Who is going to pay for all this CO2?

Distributional effects of carbon pricing in Romania

The European Green Deal is set to expand the role of carbon pricing. While the distributional effects of this policy are well-known in Western countries, it is essential for less affluent countries like Romania to explore this concept and become more resilient.

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Abstract

This paper evaluates the vertical and horizontal distributional effects of carbon pricing in Romania. By designing a series of microsimulations, I prove that carbon pricing is regressive before government redistribution, regardless of the level of taxation. However, I also show that by choosing an optimal revenue-recycling strategy, Romanian authorities can assure tax neutrality, and even progressivity. In this sense, two revenue-recycling schemes are analyzed: a lump-sum transfer, and a normative transfer derived from Rawlsian principles. The lump-sum transfer partially alleviates regressivity, while the Rawlsian transfer makes carbon pricing progressive.

Keywords

Carbon pricing; distributional effects; energy poverty;

Introduction

Background

Scientists established that the accumulation of anthropogenic greenhouse gases (GHGs) emissions in the atmosphere induces enduring effects on Earth's climate system(IPCC 2013; 2018). Effects include upsurges in the intensity and frequency of extreme weather events, irreversible damage to ecosystems, and the alteration of the cryosphere (Nunez et al. 2019).

Given the magnitude of the crisis, parties to the UNFCCC reached the Paris Agreement, intending to limit global warming to well below 2°C compared to pre-industrial levels To achieve this, the European Commission proposed the European Green Deal, a strategy aiming to make Europe carbon-neutral by 2050. Being EU's cornerstone policy in combating climate change, it is expected that the price of carbon in the EU ETS will rise accordingly. However, while indispensable to avoid further tipping points in Earth's climate system, carbon pricing has significant distributional repercussions (Narassimhan et al. 2018), disproportionately affecting the least well-off in society (Ohlendorf et al. 2021).

Research scope

One EU country to be most affected by the surge of carbon pricing is Romania. Romania has been historically reticent to ambitious climate policy due to its levels of poverty and inequality. These circumstances, as well as the lack of previous research in the field, elicit the importance of understanding the social effects of carbon pricing in Romania, to avoid potential backlash against the green transition (Dorsch, Flachsland, and Kornek 2020).

Therefore, I ask the following research question*: What are the vertical and horizontal distributional effects of carbon pricing in Romania?* I hypothesize that in the absence of targeted revenue-recycling schemes, carbon pricing is regressive. Furthermore, I analyze which revenue-recycling mechanisms reduces the regressivity of carbon pricing the most:

- A lump-sum rebate, under which the revenues obtained from the carbon tax are paid back in equal shares to the population.

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- A Rawlsian-inspired transfer, under which the revenues obtained from the carbon tax are distributed, in equal shares, to households most affected by the tax.

Literature review

Carbon pricing is a tool that captures the costs of GHGs emissions by linking them to their source of production through a mandatory price (Ramstein et al. 2019). Carbon pricing is contingent on the assumption that climate change is the consequence of an externality: parties responsible for emissions do not pay the full social costs of GHG accumulating in the atmosphere (Stern 2006).

Preventing such market failures is achieved by assigning property rights that foster the development of complete markets. However, given that climate elements are public goods, property rights are difficult to assign without large transaction costs (Libecap 2014). The absence of property rights implies, thus, a lack of complete markets for environmental amenities, leading to inefficient usage. One solution is imposing a Pigouvian tax on externality-generating activities (Atkinson and Stern 1974). Economists generally support corrective taxation as being the optimal policy strategy (Cremer, Gahvari, and Ladoux 1998). However, carbon taxes tend to be regressive, disproportionally affecting lower-income parts of the population, and regions more dependent on carbon-intensive industries (see Table 1).

Carbon pricing raises energy prices and, therefore, the percentage of income households spend on energy consumption and complementary goods and services. It also affects the production of carbon-intensive goods dependent on fossil fuels. Finally, carbon pricing affects the income of workers employed by companies producing carbon-intensive goods.

