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THE DISTRIBUTIONAL IMPACT OF CARBON PRICING AND ENERGY RELATED TAXATION IN IRELAND

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ABSTRACT

In this paper we evaluate the distributional impact of carbon pricing in Ireland via a number of different measures, Excise Duties, Carbon Taxes and the EU Emissions Trading Scheme, utilising information contained in the OECD Effective Carbon Rate (ECR) database together with the PRICES model. Essential household energy consumption constitutes a significant portion of spending, particularly for lower-income households, indicating regressive expenditure patterns across income brackets. The immediate impact of carbon pricing on household budgets varies based on their reliance on various fuels for heating and transportation (direct impact), as well as the emissions associated with other goods and services (indirect impact). Carbon footprints vary widely among households, with higher-income ones generally emitting less than lower-income ones as a percentage of their income. Although carbon footprints primarily dictate the burdens of carbon pricing, other factors such as the uneven application of carbon pricing policies and disparities in emissions between industries and fuel types also influence the equation. Despite the necessity for substantial carbon price hikes to meet climate targets, the effects on household budgets during the 2012-2021 period were relatively modest. Carbon pricing reforms typically exhibited regressive trends, disproportionately affecting lower-income households relative to their earnings. We modelled also a number of different reforms utilising the revenue generated by the additional carbon revenues. The net impact in terms of winners and losers depended very significantly upon the both the nature of the expenditure and upon the share of revenue used.

SECTION 1

Introduction

In addressing the root causes of climate change, OECD nations, including Ireland, have embraced various forms of carbon pricing to align the private cost of carbon with its social cost. The objective is to encourage emissions reduction and promote the transition from dirtier to cleaner energy sources and technologies (see Klenert et al., 2018). However, existing carbon prices and other mitigation policies fall short of the levels required by national and international commitments, such as those outlined in the Paris Agreement. Consequently, many governments are contemplating reforms to introduce or elevate carbon prices, or broaden the coverage of emissions subjected to pricing.

The implementation of carbon pricing, by charging emissions from producers and consumers, initially leads to price hikes and generates significant government revenue. Ireland introduced carbon taxation in 2010 and joined the second phase of the EU emissions trading scheme that operated between 2008 and 2012, and has been a member since. However, carbon pricing can impose considerable financial burdens on households, especially those belonging to vulnerable groups, potentially exacerbating economic disparities, particularly amid ongoing cost-of-living challenges. Such disparities in carbon-price burdens can influence support or opposition toward climate change mitigation policies. Hence, there is an argument for safeguarding vulnerable segments from the adverse impacts of increased carbon prices, not only for reasons of social equity but also to maintain or garner support for a transition to a low-carbon economy.

The literature on the distributional incidence of carbon pricing in Ireland goes back at least 30 years. Scott (1992), extended and updated in Scott and Eakins (2004), considered the direct distributional incidence of carbon taxes, while O'Donoghue (1997) considered both the direct and indirect incidence, with both highlighting the regressive nature of a theoretical carbon tax but with a flatter indirect component. These papers used tabular distributional data due to the unavailability of microdata. The next phase of work took the approach of O'Donoghue but applied it to publicly available microdata, with Verde and Tol (2009) again finding the regressive nature of a theoretical carbon tax on households with lower energy efficiency, while Callan et al. (2009) considered the net impact of a tax with revenue recycling. This work was cited in an analysis of the actual carbon tax implemented in Ireland by Convery et al. (2013). More recently, there has been a renewed interest in the distributional impact of carbon pricing. While much of the existing literature considered vertical distributional characteristics in terms of income, Farrell (2017) explored the horizontal redistributional characteristics of the tax, with socio-economic characteristics (such as age, family status, education and housing characteristics) being an important driver of carbon taxes associated with motor fuels and electricity. De Bruin and Yakut (2019; 2023) explored the general equilibrium effects of the actual carbon tax system in Ireland, while Reaños et al. (2022) estimated the distributional impact of an actual carbon tax using a sophisticated demand system, while Reaños et al. (2023) extended the analysis to incorporate the net benefit of reduced carbon emissions. Linden et al. (2023) undertook a comparative exercise across welfare regimes across Europe, finding that Ireland was mid-ranked in relation to the inequality-increasing nature of a theoretical carbon tax in Europe.

This paper examines the impact of carbon pricing policies on households, examining various avenues through which these effects are distributed. It quantifies the burdens on households arising from the influence of carbon prices on consumption expenses and explores potential compensation measures that governments can fund with carbon-pricing revenues. This analysis calculates the distributional incidence of household carbon footprints, utilising the Household Budget Survey, accounting for household emissions and those embedded in the production of goods and services consumed.[1]

The paper uses the PRICES microsimulation model (O'Donoghue et al., 2023) developed for use in price-related changes, including inflation (Sologon et al., 2022; Can et al., 2023), carbon pricing (Linden et al., 2023; Immervoll et al., 2023), and indirect taxation. The PRICES model takes Household Budget Survey data, transforming it into a standard format of expenditure, own produced consumption (where it exists) and socio-economic data for the household. The model estimates an Engle curve and budget share equations in order to derive budget elasticities and contributes to the development of LES based price elasticities using a methodology described in O'Donoghue et al. (2023) and Creedy (1999). The model contains a suite of policy algorithms set up in a generic way for application in different countries and a series of welfare and distributional analysis tools. As in the case of other European Union countries, we use the Eurostat harmonised Household Budget Survey for Ireland for 2015. For carbon taxation and carbon pricing, we utilise an Input-Output table from the World Input-Output Database (WIOD) for 2014 in order to calculate indirect effects.

These findings aim to provide insights into the implications for public support or resistance to carbon-pricing policies.

1 The Irish Household Budget Survey for 2015 has been made available as part of the cross-Europe harmonised dataset provided by Eurostat.

SECTION 2

Distributional impacts of carbon pricing strategies

Mitigation policies targeting climate change have multifaceted effects on distribution, influencing households both economically by altering their consumption capabilities, and otherwise through direct impacts on well-being, health, and ancillary benefits such as enhanced air quality resulting from CO_2 emission reductions (Zachmann et al., 2018; Rudolph et al., 2022). Economic repercussions primarily involve shifts in prices, which are the focal point of this discussion. Moreover, mitigation efforts reshape the incomes of workers and asset owners by modifying returns across various production factors, encompassing labour, natural resources, and equity in sectors deemed ‘green’ or ‘brown’ (Rausch et al., 2011). Numerous meta-analyses offer systematic evaluations (Peñasco et al., 2021; Lamb et al., 2020; Markkanen and Anger-Kraavi, 2019). This section describes the distributional mechanisms through alternative channels, with a focus on non-price mitigation.

Energy-efficient and clean technologies are pivotal in the climate change mitigation agenda. Demand-side interventions, including subsidies and related incentives (e.g. preferential feed-in tariffs for solar power), typically accelerate technology adoption and dissemination and may hold political appeal (Giraudet et al., 2011; Douenne and Fabre, 2022). However, assessments of past measures often indicate regressiveness, surpassing that of carbon pricing, as they primarily benefit higher-income households with the necessary capital for investing in low-emission assets (Lihtmaa et al., 2018; Lekavičius et al., 2020; Winter and Schlesewsky, 2019; West, 2004; Levinson, 2019). Impact disparities across technologies exist, with subsidies for electric vehicles displaying more regressive effects than those for home insulation or solar panels, and minimal income correlation observed in heat pump adoption (Borenstein and Davis, 2016; Davis, 2023). Design features of subsidies or tax credits, such as refundability, timing and targeting significantly influence distributional outcomes (Giraudet et al., 2021). Outright bans on the demand side, relatively prevalent in Europe, impose restrictions on vehicle usage or specific residential heating types (Braungardt et al., 2023). However, bans raise equity concerns, potentially burdening the poorest with unaffordable asset replacement costs unless accompanied by targeted exemptions or compensation (Torné and Trutnevyte, 2024).

Supply-side measures influence production processes through regulation or subsidies, exemplified in the US Inflation Reduction Act and the European Union’s Net-Zero Industry Act. While comprehensive studies are limited, initial evidence suggests progressive impacts of ‘supply-push’ policies integrated into such packages (Brown et al., 2023). Regulatory approaches encompass targeted measures like building energy codes, fuel economy standards and vehicle pollution control, including bans on high-emission technologies, with some evidence indicating greater burdens on lower-income households (Davis and Knittel, 2019; Jacobsen, 2013; West, 2004; Bruegge et al., 2019). Regulatory frameworks may involve comprehensive packages with varied scopes and distributional impacts, with some evidence pointing to regressive effects (Levinson, 2019).

