across countries. The energy mix therefore has a significant impact on carbon-price burdens. As shown in Figure 1, the mix varies markedly by income. In addition, other characteristics, such as location, also play an important role and tend to be correlated with income[6]. Households in urban areas are, for instance, more likely to have access to district heating networks, while poor and rural household may rely more heavily on traditional biomass or liquid fuels. Some households rely heavily on electric heating. Figure 1 shows that carbon-intensive wood and coal consumption is concentrated among low-income households in Lithuania, while wealthier households rely more heavily on comparatively low-carbon district heating. In Finland, households appear to rely on electric heating to a significant extent. Higher energy budget shares for low-income groups, and a carbon-intensive energy mix, both suggest that carbon-price burdens will be larger, and likely more regressive, in Lithuania than in Finland.

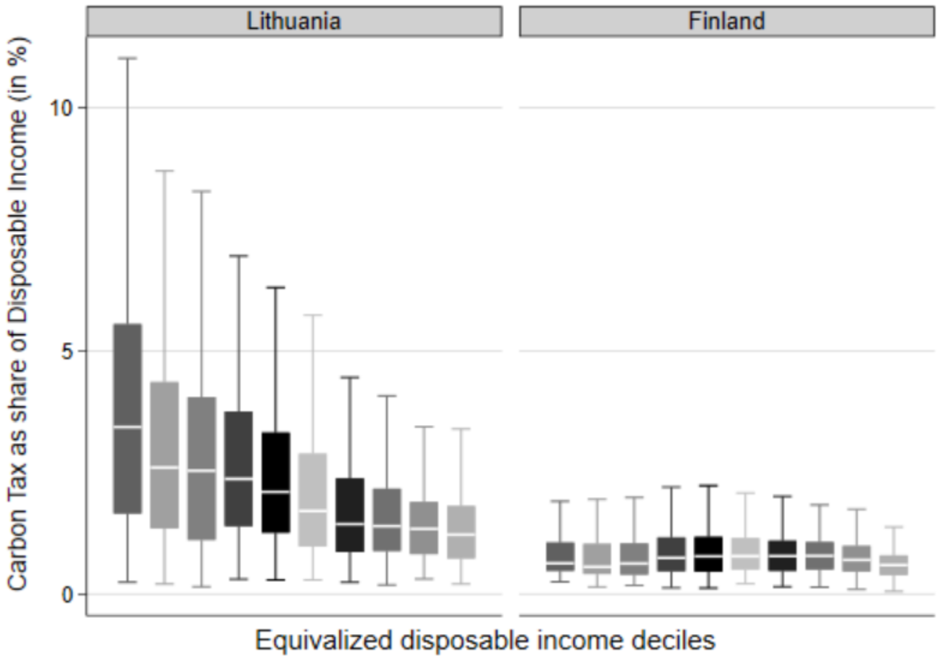
Households differ also in their capacity to absorb the costs of carbon pricing. Carbon charges are levied in relation to consumption (of carbon-intensive goods), while analysts and policymakers are often interested in carbon-price burdens relative to income. The difference between expenditure and income is given by savings. Households with higher savings rates will thus see smaller burdens relative to their income, and they will have a greater capacity to absorb higher energy prices and living costs. By contrast, for households that barely manage to save at all, or that dis-save, higher carbon prices are more likely to create binding constraints on their ability to purchase essential goods and services. The role of savings rates for distributional impacts of carbon pricing is commonly recognized[28], though often only implicitly so. Where savings rates vary strongly with income, carbon pricing tends to be more regressive[7]. Relatedly, savings also play an important role for investments into low-carbon heating systems and vehicle, as they are a pre-requisite to invest for most households.

Accounting for differences in both consumption patterns and savings rates, Figure 2 shows a much more regressive distribution of carbon tax burdens in Lithuania than in Finland. Comparing with Figure 1 demonstrates that energy expenditures are not the only determinant; for instance, carbon tax burdens do not follow the same inverted U-shape as energy expenditure[29]. A higher-carbon energy mix in Lithuania, and negative savings rates among Lithuanian low-income households, explain the bigger impact on low-income groups, and the regressive overall impact.

[28] Poterba, James M. "Tax policy to combat global warming: on designing a carbon tax." (1991).