REFERENCE	REGION	MODEL	RESULTS
BOYCE (2018)	USA	Literature review and imputation	Regressive
LABANDEIRA AND LABEGA (2004)	Spain	I/O + AIDS estimation	Regressive
TIEZZI (2001)	Italy	AIDS estimation	Regressive
WIER ET AL. (2005)	Denmark	CGE	Regressive
KERKHOF ET AL. (2008)	Netherlands	I/O estimation	Regressive
VAN HEERDEN ET AL. (2006)	South Africa	CGE	Progressive
SCOTT AND EAKINS (2004)	Ireland	CGE	Regressive
CREEDY AND SLEEMAN (2006)	New Zeeland	I/O estimation	Regressive
DISSOU AND SIDDIQUI (2014)	Canada	CGE	Regressive
DOUENNE (2020)	France	QUAIDS estimation	Regressive
REAÑOS AND WÖLFING (2018)	Germany	EASI estimation	Regressive
BERRY (2019)	France	Static microsimulations	Regressive
JAKOB (2020)	Germany	I/O estimation	Regressive

Table 1. Distributional effects of carbon pricing

As distributional concerns are questions of fairness, it is essential to comprehend the ethics of climate action (Klenert et al. 2018). The literature distinguishes between horizontal and vertical equity with both dimensions being essential for socially-just climate policymaking (McDaniel and Repetti 1992). Vertical equity refers to the appropriate pattern of differentiation between groups of unequal individuals, while horizontal equity refers to the equal treatment of groups of equal individuals.

To effectively analyse both the vertical and horizontal distributional effects of carbon pricing, it is essential to understand how governments spend the respective carbon tax revenues. Different revenue-recycling mechanisms have different implications for the two equity dimensions. Thus, a socially optimal revenue-recycling scheme can lead to the long-term viability of carbon pricing, as it can incorporate the interests of heterogenous agents (Douenne 2020; Levi, Flachsland, and Jakob 2020).

Climate policy in Romania

There is no carbon tax in Romania outside the EU ETS. This is in line with the country's unambitious climate objectives, which are a consequence of national economic characteristics (Lenz and Grgurev 2017). Romania remains one of the poorest countries in the EU), with high levels of inequality, and large economic disparities between internal regions (Oancea, Andrei, and Pirjol 2017). While the lack of climate policy in Romania at the time hinders a comprehensive analysis, several points remain significant:

- In rural areas, there is a dependency on livestock for caloric intake. People living outside main cities are practicing subsistence agriculture to meet their household needs. Subsistence agriculture has proven to be one of the most carbon-intensive activities (Czyżewski and Kryszak 2018).
- Biomass has been used for heating purposes, especially in areas with no access to natural gas. It is important to note that the production and consumption of biomass in Romania is not sustainable (Aceleanu et al. 2018).
- The lack of policies supporting energy efficiency in buildings resulted in residential facilities with no thermal insulation, with dwellings made primarily from adobe (Baran, Dumitrescu, and Pescaru 2016).

Defining Rawlsian redistribution

Designing a Rawlsian policy process means assuring that individuals with comparable skills face similar chances of benefiting from a policy, and that inequalities caused by the policy work to benefit the least advantaged in the society (Rawls 2009). When applying this Rawlsian framework to the distributional effects of carbon pricing in Romania, I infer that for carbon pricing to be fair, revenue-recycling should be designed to avoid regressive effects for the least well-off in society.

One consideration has to be the administrative capacity of Romania to implement this Rawlsian-inspired revenue-recycling scheme. Normative transfers should be designed in a manner that allows the rapid identification of the least well-off, as well as the expeditious calculation by the national bureaucracy of the sums of money owed to each one of the households identified as being vulnerable.