SECTION 3

Effective carbon rates: Concept, measurement and interpretation

This paper utilises information from the OECD Effective Carbon Rates (ECRs) database, which reports carbon prices derived from carbon taxes, emissions trading systems (ETSs), and fuel excise taxes levied on energy use. It encompasses 72 countries, collectively responsible for approximately 80 per cent of global greenhouse gas (GHG) emissions in 2021. Effective carbon rates take into consideration implicit fossil fuel subsidies when provided through preferential excise or carbon tax rates, ensuring that total ECRs are always equal to or greater than zero. However, they do not consider government interventions that decrease pre-tax fossil fuel prices, resulting in negative carbon prices. 'Carbon taxes' encompass explicit taxes not only on CO_2 emissions but also on emissions of other GHGs, such as taxes on fluorinated gases (F-gases). It however only includes emissions from energy sources. It ignores, for example, methane or nitrous oxide emissions from agriculture, or emissions from other sources such as land use change or non-energy industrial processes. It should be noted that carbon prices are typically subject to VAT, which is not considered in this study as a carbon price.

The pricing mechanisms included in the ECR dataset either establish an explicit price per unit of GHG (e.g. per tonne of CO_2e in the case of ETSs or carbon taxes)[2] or a base that is proportional to the resulting GHG emissions (e.g. excise taxes per unit of fuel). Carbon taxes typically set a rate on fuel consumption based on its carbon content, or less commonly, apply directly to GHG emissions. Fuel excise taxes are usually set per physical unit or per unit of energy, which can be converted into rates per tonne of CO_2. Tradable emission permit prices under ETSs represent the opportunity cost of emitting an additional unit of CO_2e.

The detailed granularity of the ECR data is essential for capturing variations in emission prices across sectors and, consequently, across consumption categories that influence carbon price burdens for households. The database encompasses six sectors covering all energy uses; road transport, electricity, industry, buildings, off-road transport, agriculture, and fisheries. Fuels are categorised into nine groups, including coal, fuel oil, diesel, kerosene, gasoline, liquefied petroleum gas (LPG), natural gas, other fossil fuels and non-renewable waste, and biofuels. CO_2 emissions in the ECR database are based on energy use data from the International Energy Agency's World Energy Statistics and Balances (IEA, 2020). The database

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2 tCO_2e stands for tonnes (t) of carbon dioxide (CO_2) equivalent (e). See https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Carbon_dioxide_equivalent.

also incorporates other GHG emissions, such as methane (CH_4), nitrous oxide (N_2O), F-gases, and process CO_2 emissions, sourced from the CAIT database (Ge and Friedrich, 2024).

In the context of this paper, the standard ECR indicator is utilised as the price passed on to consumers, disregarding free emissions allocations to producers. This assumption implies full marginal-cost pass-through, irrespective of the permit allocation method, with any free allocations serving as a rent for emitting firms. Empirical evidence suggests marginal-cost pass-through and associated 'windfall profits' in the energy sector.

From 2012 to 2021, Effective Carbon Rates (ECR) increased in most OECD countries.[3] This increase occurred in both nominal and real terms. When ECR decreased, it was usually due to inflation or changes in exchange rates. Fuel excise taxes constitute the largest portion of total ECR in many OECD nations. Since 2005 EU countries, along with Iceland and Norway, have participated in the EU Emissions Trading System (ETS), experiencing significant increases in permit prices from 2018 to 2021. The European Union aims to expand carbon pricing into transportation and building sectors through emissions trading as part of its 'Fit for 55' package. Explicit carbon taxes were first introduced in Finland in 1990 and Norway in 1991, and many countries have followed suit or announced plans to do so since then. Additionally, countries are taking various steps to phase out fossil fuel subsidies (G20 Leaders Statement, 2009[4]; OECD/IEA, 2021).

Similarly, per-capita carbon emissions from energy use decreased in most OECD countries, as illustrated in Figure 3.1. On the other hand, despite having lower average emissions than OECD countries in 2012, not all non-OECD G20 countries have seen a decline like the OECD area.

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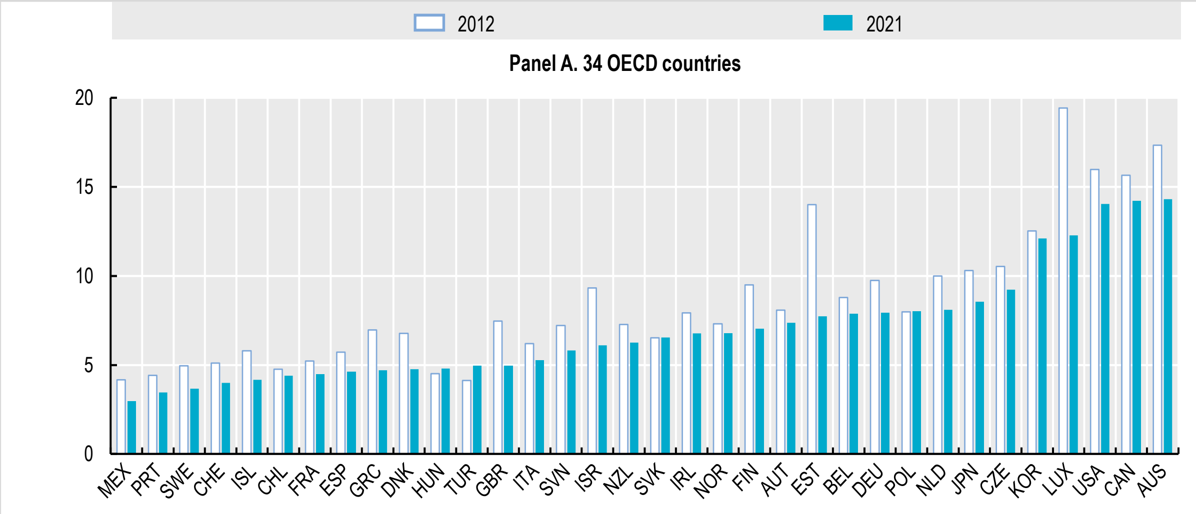
3 See forthcoming chapter in OECD Employment Outlook.
4 https://www.oecd.org/g20/summits/pittsburgh/G20-Pittsburgh-Leaders-Declaration.pdf.

FIGURE 3.1 CARBON EMISSIONS FROM ENERGY USE IN OECD COUNTRIES (TONNES OF CO_2 PER CAPITA, 2012 AND 2021)



Source: OECD Employment Outlook (forthcoming).