[29] A previous analysis of a carbon tax in Lithuania was published as a working paper (Immervoll, Herwig, Cathal O'Donoghue, Jules Linden, and Denisa Sologon. "Who pays for higher carbon prices? Illustration for Lithuania and a research agenda." OECD Social, Employment, and Migration Working Papers 283 (2023): 0_1-53.). The distributional impact estimates presented in this chapter differ from those in the published working paper for various reasons. First, this chapter analyses a €30 per ton of carbon tax while the working paper analyses a €60 per ton tax. Second, the base year in this chapter is 2015 and 2022 in the working paper. Third, the primary dataset in this chapter is the Lithuania Household Budget Survey, while the working paper uses the Survey on Income and Living Conditions with expenditure patterns imputed, rather than observed. Fourth, the working paper accounts for household behavioural responses, not included in this chapter.

Figure 2. Carbon tax burden as share of household disposable income (direct and indirect emissions)



Note: Simulation of a uniform €30 per ton CO2 tax. Box represents the middle 50% (25th to 75th centile), light horizontal lines represent the median, whiskers show the overall spread (2.5th to 97.5th centile). Household emissions, and thus carbon tax payments, include direct emissions (from household fuel consumption) and indirect emissions (from the production of non-fuel goods and services, including electricity).

Source: Authors' calculations. Based on 2015 EU-Household Budget survey data and World Input Output Data. For methodological details see O'Donoghue et al. (2025)[30].

Figure 2 shows a significant spread of burdens within income groups, indicating that they can differ as much, or more, within income groups as between them, and confirming findings from some earlier studies [31].While the main attention here is on income groups, differences between demographic groups or regions can help to understand patterns of public support for, or resistance to, carbon pricing policies. They are also

[30] ODonoghue, Cathal, Beenish Amjad, Jules Linden, Nora Lustig, Denisa Sologon, and Yang Wang. "The Distributional Impact of Inflation in Pakistan: A Case Study of a New Price Focused Microsimulation Framework, PRICES." *International Journal of Microsimulation* (2025 forthcoming).
[31] Cronin, Julie Anne, Don Fullerton, and Steven Sexton. "Vertical and horizontal redistributions from a carbon tax and rebate." *Journal of the Association of Environmental and Resource Economists* 6, no. S1 (2019): S169-S208.

needed for targeting support to the most impacted groups, and for anticipating future emission trends and associated policy priorities, e.g. in the context of population ageing.

Results II: Using carbon-pricing revenues to compensate households

A key advantage of carbon pricing over other climate-change mitigation measures is that it raises revenues[32]. The use of these revenues, in turn, determines the net distributional impact of carbon price reforms, and is likely to shape public support for it[33]. Revenues can be used for redistributive, environmental or unrelated purposes[34]. Here, we focus on the impacts of revenue recycling on distributional outcomes.

A central insight from existing research on the distributional impact of carbon pricing is that, with full revenue recycling, the distributional impact of revenue use can outweigh that of carbon pricing itself[31]. Even a fraction of carbon-price revenues may be sufficient to make the overall impact of a carbon price progressive[26]. Whether net impacts are in fact progressive or regressive depends, however, on the specific design and targeting of household compensation. In designing compensation mechanisms, a fundamental challenge is that full compensation for everyone is not possible[35]. Consumption patterns and the resulting carbon price payments are diverse and correlate imperfectly with observable household characteristics that can be used to target payments. Reforms will necessarily create winners and losers and the incidence of gains and losses is important for social equity and for political-economy reasons.

Environmental tax reform may involve shifting the tax burden from existing distortionary taxes, such as taxes on labor, to resources or pollution and may possibly achieve a “double dividend”. Under the double dividend hypothesis, environmental taxation combined with reductions in existing taxes (income, corporate,

[32] Revenues differ across carbon pricing schemes, depending on their scope and design. Emission trading schemes in particular often include free allocations to specific industries, for instance emission intensive trade exposed industries. Free allocations reduce the revenue collected.

[33] Klenert, David, Gregor Schwerhoff, Ottmar Edenhofer, and Linus Mattauch. "Environmental taxation, inequality and Engel’s law: The double dividend of redistribution." *Environmental and Resource Economics* 71, no. 3 (2018): 605-624.

[34] Steenkamp, Lee-Ann. "A classification framework for carbon tax revenue use." *Climate Policy* 21, no. 7 (2021): 897-911.

[35] Sallee, James M. *Pigou creates losers: On the implausibility of achieving pareto improvements from efficiency-enhancing policies*. No. w25831. National Bureau of Economic Research, 2019.

consumption, or capital tax) could simultaneously improve economic and environmental conditions. The initial impact of reductions in income, consumption, and corporate taxes however may be regressive[36]. Analysis incorporating adjustments in employment, wages, and capital incomes find that income tax cuts may benefits low-income households sufficiently to turn regressive into net progressive impacts[36].