In the following section I propose an arithmetic indicator for regressivity which could be used to determine the beneficiaries of the Rawlsian transfer. This indicator uses national consumption data to generate information regarding regressivity levels. In terms of determining the value of the transfers, there are two options:

- The first would be using a lump-sum transfer, limited to those deemed eligible after the computation of the regressivity indicator.
- The second would be to make the transfer inversely-proportional to the regressivity indicator—in this sense, if you are eligible for the Rawlsian transfer, the worst you are affected by the carbon tax, the higher the transfer

This paper only discusses the first option, as it would currently be the only politically feasible policy in Romania.

Methodology

Datasets

For the purpose of this paper, I have used Eurostat's Household Budget Surveys (HBSs) and the EXIOBASE.

The HBSs are national surveys focusing on consumption expenditure. They provide information on regionally disaggregated demand patterns from expenditure surveys, following the COICOP classification. The spatial coverage is based on the NUTS taxonomy. In the case of Romania, the most up-to-date surveys only date back to 2010. A series of descriptive statistics can be seen in Table 2:

INCOME DECILE	ANNUAL INCOME INTERVAL (EUR)	AVERAGE HOUSEHOLD SIZE	AVERAGE INCOME PER CAPITA (EUR/CAP)
1	0-2384	1.386	1344
2	2384-3079	1.576	1741
3	3079-3734	1.803	1893
4	3734-4384	1.994	2036
5	4384-5093	2.208	2145
6	5093-5877	2.398	2283
7	5877-6842	2.551	2485
8	6842-8113	2.804	2653
9	8133-10238	3.037	2983
10	>10238	3.373	4072

Table 2. Descriptive statistics for Romania

The EXIOBASE is a global collection of Multi-Regional Environmentally Extended Supply-Use Tables and Input-Output Tables. These tables are frequently used to analyze the environmental impacts of consumption patterns across industries, both at a national and at an international level. The latest version contains information on 43 countries, including Romania.

Given the existing datasets, I have identified that there is no methodology of computing the carbon footprint of households by income decile in Romania. Papers investigating carbon emissions in European countries also make use of incomplete datasets, relying , thus, on complex imputations that approximate real CO_2 emission. Given these gaps in the literature, I propose a new method of imputing household carbon footprint, based on existing literature (Ivanova et al. 2017).

A simple robustness check for this original imputation method that I employ in this paper would be to compare imputed CO2 emissions in the Romanian economy to the actual emissions in the year 2010. After this check, I observe that total emissions and the average emissions per capita are

over-estimated by a factor of 1.105. This shows that the distribution obtained through imputation is the same as the original distribution, only marginally inflated.

Conceptualisation

I assess the financial costs incurred by households to maintain their original consumption pattern after introducing a carbon tax. I assume the carbon tax applies uniformly across economic sectors. While this approach disregards disparities between the treatment of EU products and other imports, as well as subsidies for domestic industries, it is a standard approach in the literature (Dorband et al. 2019). I conceptualize this tax as an EU-wide carbon tax with a border-adjustment mechanism for imports from outside the EU.

Level of taxation

There is no expectation from Romania to introduce a carbon tax. Therefore, any choice of the tax level is detached from the authorities' thinking: as such, I propose two scenarios: an entry-level carbon tax of EUR 12/tCO_2, and an ambitious tax of EUR 34/tCO_2. These choices are based on the average prices of the EU ETS allowance in the years 2010 and 2020, reflecting the increasing burden of carbon pricing.

Designing microsimulations

I employ static microsimulations of household short-term responses. This assumes that households maintain fixed consumption patterns and firms stick to the initial prices. The model describes a scenario in which supply and demand are fully inelastic, which is appropriate for Romania in 2010, given the regulated economies. Nevertheless, one must be aware that using a static model has the potential to overstate vertical distributional effects (Ohlendorf et al. 2018; Davis and Knittel 2019).