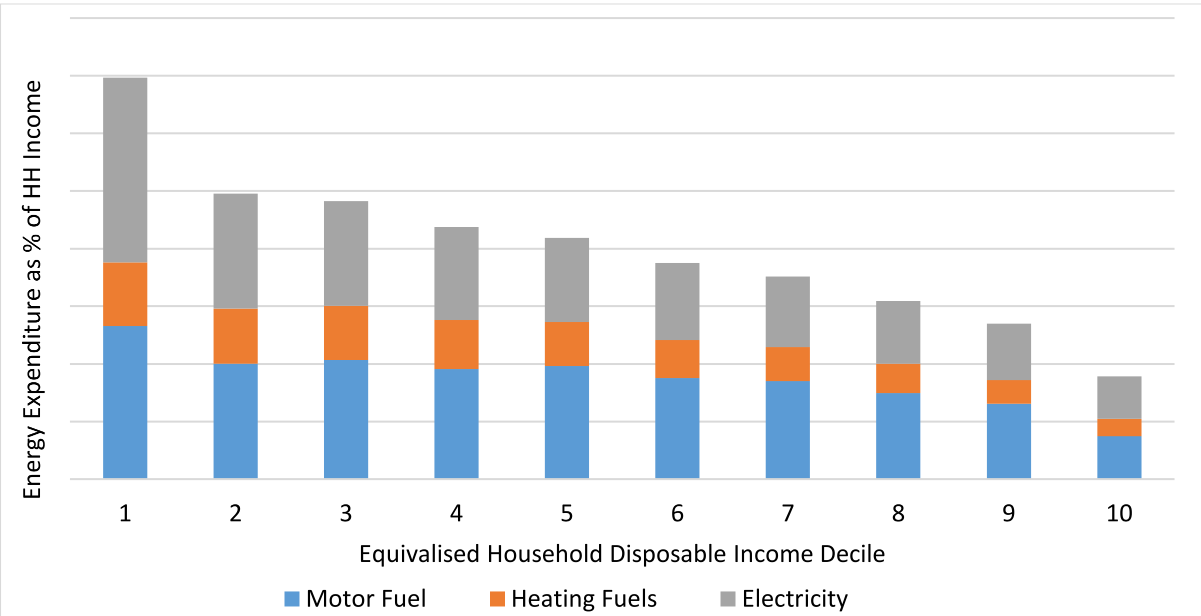
SECTION 4

Results for Irish analysis

Carbon prices impact household budgets both directly and indirectly. Directly, they influence households' expenses on their own fuel consumption, including heating and transportation fuel. Indirectly, carbon prices affect the cost of goods and services that generate CO_2 emissions during production. Figure 4.1 illustrates this impact, showing spending on electricity, which is a derived product often produced using fuel-intensive methods. Energy-related emissions from various derived goods, such as food and public transport, contribute to overall carbon footprints.

Low-income households tend to save less or even spend beyond their means, resulting in a higher proportion of their income being allocated to consumption compared to more affluent households. Examining household expenditure relative to Equivalent Household Disposable Income percentage, as illustrated in Figure 4.1, reveals that the lowest-income households, constituting the initial percentile, allocate a significant portion of their income towards energy consumption. As we progress from the lower income decile to the higher income decile in terms of equivalent household disposable income percentage, there is a corresponding reduction in the proportion of household resources earmarked for energy expenditures (Figure 4.1).

FIGURE 4.1 HOUSEHOLD EXPENDITURES ON FUEL AND OTHER ENERGY, AS A PERCENTAGE OF INCOME, BY INCOME DECILE (IRELAND)



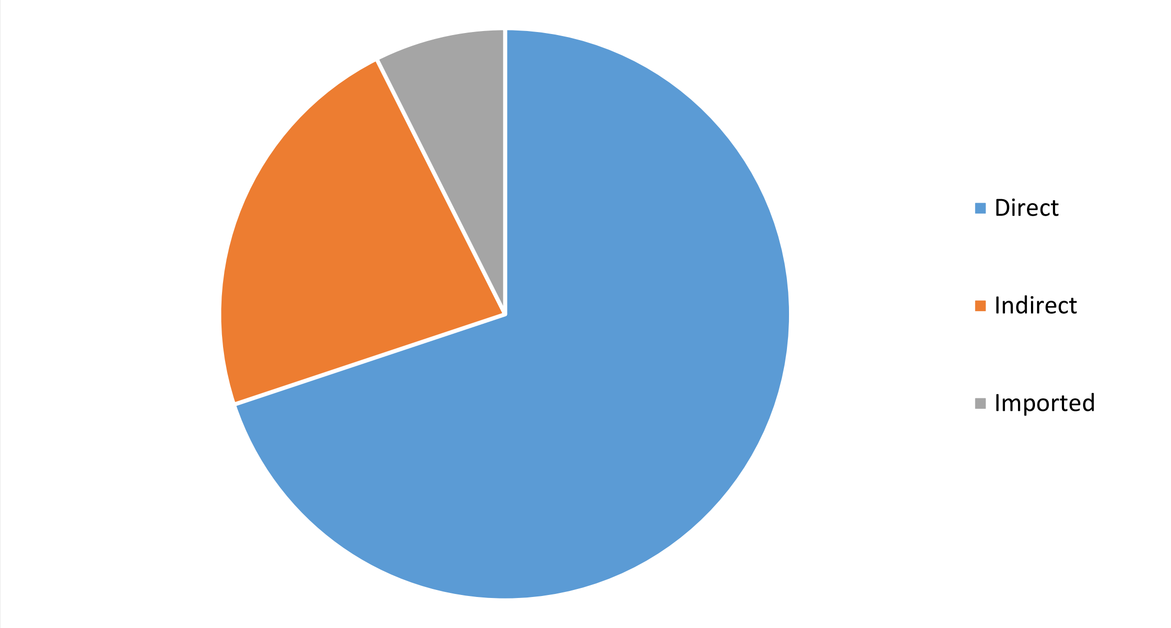
Source: Authors' calculations.

Total energy consumption is a major factor contributing to emissions, but it is not the sole one. Emissions vary depending on the type of fuel used, with solid fuels like coal or firewood emitting more CO_2 than liquid fuels or natural gas.

For lower-income or rural households, solid fuels may make up a significant portion of energy use, leading to higher emissions. On the other hand, urban areas often rely more on natural gas, which produces fewer emissions per unit of energy. Motor fuels, though generally more expensive, also emit less CO_2 per unit compared to solid fuels. Non-fuel spending also plays a significant role in household expenses. While using fuel generates more emissions per dollar spent compared to other purchases, the substantial amount of non-fuel spending also contributes significantly to carbon footprints. As depicted in Figure 4.2, approximately 70 per cent of all emissions related to consumer activities stem directly from households using fossil fuels themselves. This disparity can be attributed to differences in how households allocate their spending between fossil fuels and electricity, as well as the types of fuel they utilise. Emissions associated with imported goods or materials utilised in manufacturing final products (excluding fuel) also play a role, albeit a smaller one, typically constituting less than 10 per cent of total emissions.[5] Understanding the indirect emissions stemming from non-fuel consumption is crucial for comprehending how different demographics are affected. These indirect emissions are not immediately apparent, as consumption habits and resulting carbon footprints vary widely among households in, for example, diets, durable expenditure, flights etc.

5 We include sectors that are highly correlated with energy consumption such as electricity and public transport in the direct emissions definition.

FIGURE 4.2 EMISSIONS FROM FUEL ('DIRECT') AND NON-FUEL ('INDIRECT') CONSUMPTION, AS A PERCENTAGE OF TOTAL (IRELAND)

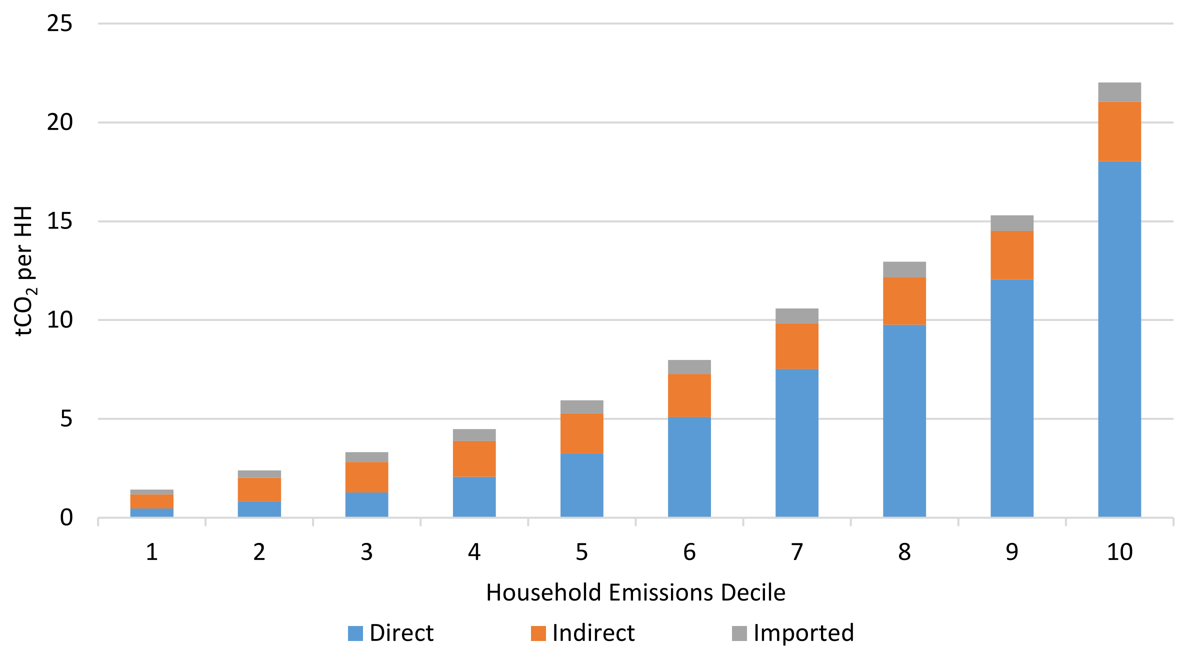


Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as household budget surveys (2015).