If the aim is to compensate households and avoid increases in inequality in the short-term, other revenue recycling options may be preferable. Per capita lump-sum transfers tend to turn net impacts progressive[37], overcompensating most low-income households. Targeted benefits to the poor, the energy poor, or to disproportionally affected regions also turn net impacts progressive, and can do so at significantly lower fiscal cost than untargeted lump-sum transfers[37]. Similarly, proportional increases in existing social benefits will be progressive[38], if the underlying benefit system is.

Various countries have implemented some form of revenue recycling. South Africa uses carbon-tax revenues to finance a reduction of existing electricity generation levies. British Columbia uses revenues to cut other taxes, and to provide for direct transfers to households. Switzerland uses one third of revenues to support a green transition and reduce energy consumption, and the rest to lower health insurance premiums. Austria introduced a “climate bonus” paid to residents, a lump-sum payment, whose level varies by region. At the EU level, countries are currently designing Social Climate Plans, detailing their plans to use EU-ETS revenues to compensate vulnerable households.

The impact of these different revenue recycling options differs across countries, however. Households with characteristics used to target payments may be wealthier or poorer in some countries than others. Figure 3 shows the distributional impact of three reforms where all revenues are returned to households through

[36] Goulder, Lawrence H., Marc AC Hafstead, GyuRim Kim, and Xianling Long. "Impacts of a carbon tax across US household income groups: What are the equity-efficiency trade-offs?." *Journal of Public Economics* 175 (2019): 44-64.

[37] Berry, Audrey. "The distributional effects of a carbon tax and its impact on fuel poverty: A microsimulation study in the French context." *Energy Policy* 124 (2019): 81-94.

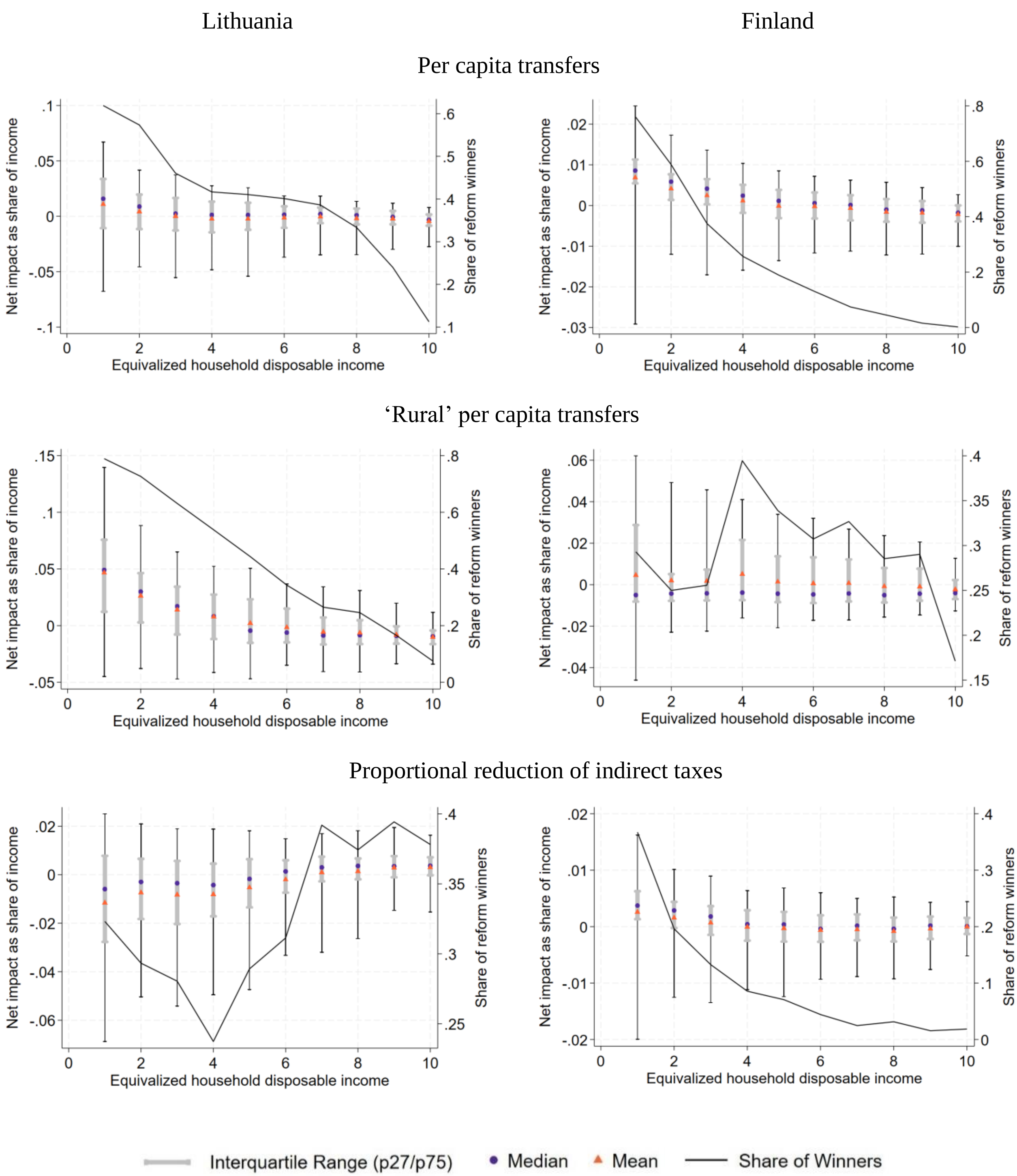
[38] Immervoll, Herwig, Cathal O'Donoghue, Jules Linden, and Denisa Sologon. "Who pays for higher carbon prices? Illustration for Lithuania and a research agenda." OECD Social, Employment, and Migration Working Papers 283 (2023): 0_1-53.