I compute the annual additional tax burden from the carbon tax for household *i* after the introduction of the carbon tax *t* as a multiplicative function of the carbon footprints of consumption *c* in each sector *j* (tCO_2) and the tax rate imposed by the government (EUR/tCO_2):

$$burden_i = \sum_j c_j * t$$

After computing additional tax burden for each household, I move towards computing, for each income decile, the average annual additional tax levy. The first step is calculating the share of income represented by the tax levy for each income decile. To check this measure's robustness, we calculate the tax levy relative to the national average for each income decile. The rationale behind this approach is that if a household consumes a large share of goods and services from carbon intensive sectors, they will disproportionately bear the costs of the newly-imposed carbon tax.

Assuming that an income group *i* deviates from the average consumption in sector *j* by $\Delta c = c_{ij} - c_j^{avg}$, we can express the distributional effects of the carbon tax on the income group as following:

$$\delta = \frac{\sum_j c_{ij}}{\sum_j c^{avg}} = \frac{\sum_j (\Delta c + c_j^{avg})}{\sum_j c^{avg}} = 1 + \frac{\sum_j \Delta c}{\sum_j c^{avg}}$$

Suppose households from a given income group consume more from a sector than the average national consumption in that sector, $\delta > 1$. If their consumption level is below the national average, $\delta < 1$.

Distributional effects of carbon pricing in Romania

Vertical effects

Figure 1 displays the vertical distributional effects of carbon pricing in Romania by plotting the incidence of both a EUR 12/tCO_2 and a EUR 34/tCO_2 tax across income deciles.

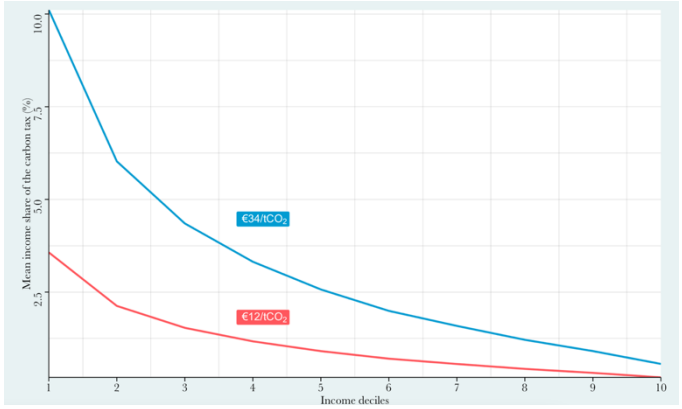

Figure 1. Vertical distributional effects

When expressed as a percentage of annual consumption expenditure per household, carbon taxation is vertically regressive in Romania. The direct implication is that carbon pricing in Romania would disproportionately affect households from the lower income-deciles, thus inducing a much higher policy effort for the least well -of in society. In the case of the EUR 34/tCO_2 tax, the results are extreme, as the price of carbon would represent more than 10% of annual consumption expenditure for the lowest income-decile, and only 0.56% of annual consumption expenditure for the richest 10% of the population. This harsh tax incidence can be explained by Romania's high poverty level in 2010, when the minimum wage was only EUR 142/month

and the median wage was barely EUR 385/month. Corroborated with the carbon-intensive lifestyle displayed by poor people in Romania, the expectation would indeed be that carbon taxation would severely punish the least well-off. While the EUR 12 /tCO_2 produces the same vertical distributional effect, the steepness of the tax curve is less pronounced. This suggests that by choosing the EUR 12/tCO_2 rate, it would be easier to achieve progressivity through revenue-recycling.

To characterize the regressivity of carbon taxation, I also look at the regressivity indicator previously described. Figure 2 displays this scenario and confirms the regressivity of carbon taxation in Romania, with large variations in the indicator, as $\delta \in [0.62, 1.47]$. δ becomes sub-unitary from the sixth income decile, suggesting that income is a strong indicator of the burden a carbon tax imposes on the different earning groups. Combined with the linearity of δ, these characteristics suggest that in theory, one could redistribute the revenue resulting from those who pay below average to compensate for the additional costs suffered by the ones who pay above average.