Notes: 'Direct' includes households' own consumption of fossil fuels, both domestically sourced and imported. 'Indirect imported' accounts for emissions linked to all other non-domestically sourced inputs and consumption goods. Estimates are based on the 'consumer responsibility' principle, accounting for all household consumption.

Across households, differences in carbon footprints were very large, reflecting levels of development, consumption patterns and production technology. Figure 4.3 shows emissions linked to household consumption across household emissions, at different points of the national emissions distribution (rather than the income distribution). Average emissions range from around 1.7 tonnes of CO_2 per household in the first decile to 22 in the tenth decile of household emissions. The range in terms of household equivalised disposable income decile is narrower, ranging from 5 tonnes of CO_2 per household in the first decile to 12 in the tenth decile. As we go from the poorest 10 per cent to the top 10 per cent wealthiest households and in terms of emissions, the amount of CO_2 emissions they cause rises, especially from indirect and imported sources, but direct emissions are the highest. It should be noted however that when expressed as a percentage of disposable income, the opposite trend applies, that emissions per euro of income decline with income even if emissions per household increase.

FIGURE 4.3 EMISSIONS FROM HOUSEHOLD CONSUMPTION, tCO_2 PER HOUSEHOLD AT DIFFERENT POINTS IN THE NATIONAL EMISSIONS DISTRIBUTION (IRELAND)



Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).

Notes: Average emissions across the national emissions distribution (not income distribution), from lowest-emitting to the highest-emitting households. The ranking variable is emissions linked to household consumption, equivalised to account for household size. Estimates follow the 'consumer responsibility' principle, accounting for all household consumption, including both domestically produced and imported goods.

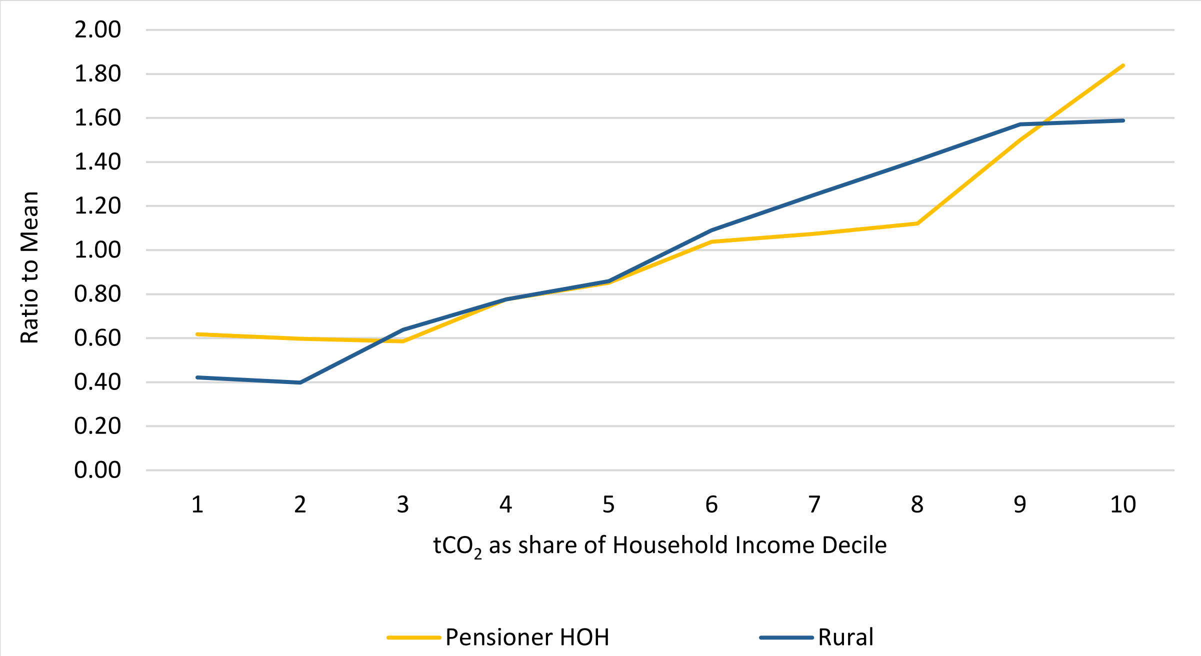
Figure 4.4 illustrates a comparative analysis of diverse household characteristics between high-emission and low-emission households. The graphic reports the average value of each characteristic variable for each emission as a share of household income decile compared to the average for the population. A higher value indicates a relatively higher value for the characteristic for the particular emissions decile, relative to the mean. We report two figures for ease of reading (a) where the ratio increases with carbon intensity and (b) where the ratio decreases with carbon intensity.

As identified in Reaños and Lynch (2022), pensioners and rural dwellers have the greatest horizontal inequality in relation to the carbon price as a share of household income. Pensioner and rural households are less represented for lower carbon intensities and over-represented for higher carbon intensities.

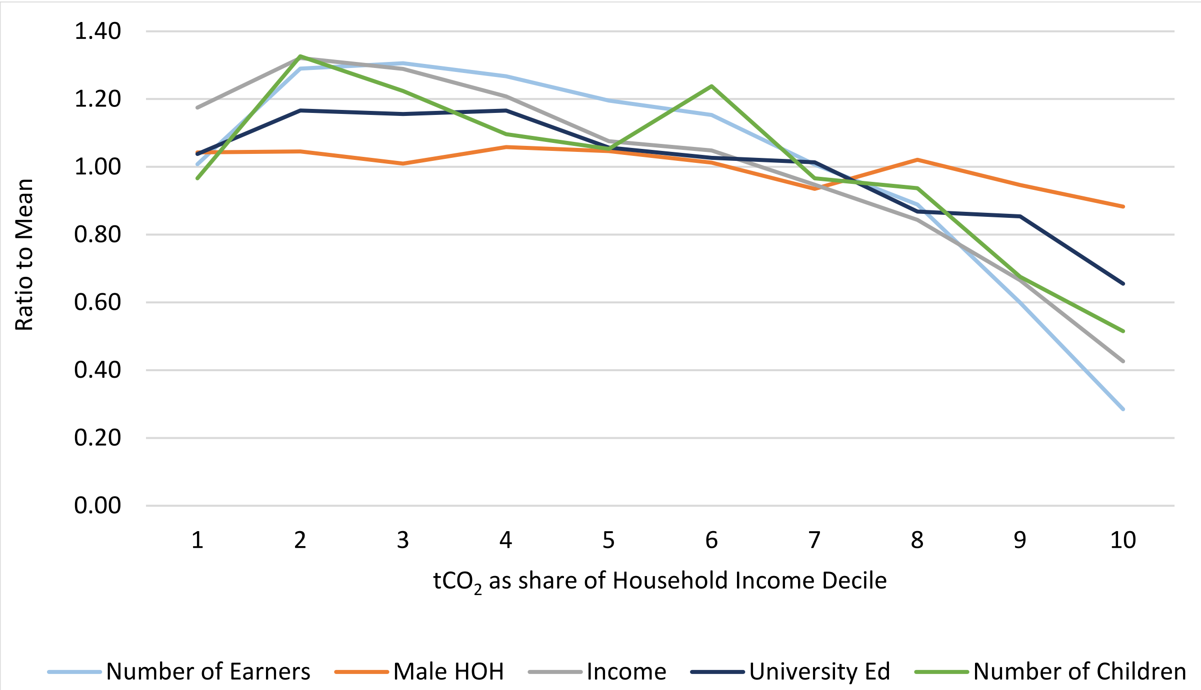
Gender has a relatively minor differential when adjusted for household size, while the factors associated with income see a reduced ratio to the average as the emissions intensity rises, reflecting the vertical inequality associated with carbon pricing. Families with more children are more represented amongst lower emissions intensity households than at the bottom of the distribution.

