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Social sustainability in the decarbonized welfare state: Social policy as a buffer against poverty related to environmental taxes

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Abstract

Decarbonization, environmental protection, and sustainable development are more topical than ever. Despite long-standing debates about the regressive profile of environmental taxes, the welfare state's role in buffering adverse distributive impacts of climate policy is largely unexplored. We examine if social policy shields households from falling into poverty due to environmental taxes tied to consumption. We specifically focus on the importance of income replacement in social insurance and social assistance. To enable detailed assessments of the distributive outcomes of environmental policy, we impute environmental taxes into the European Union Statistics on Income and Living Conditions (EU-SILC). Our comparative analysis of 26 European countries indicates that the welfare state protects households from relative income poverty due to environmental taxes. Moreover, comparisons between educational groups suggest that both social insurance and social assistance play different yet complementary roles in reducing socio-economic gradients in poverty related to environmental taxes.

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Introduction

The escalating seriousness of many environmental challenges does not only pose threats to ecological sustainability. Environmental taxes and other climate policies put in place to steer people toward less ecologically harmful consumption tend to be regressive and weigh more heavily on the poor (Büchs et al., 2011). Without an ambitious redistributive social agenda, environmental taxes may thus increase poverty risks and create less socially sustainable societies. The purpose of this study is to analyze if the welfare state buffers against such adverse distributive outcomes of taxes imposed on household consumption for various environmental purposes, most notably to mitigate carbon gas emissions.

The welfare state is the main political arena for providing social security and resolving distributive conflicts by creating positive-sum solutions (or societal compromises) among various interest groups in society. Previous research has highlighted the welfare state's role in balancing inequalities based on class (Korpi, 2006), gender (Lewis, 2002), and age (Birnbaum et al., 2017). In this study, we explore its potential to also mitigate social divisions and injustices related to slowing down global warming. Poverty risks related to critical life events tend to disproportionately affect people who are already in socio-economically vulnerable positions. As such, we will not only analyze if the welfare state prevents people from ending up in poverty by having to pay environmental taxes, but also if social policy reduces important socio-economic gradients in the distribution of costs associated with the transition to more environmentally friendly societies.

Our analytical framework positions social policy as an intermediate variable that moderates how environmental taxes affect poverty. The basic idea of a close relationship between climate mitigation efforts and social policy is not far-fetched. By providing security against major social risks in society, the welfare state makes people less economically vulnerable to life-changing events such as illness, unemployment, and retirement. We expect that protection against income loss during such critical life events reduces some of the most undesired distributive outcomes of environmental policy. Thus, without an effective system of income redistribution in place, rising fuel prices or increased energy costs that stem from increases in environmental taxes may push a greater number of vulnerable households into poverty. It is precisely because of such risks of escalating household costs that the European Commission has become more concerned about energy poverty among its Member States in recent years (Filippidou et al., 2019).

The welfare state includes a complex set of redistributive programs that re-allocate income horizontally between different groups in society and vertically across socio-economic strata, but also smooths individual incomes over the life cycle. Identifying the precise programs and institutional characteristics of welfare states that are most effective in reducing economic hardships is a challenging endeavor. In this study, our attention is directed toward two likely candidates: contributory social insurance and means-tested social assistance. These programs can be seen as communicating vessels as they enter the distributive process in different stages (Nelson, 2006). We will therefore test a series of hypotheses about the complementary nature of social insurance and social assistance in buffering poverty risks related to environmental taxes.

Environmental taxes have gained prominence on the policy agendas of several European countries. According to data from the European Statistical Office (Eurostat), environmental taxes in the European Union (EU) corresponded to 2.2% of the EU gross domestic product (GDP) in 2020 and 5.4% of the total EU government revenue from taxes and social contributions (Eurostat, 2023). Slightly less than half of this revenue, or 44.3%, was from environmental taxes levied on household consumption. While these shares have been relatively stable since the mid-1990s, tax revenues differ substantially between the European countries. Although there has been some convergence in environmental tax revenues among the EU countries in recent decades (Delgado et al., 2022), there are thus good reasons of focusing on cross-national differences rather than longitudinal trends.