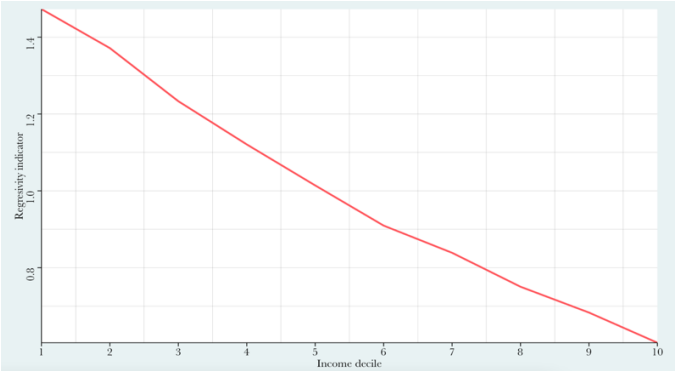

Figure 2.Regressivity indicator

One surprising result is seeing that even the richest households in Romania would pay on average more than the median household in Western European countries such as Germany or France, as a share of annual consumption expenditure. Once again, this can be explained by Romania's comparative-poverty – in 2010, the median wage in Romania was only EUR 344, almost five times lower than the minimum wage in France in the same year.

A policy implication of this incidence on the wealthier people in Romania is the potential lack of support for introducing any form of carbon taxation. Usually, in developed countries, people from the upper income deciles are more supportive of strong climate action. However, given the impact any particular carbon tax would have on the budget of the wealthier people, their support for carbon pricing in Romania could be drastically reduced, despite the impact of such a tax on the emissions level.

The carbon footprint of lower income deciles is dominated by carbon-intensive food production, mobility, and dwelling. Figure 3 offers a visualization of the determinants of carbon tax incidence in Romania. We can see that in relative terms, poor people pay more for all spending categories that tend to be carbon-intensive, given the life conditions described in the previous sections. One striking factor is that households from the poorest income-group tend to pay double that of households from the richest income-group on essential needs. This shows that carbon taxation in Romania could achieve distributional neutrality only through an aggressive redistribution strategy.

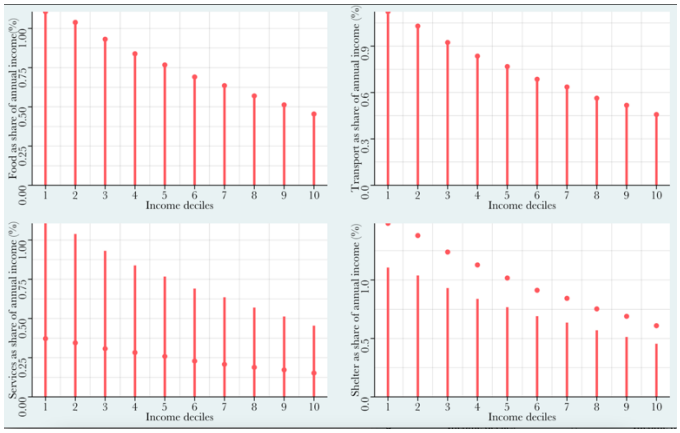

Figure 3. Drivers of the distributional effects

Revenue recycling schemes

In order to properly analyze the distributional effects of carbon pricing, we need to account for potential revenue-recycling options. This section analyses two mechanism of spending the revenue to mitigate the regressivity of carbon pricing:

- A lump-sum payment which would result in an equal per-household distribution of the revenue obtained from the imposition of a carbon tax.
- A Rawlsian transfer, in which people shown to disproportionately bear the costs of carbon pricing receive a transfer. In this case, I use the regressivity indicator as a measure of policy effort—if >1 for a given household in the sample, that household will be eligible for the transfer.

Figure 4 shows the distributional effects of carbon pricing over income deciles after redistributing revenues through a lump-sum transfer. In the case of the EUR 12/tCO_2, carbon tax, the lump-sum would be EUR 42.24, while in the case of the EUR 34/tCO_2, carbon tax, the lump-sum would be EUR 119.68.