FIGURE 4.4 HOUSEHOLD CHARACTERISTICS AT DIFFERENT EMISSION LEVELS (RATIO OF THE HOUSEHOLD CHARACTERISTIC RELATIVE TO THE MEAN) (IRELAND)

(a) Increasing ratio



(b) Decreasing ratio



Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).

Note: Ratios compare socio-economic characteristics between high-emitting households and low-emitting households (decile of emissions as a share of household income) as follows. Number of earners and number of children in the household: Ratio of average numbers of earners and children per household. Other categories: Ratio of number of households in a rural area, or headed by a male, by a person with completed tertiary education, or by a pensioner.

4.1 DISTRIBUTIONAL INCIDENCE OF CARBON PRICES

Household carbon footprints play a significant role in determining the impact of carbon pricing, yet they are not the sole factor. Table 4.1 reports from the OECD ECR database, the carbon price per tCO_2 from the three instruments (Excise Duties, ETS and Carbon Tax) for different sectors and different fuel types for Ireland in 2021. In practice, carbon pricing measures are not consistently applied, leading to unequal treatment, and not all emissions carry the same price tag. Excise taxes, carbon taxes and emissions trading systems can differ significantly based on industry and fuel type. For example diesel has a lower price for agriculture than it does for motor fuels or for domestic heating. This is driven largely by differences in Excise Duties which relate in any case to volume rather than carbon. This is also the case when comparing between fuels. Excise duties for domestic heating for example are higher for motor fuels like petrol and diesel than for coal, despite having a lower carbon footprint. It is a reason why, when carbon taxes were introduced for non-motor fuels, that the proportional price increase felt higher than when introduced for motor fuels.

TABLE 4.1 CARBON PRICE PER tCO_2 BY INDUSTRY AND FUEL TYPE (2021) (IRELAND)

	Agri & fisheries	Electricity	Industry	Off-road	Road	Buildings
Solid fossil fuels	0	53	22	0	0	31
Diesel	40	53	101	10	194	45
Fuel oil	0	53	29	0	0	0
Gasoline	0	0	0	184	274	0
Kerosene	0	0	14	12	0	24
LPG	0	0	16	0	68	27
Natural gas	0	53	20	26	0	26
Other fossil fuels and non-renewable waste	0	53	15	0	0	0

Source: OECD ECR database based upon calculations using IEA emissions factors for different fuels.
Note: Road refers to fuel used in transportation on public roads while off-road refers to other transport.

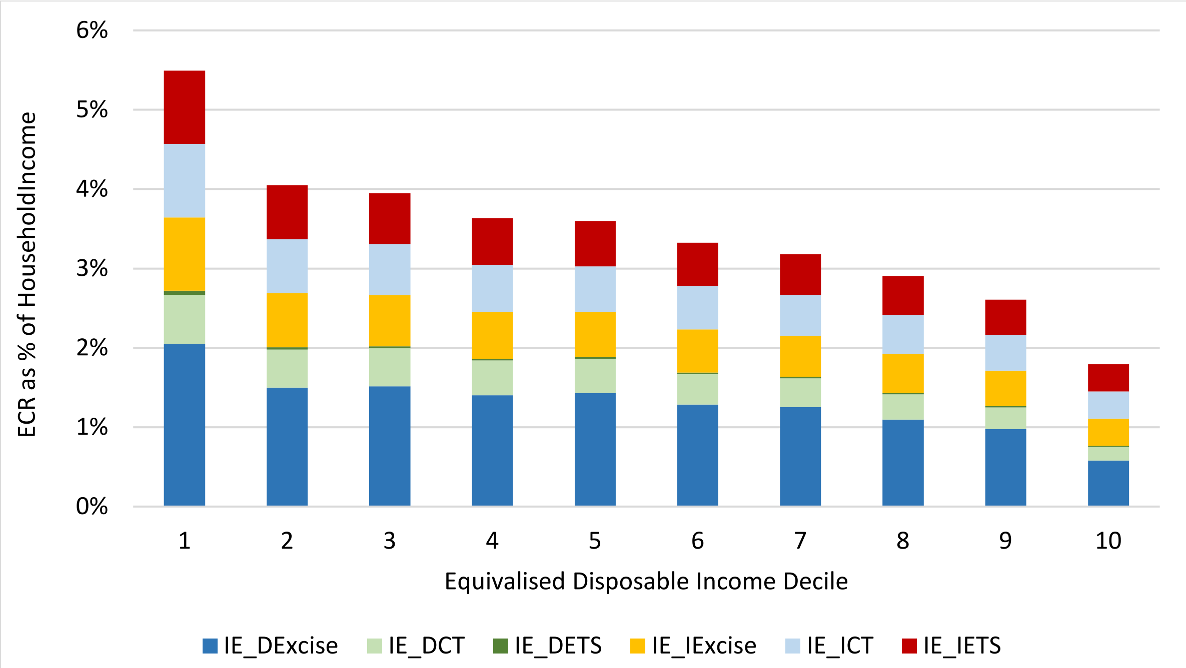
Figure 4.5 reports the distributional incidence in terms of the equivalised disposable income, the distribution of the rate of carbon prices as a share of disposable income. In total the average carbon price per euro of household income falls with equivalised disposable income indicating that, like for other indirect taxes, these taxes are regressive with a higher share at the bottom of the distribution than at the top. This chart is broken up into the three instruments – ETS, Excise duties and carbon taxes – and for both direct carbon prices based upon energy consumed by the household, and indirect carbon prices based upon energy used in the production of goods and services consumed by the household. Excise duties, both direct and indirect, have the largest impact on the total carbon price, followed by direct and indirect carbon taxes, followed by ETS levied on purchased goods and services. The correspondence between household emissions and their carbon price burden is thus neither perfect nor straightforward, and depends on the specific design of carbon-pricing measures, the expenditure profile of households and the savings rate of the household.

Significant policy innovation has been seen in Ireland over the past decade and a half, with carbon taxes introduced in 2010 growing over time, and by the introduction of the European Union Emissions Trading Scheme. Annual increases are planned for the carbon tax of approximately €7.50 up until 2029, and €6.50 in 2030 when the rate will reach €100 per tonne of CO_2 (Finance Act 2020).[6]

We utilise the OECD ECR database for the period 2012 to 2021 in this work. The results miss, therefore, the change since the introduction of the carbon taxation policy and subsequent increases in carbon tax since 2021. However the results capture a period of significant policy change in Ireland. In Figure 4.6, we report the change in the average carbon price per euro of disposable income for each equivalised disposable income decile. In this chart, we deflate the carbon prices to 2015 values using the Consumer Price Index. Carbon prices have increased in real terms over time. The overall trend is similar to Figure 4.5, with the highest increases for the lowest incomes, again reflecting differential savings and household consumption patterns. The bottom decile saw an increase of 2.2 per cent as a percentage of household disposable income (in 2015 prices) and the top decile saw an increase of 0.8 per cent; quite a substantial difference. However the composition of the change varies across instrument. Excise duties have fallen in real terms as carbon taxes and ETS have increased, reflecting a movement from using Excise duties as the primary taxation on energy.

[6] https://data.oireachtas.ie/ie/oireachtas/parliamentaryBudgetOffice/2024/2024-02-29_carbon-tax-series-part-1-of-3-what-is-the-carbon-tax_en.pdf.