transfers or lower indirect taxes. Unconditional per capita lump-sum transfers lead to progressive impacts in Lithuania and Finland, but the share of low-income households gaining from the reform is higher in Finland. Compared to Finland, a greater share of middle-income households in Lithuania gain from such a reform. In Lithuania, close to 15% (34%) of revenues would be sufficient to fully compensate the bottom two (four) deciles, while 8% (23%) would be sufficient in Finland. A version of the lump-sum, per capita transfers, where (all) revenues are returned to rural households only, is more progressive in Lithuania, as the correlation between location and carbon tax burdens is stronger in Lithuania than in Finland. Some countries, like France or Germany, and recently also Finland[39], have lowered indirect taxes on energy commodities to limit the increase in energy prices due to carbon pricing[6]. In our simulations, a simple proportional reduction in indirect taxes is overall progressive in Finland but regressive in Lithuania. These examples highlight that the distributional impact of revenue recycling programmes can dominate that of the carbon tax, and that even simple revenue recycling schemes can have very different distributional impacts across countries. Some further countries, like Portugal and Sweden used revenues to reduce income taxes. This type of revenue recycling is not modelled here. As noted above, it likely results in more regressive initial impacts, though the medium-term impacts are unclear[40].

[39] OECD. Effective Carbon Rates 2023: Pricing Greenhouse Gas Emissions through Taxes and Emissions Trading. OECD Series on Carbon Pricing and Energy Taxation. Paris: OECD Publishing, 2023. https://doi.org/10.1787/b84d5b36-en.

[40] For a simulation of this scenario, see also Immervoll, Herwig, Jules Linden, Cathal O'Donoghue, and Denisa Maria Sologon. "Who pays for higher carbon prices? Illustration for Lithuania and a research agenda." (2023).

Figure 3. Distributional impacts with revenue recycling, and share of individuals gaining overall



Note: Positive values represent net gains for the household (the household's revenue recycling payment exceeds its carbon tax payment) and negative values represent net losses (the household's carbon tax payment exceeds its revenue recycling payment).

Conclusion

This chapter reviewed the evidence on the distributional impact of carbon pricing and provided a comparison of its impact across two countries with comparable climate but different development levels, Lithuania and Finland. The distributional effects of carbon pricing result from complex interactions of numerous factors, leading to substantially different impacts across countries, and relevant driving factors including the proportion of energy consumption relative to income across different groups, the types of energy consumed by these groups, the pricing of various energy sources, and how carbon-pricing revenues are allocated or utilised.

The results illustrate how expenditure patterns, notably on energy, and income levels in the two countries lead to markedly different burdens for households. Further, it shows how differences in population characteristics and existing tax-benefit systems cause a divergence in the impact of even simple revenue recycling schemes. In doing so, this chapter highlights the complexity that drives short-term distributional outcomes of carbon pricing, and the need for timely country-and region-specific analysis.

The primary aim of a carbon price is to change the behaviour of individuals and firms so to reduce emissions. In the medium and long run, these changes in behaviour have effects on production, investments, and jobs, and affect environmental quality, and thus people's health and exposure to climate damages. Short-term impacts on households are, however, an important consideration for social equity reasons, and they can be decisive factor for the political feasibility of necessary climate mitigation efforts.