While this revenue-recycling scheme would make both carbon taxes less regressive, only in the case of a carbon price

of EUR 12/tCO_2, would the tax be close to neutrality. In the case of the low carbon price, all deciles except the first, have resulting policy effort of just under 1% of annual consumption expenditure. In the case of the high carbon price, however, the first three deciles would still have to pay more than 1% of their annual consumption expenditure, which is a much higher sum than what is expected to be paid for carbon in Western countries. This figure also demonstrates that an EUR 34 /tCO_2 carbon tax would be politically unfeasible, as it would force people living on minimum wage to save two weeks' worth of their income only for the purpose of paying the carbon tax.

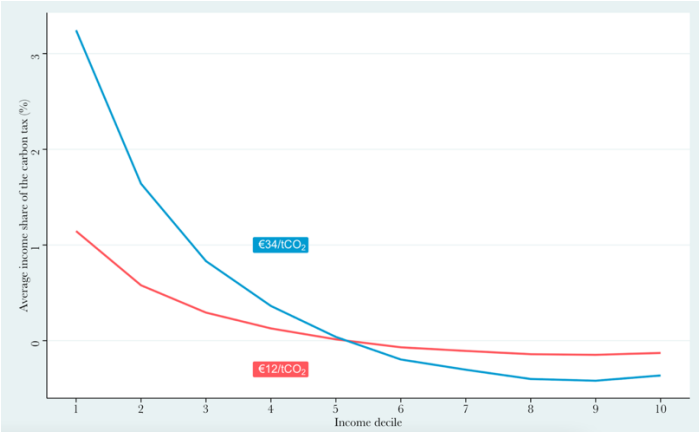

Figure 4. Post lump-sum vertical effects

By comparing the two taxes after redistribution, one can observe that richer households would disproportionately benefit from the process of redistribution in the case of the larger carbon price. While this is a consequence of the distribution of carbon-intensive activities across the population in 2010, from a political perspective it is improbable that such a tax would be popular, as it would redistribute money from the poor to the rich. Thus, under the lump-sum redistribution scheme, only a low carbon price would be feasible. Nevertheless, it would still not be progressive. One interesting point is that in Western states, such as Germany or France, lump-sum transfers are sufficient to assure tax neutrality, and sometimes even progressivity. A large part of this difference can be explained by the extreme effects the carbon taxes would have on the lower income-deciles. In turn, these extreme effects are the result of the structure of the Romanian economy in 2010. Additionally, the lack of a carbon-intensive rich class implies that the total sum collected from the carbon tax will not be sufficiently high to compensate the distributional effects for the entire population.

Given that the lump-sum transfer has proven to be sub-optimal in mitigating the vertical distributional effects of a carbon tax, I move towards a normative revenue redistribution system, based on Rawlsian principles. As previously mentioned, I use the regressivity indicator as a measure of policy effort. I firstly select only households with > 1, which implies that they are overpaying for carbon given the national averages. The redistribution of revenues obtained from a carbon tax is then focused on these individuals. Figure 5 shows the distributional effects of carbon pricing in Romania under Rawlsian redistribution. In this case, carbon pricing would be highly progressive. The only households that would actually incur any costs of carbon pricing would be from the richest 4 income deciles.