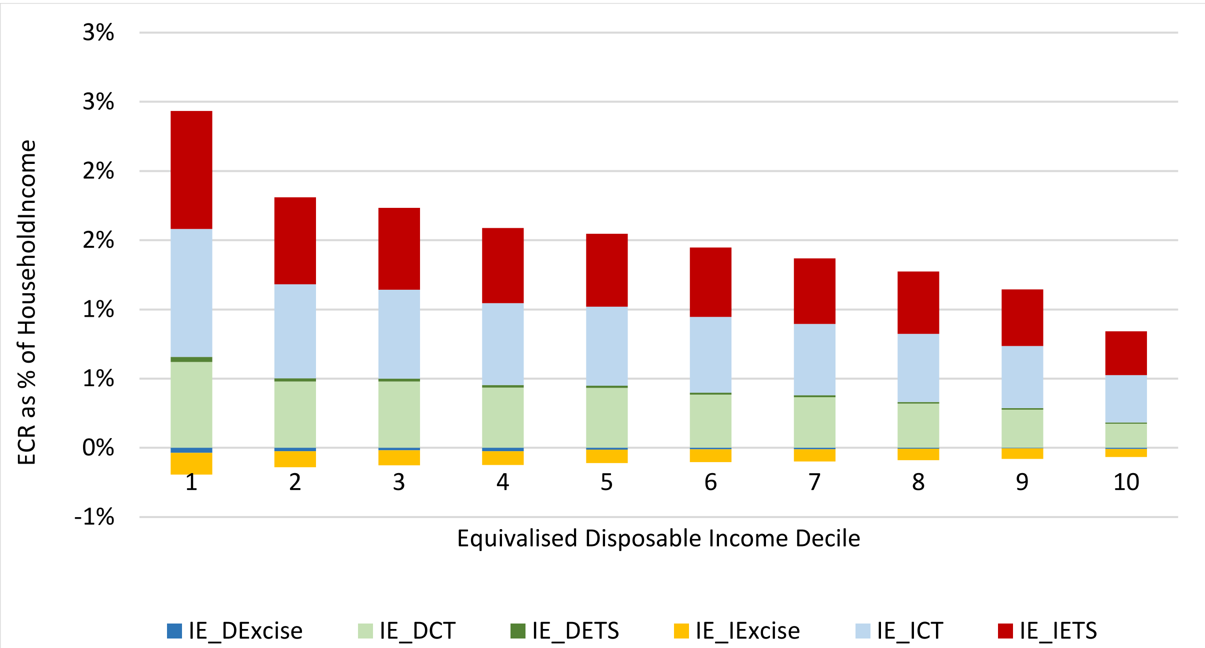
FIGURE 4.5 CARBON PRICING INSTRUMENTS AS A PERCENTAGE OF DISPOSABLE INCOME BY EQUIVALISED DISPOSABLE INCOME DECILES, 2021 (IRELAND)



Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).

Note: Excise – Excise Duties; CT Carbon Tax; ETS – Emissions Trading Scheme. D prefix means Direct; I prefix means Indirect.

FIGURE 4.6 CARBON PRICING INSTRUMENTS AS A PERCENTAGE OF DISPOSABLE INCOME BY EQUIVALISED DISPOSABLE INCOME DECILES (CHANGE 2012-2021 - DEFLATED BY CPI) (IRELAND)



Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).

Note: Change in the cost of household-specific consumption baskets, as a share of household incomes (2015). Averages by income decile (equivalised disposable household income).

4.2 REVENUE RECYCLING

However the net distributional incidence depends not only on the revenue generated by carbon pricing, but also by the distributional incidence of what the revenue generated is spent on. Marten and van Dender (2019) provide an overview of the utilisation of revenues from various carbon pricing mechanisms across 40 OECD and G20 economies. Like other 'Pigouvian' taxes, carbon pricing is typically not intended as a stable source of funding and will diminish as it achieves emission reduction objectives. Similar to other government revenues, those generated from carbon pricing are subject to competing demands, potentially constraining their earmarking for income transfers. However, there are several reasons why carbon revenues could serve a significant redistributive purpose. Firstly, under commonly discussed carbon price trajectories, prospective revenues are substantial. Secondly, while increasing carbon prices are aimed at gradually narrowing the tax base, initially any negative impact on government revenues can and should be offset by further rate increases. While carbon price revenues are projected to decrease eventually, this is expected to occur over decades rather than years. Thirdly, redistribution and associated social protection play a crucial role in mitigating adjustment costs for affected households and garnering voter support. Thus, the resource requirements are arguably temporary rather than permanent, making them feasible to be financed through a temporary revenue source.

In Ireland, a carbon tax was put in place in 2010, employing a 'soft' type of earmarking, with a political commitment to use a share of revenues for raising social assistance benefits for households with children, and to provide retraining for workers in carbon-intensive sectors. The value is currently €56 per tCO_2. Since the implementation of Budget 2020, any carbon tax revenue surpassing the €20 per tonne of CO_2 benchmark has been ring-fenced for specific purposes. Over the period 2010 to 2023, a total of €5.288 billion in carbon tax revenue has been raised. Between 2020 and 2023, an estimated €1.363 billion of this revenue has been allocated to the Central Fund. An additional €788 million is forecast to be set aside in 2024.[7] These funds are earmarked to support environmentally friendly initiatives and various climate-focused policies, such as home retrofitting and addressing energy poverty. Certain sectors heavily reliant on carbon-based fuels, such as heavy industry, haulage, commercial aviation, electricity generation and farming may qualify for either partial or complete exemptions from this tax. In addition there are relatively clear rules in relation to EU ETS revenues.

Although, we do not have the information to model the distributional incidence of revenue recycling in this paper, we attempt to assess the net distributional incidence of carbon pricing together with a theoretical application of revenue

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7 See https://data.oireachtas.ie/ie/oireachtas/parliamentaryBudgetOffice/2024/2024-02-29_carbon-tax-series-part-1-of-3-what-is-the-carbon-tax_en.pdf.

recycling.[8] This clearly ignores the actual hypothecation of revenue that is explicit in law. An analysis of this type is beyond the extent of this study. For tractability reasons, estimates are based on the simplest of the revenue recycling scenarios, an equal lump-sum transfer equal to the average carbon-price burden, to everyone.[9] Income and other information in Household Budget Surveys is not sufficiently granular for simulating more targeted social benefits or, for example, labour-tax reductions, and matching with income data is beyond the scope of this comparative study. See, however, Immervoll et al. (2023[12]) for an example of such an approach in a country-specific context.

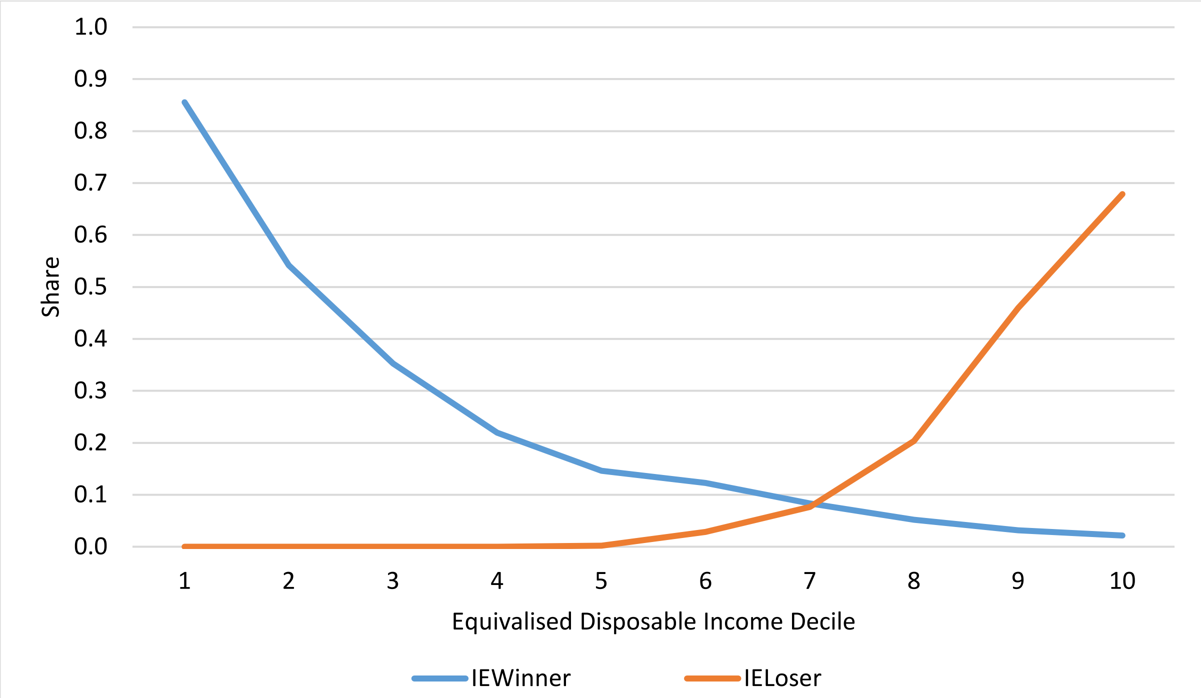
Figure 4.7 shows the distribution of this net change across each income stratum after the complete redistribution of carbon pricing revenue. We assume that all revenue growth from 2012 to 2021 from each source including excise duties is available for redistribution. Winners and losers are those who have respectively gains or losses of at least 0.5 per cent of their income. Thus there are households with small gains and losses that are not considered here. Combining lump-sum revenue recycling of all carbon price revenues sees a different distributional profile to the distributional incidence of the reform itself.

Notably, a majority of individuals situated towards the upper end of the income spectrum are losers, while the bottom of the distribution win. This phenomenon is particularly conspicuous among households with substantial expenditures on fuel and other commodities, where the burden of carbon pricing tends to surpass the lump sum received in compensation. Conversely, the majority (70 per cent or more) of households in the lowest income deciles either derive benefits or face no additional financial strain. This favourable outcome stems from their relatively modest expenditures in absolute terms, allowing the flat-rate transfer to offset or even surpass the impact of carbon pricing for many within this demographic.

8 We consider all potential revenues from carbon pricing, even if some of the revenues accrue to the European Union via Innovation and Modernisation Funds. Between 2013 and 2022, 76 per cent of revenues were allocated to sustainability funds (see https://www.homaio.com/post/eu-ets-revenues-for-member-states-in-2024-projections-and-insights).

9 The lump-sum transfers in these cases are therefore the same as the average carbon-price burden. Results account for carbon-price burdens at the household level, and therefore capture the variability of gains and losses across and within income groups, which remain hidden when assessing average burdens by decile.

FIGURE 4.7 FULL REVENUE RECYCLING: SHARES OF INDIVIDUALS WITH NET LOSSES, BY INCOME GROUP (IRELAND)

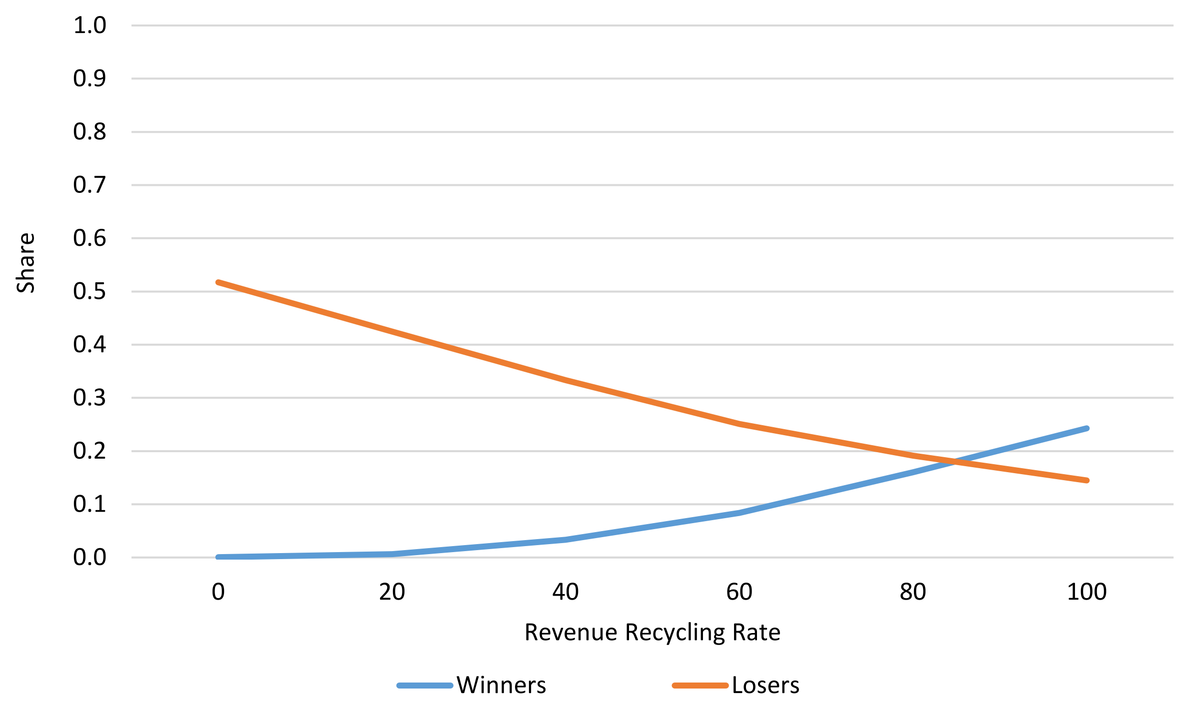


Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).

Notes: Household compensation takes the form of uniform lump-sum transfers to each individual. Income deciles refer to equivalised disposable household income. Winners or Losers are defined as having a gain or loss respectively of at least 0.5 per cent of total expenditure.

In Figure 4.8 we consider the consequence of varying the share of the carbon price revenue that is recycled as mitigation by adjusting the per-capita transfer. The relationship between the magnitude of the lump-sum payment and the prevalence of disadvantaged individuals is elucidated. Figure 4.8 illustrates the total share of winners and losers depending upon the share of revenue redistributed. Without any compensation, households maintain their incomes unchanged, with carbon prices leading to increased expenses, worsening their financial situation. As transfers rise, fewer individuals experience losses. At lower levels of transfer, the losers dominate the share of winners. At 60 per cent transfer range the winners are one-third of the losers (8 per cent versus 25 per cent). At 80 per cent this ratio is 85 per cent (16 per cent versus 19 per cent), reaching over 100 per cent (24 per cent versus 15 per cent) when all revenues are recycled.

FIGURE 4.8 REVENUE RECYCLING AT DIFFERENT RECYCLING RATES: SHARES OF INDIVIDUALS WITH NET LOSSES (IRELAND)



Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).
Notes: Household compensation takes the form of uniform lump-sum transfers to each individual at varying rates. Winners or Losers are defined as having a gain or loss respectively of at least 0.5 per cent of total expenditure.

The use of a relatively flat transfer mechanism results in quite a high share of losers for the flat per capita payment. In Figure 4.9 we consider the share of winners across the distribution for different types of revenue recycling with varying degrees of redistribution. We consider:

a. A targeted instrument which varies according to how far below the poverty line the household is;

b. A Universal Basic Income for adults;

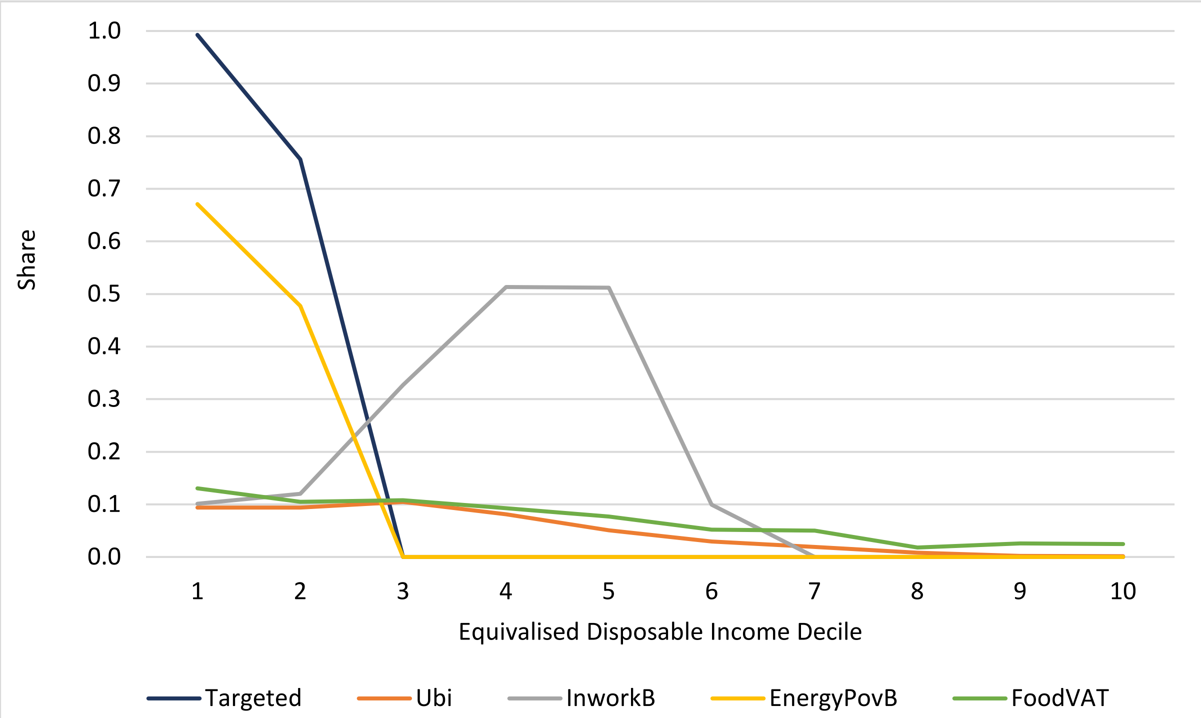
c. An in-work benefit targeted at working households whose income is less than twice the poverty line;

d. A targeted instrument going only to those below the poverty line as a function of the households poverty gap and who are in energy poverty (where fuel expenditure accounts for more than 10 per cent of income);

e. An instrument reducing VAT (targeted at food items with positive VAT).