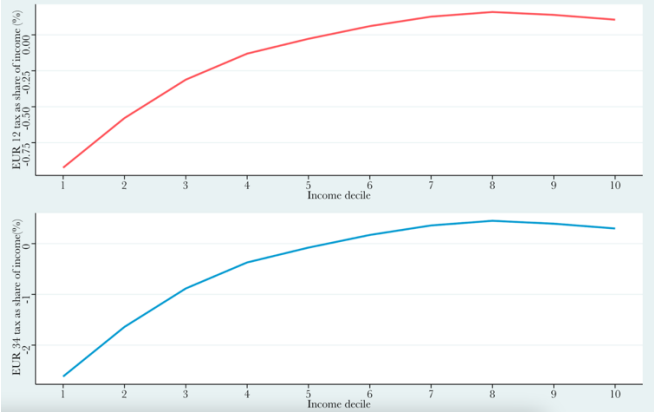

Figure 5. Post-Rawlsian redistribution vertical effects

Nevertheless, while socially optimal, this might not be optimal from the perspective of internalizing the climate externality—people that are disproportionately responsible for carbon emissions should bear more of the costs of carbon pricing, otherwise the assumptions of this policy are purely theoretical. From a behavioural perspective, this policy might be more complex than the current thesis discusses. When faced with increased prices at the shelf, people are not acting fully-rational by computing the expectation of receiving transfers and deducing it from the price of the carbon-intensive goods. One would need to compute both the demand and the supply behavioural responses, although this is beyond the scope of the current thesis. Nevertheless, the essential point is that Rawlsian redistribution would make carbon pricing progressive in Romania, avoiding the massive social drawbacks.

Horizontal effects

If in terms of vertical effects, it is clear that carbon pricing would be regressive in Romania. However, it is also crucial to analyze the horizontal distributional effects. Given the data currently accessible, the only measure for which I can compute horizontal tax incidence is the regional distribution. Additionally, given the extreme results achieved by imposing any carbon tax in the absence of revenue-recycling schemes, this section focuses on the horizontal distributional effects in the presence of a lump-sum redistribution. The Rawlsian-based redistribution strategy is not portrayed, as Romania forbids any form of regional discrepancy in the case of fiscal policy.

Figure 6 displays the incidence of both a EUR 12/tCO_2 and a EUR 34 /tCO_2across the NUTS1 regions in Romania. The lower tax would imply a policy effort rate between 1.04%-1.31% of annual regional consumption expenditure, while the higher tax implies an effort rate between 2.96%-3.72%. While the inter-regional discrepancies remain rather small, I nevertheless observe a significant gap between two NUTS1 regions in Romania: RO3, where the policy effort rate implied by carbon pricing is the smallest, and RO4, where the effort is the largest.

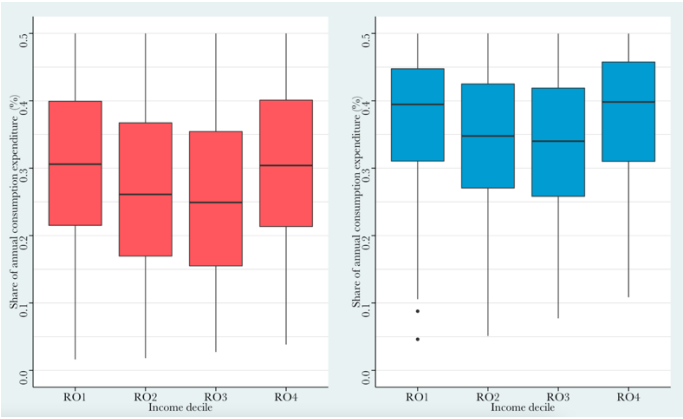

Figure 6. Horizontal effects

While the available data do not allow me to fully characterize the determinants of the horizontal distributional effects quantitatively, there are a couple of hypotheses worth discussing in future research:

- RO4 is the primary agricultural region of Romania, as well as the least dense region. Subsistence agriculture has been central to regional development until recent years.
- RO3 is the region containing Bucharest, the most developed part of Romania. As such, it is more likely that this region's economic structure resembles the EU's economic structure and it is less reliant on carbon-intensive activities.

Lastly, Figure 7 shows the combined distributional effects of carbon pricing in Romania, prior to any form of redistribution. As one would expect, while carbon pricing affects the four Romanian regions in a unique manner, it is nevertheless constantly regressive.