Figure 4.9 illustrates the dramatically different winner profile depending upon the nature of the revenue recycling. The targeted instruments unsurprisingly have most winners at the bottom, the in-work benefit at the middle of the distribution, while the UBI and the VAT reduction are flatter across the distribution. There are many different goals for the use of the revenue generated from revenue recycling from carbon prices, from mitigation of distributional impacts, to reducing work disincentives, to facilitating investment in upfront investment costs to reduce emissions, to merely substituting for existing excise duties. In reality there is unlikely to be a single mechanism or goal. Further work is merited to explore detailed portfolios of instruments.

FIGURE 4.9 SHARE OF WINNERS BY ALTERNATIVE REVENUE RECYCLING



Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).

Note: Household compensation takes the form of uniform lump-sum transfers to each individual at varying rates. Winners or Losers are defined as having a gain or loss respectively of at least 0.5 per cent of total expenditure.

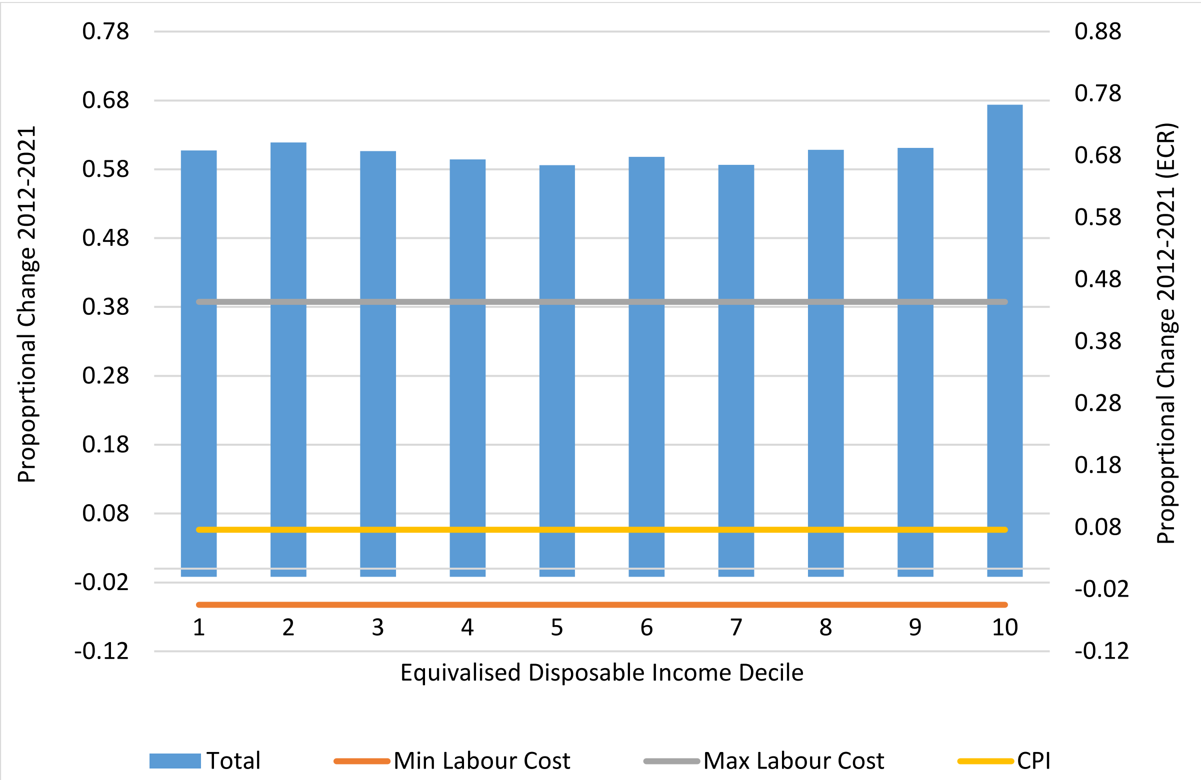
The impact of changes in carbon pricing on welfare is not solely determined by the carbon price itself; it also hinges on the rate at which income is growing. A rough measure for income growth rate is the rise in labour costs over time. If carbon prices increase more rapidly than labour costs, it is probable that purchasing power (considering interactions with other policies like taxation and benefits) will decline; conversely, purchasing power might increase if carbon prices lag behind labour cost growth. While our data do not allow us to consider labour cost changes at an individual level, we will analyse how carbon price changes compare to the average sectoral labour cost growth and consumer price change over time.

While Figure 4.6 presents the adjusted fluctuation in carbon prices as a proportion of income, reflecting the carbon price's relative significance, Figure 4.10 illustrates the growth rate in comparison to both the Consumer Price Index (CPI) and labour income growth (measured by sectors with the highest and lowest growth rates).

The growth rate in labour costs was calculated for each sector from Eurostat data. The sector with lowest growth rates was 'Transportation and storage' while the sector with the highest growth rate was 'Information and communication'.

We find that carbon prices escalated more swiftly than consumer price inflation for all income brackets, signifying an expanding portion of purchasing power subject to carbon pricing. This increase is equivalent to an average growth of 5-6 per cent over the nine-year period. Thus while the growth rate of carbon prices has been lower than some of the highest inflation rates experienced during the cost of living crisis, it exceeds long-run price increases. Labour costs also grew during this period at a pace surpassing inflation. Although disaggregating actual labour cost increases for individual households is not feasible with our available data, Eurostat data enable us to segment by sector, presenting sectors with the highest and lowest increases. The growth rate exceeds that of all income brackets.

FIGURE 4.10 CHANGE IN ECR BY ECR CO_2 DECILE COMPARED WITH GROWTH RATE IN CPI AND LABOUR COSTS 2012-2021



Sources: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as Household Budget Surveys (2015).

SECTION 5

Conclusions

In this paper, we evaluate the distributional impact of carbon pricing in Ireland via a number of different measures; Excise Duties, Carbon Taxes and the EU Emissions Trading Scheme. To do this we utilise information contained in the OECD Effective Carbon Rate (ECR) database together with the PRICES model that is built upon the Household Budget Survey.

Essential household energy consumption constitutes a significant portion of spending, particularly for lower-income households, indicating regressive expenditure patterns across income brackets. The immediate impact of carbon pricing on household budgets varies based on their reliance on various fuels for heating and transportation (direct impact), as well as the emissions associated with other goods and services (indirect impact). Carbon footprints vary widely among households, with higher-income ones generally emitting less than lower-income ones as a percentage of their income. Although carbon footprints primarily dictate the burdens of carbon pricing, other factors such as the uneven application of carbon pricing policies and disparities in emissions between industries and fuel types also influence the equation. Despite the necessity for substantial carbon price hikes to meet climate targets, the effects on household budgets during the 2012-2021 period were relatively modest.

Carbon pricing reforms typically exhibited regressive trends, disproportionately affecting lower-income households relative to their earnings. Middle-class households also felt considerable impacts, suggesting that carbon pricing affects a broad swath of the population. Choices in relation to redirection of carbon pricing revenues back to households, as part of broader policy strategies, help to mitigate losses and influence distributional outcomes. However policy design is critical. Straightforward compensation measures like uniform lump-sum transfers may not be cost-effective and could detract from funding for other critical programmes. Given the urgency of climate change mitigation, future carbon price increases may need to be more substantial and rapid, underscoring the importance of considering distributional effects and implementing appropriate compensation measures to ensure both fairness and essential support for climate policies.

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