Concluding remarks

This paper analyses the vertical and horizontal distributional effects of two carbon taxes, of EUR 12 and EUR 34, imposed in Romania. I find both taxes regressive in terms of vertical distributional effects, while the horizontal distributional effects remain unclear. Given the lack of support for ambitious climate policy in Romania, these results show that policymakers should pay special attention to how the revenue from any potential carbon taxes is distributed. Carbon pricing would be feasible, but complex to implements.

I show that while a uniform lump-sum transfer would reduce regressivity, this recycling mechanism is suboptimal as it actually leads to financial gains for the most well-off in society. Following this, I propose a revenue-recycling mechanism based on Rawlsian normative considerations — only people disproportionately affected by the carbon tax would receive transfers. This mechanism indeed makes carbon pricing progressive, while also being in line with the mainstream equity concerns of climate policymaking.

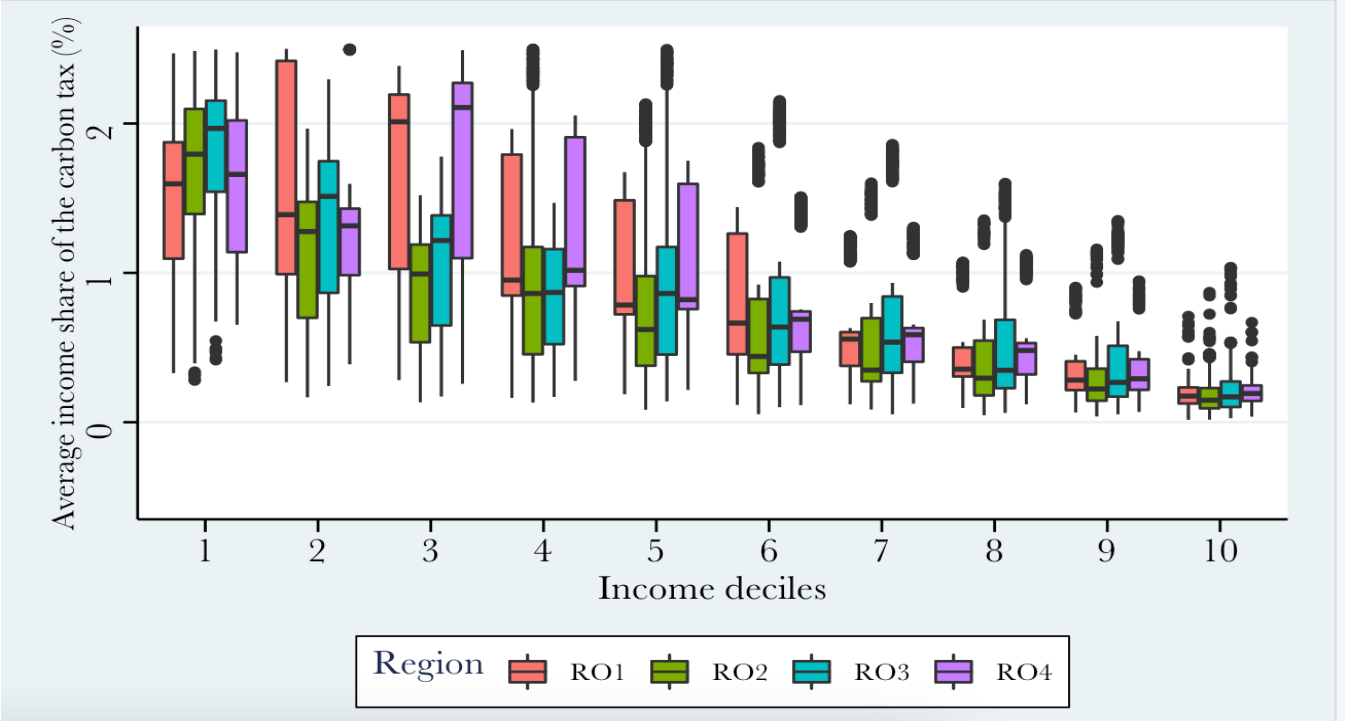

Figure 7. Vertical and horizontal distributional effects

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