We analyze 26 EU Member States, primarily relying on data from 2015. The empirical analyses are based on household-level survey data from the EU Statistics on Income and Living Conditions (EU-SILC). In addition, we innovatively imputed environmental taxes into EU-SILC based on a combination of data from the European Household Budget Surveys (HBS) and the Eurostat Tax Revenue Statistics Database. This approach facilitates a detailed comparative analysis of the distributive outcomes of environmental policy that hitherto has been impossible to carry out. At the country level, we use data from the renowned Social Policy Indicators (SPIN) database (Nelson et al., 2020). All these data are analyzed by means of logistic regression.

The study is structured as follows. Next, we review theory and previous research on the social sustainability of environmental policy and formulate our hypotheses about the buffering effects of social policy. Before discussing some methodological considerations, we describe our data and explain how we imputed environmental taxes into EU-SILC. After this, we present our results, followed by a concluding discussion.

Theory and previous research

There is a growing interest in research about the social sustainability of policies to protect the ecological environment, including how climate policy is connected to other societal issues such as well-being, work, and inequality. The Intergovernmental Panel on Climate Change (IPCC) of the United Nations (UN) is one prominent actor in the field that increasingly emphasizes the economic and social dimensions of climate change. However, main attention is on changing the polluting behavior of supposedly rational actors via various market interventions, rather than on the social consequences of the climate mitigation efforts put in place.

Notwithstanding that the rationality of household decision-making is sometimes contradicted in practice (Chetty et al., 2009), the core idea of correcting markets to steer consumption in more environmentally friendly directions is not new. It has inspired environmental policymaking at least since the early 1990s (Nordhaus, 1994), and placed carbon pricing as one of the most cost-efficient tools for reducing greenhouse gas emissions (Stiglitz et al., 2017). Against this background, the widespread use of carbon taxes across Europe is not surprising. However, concerning the distributional and social impacts of environmental taxes and carbon pricing within countries, the IPCC thus far offers little guidance, as they are mostly concerned with the sharing of burdens between rather than within countries (Stavins et al., 2014).

Global climate justice is, of course, of great importance, particularly regarding how obligations to reduce greenhouse gas emissions are to be distributed between high-, middle-, and low-income countries. However, inequalities and tensions related to the distribution of costs and benefits among households within countries should not be neglected. Although obligations to reduce greenhouse gas emissions and slow down global warming are regulated in international treaties such as the Paris Agreement, the European Green Deal, and more recently the Glasgow Climate Pact, the precise policies implemented typically remain under the authority and jurisdiction of national governments. Environmental and decarbonization policies are, therefore, subject to similar political processes and challenges that characterize other areas of policymaking (Boasson et al., 2021; Dubash, 2021). The potential of policies to generate lock-in effects and positive feedback or contribute to public discontent and political backlash, are a few examples (Klenert et al., 2018). To scale up mitigating efforts, it should thus be in the interest of policymakers to find ways in which environmental taxes can be considered equitable and socially sustainable within countries.

Although indirect taxation on consumption is a popular instrument among policymakers to reduce greenhouse gas emissions, public support for environmental taxes is often low (Harrison, 2010). Environmental taxes on household consumption are typically flat-rate and thus constitute a greater share of disposable income for low-income than middle- or high-income groups. Placing this extra financial burden on economically vulnerable groups is something that also more well-off people may find unfair. Research on climate policy attitudes has taken off in recent years (Drews and van den Bergh, 2016), and the take-home message from this research is pretty clear. A majority of citizens recognize and worry about the climate (Steg, 2018). Yet, opposition against environmental taxes that impose direct costs on households tends to be strong, particularly among less educated and socio-economically disadvantaged groups (Fairbrother et al., 2019; Parth and Vlandas, 2022).

While analyses of environmental attitudes and beliefs about fairness have grown in popularity among sociologists and political scientists, the distributive profile of environmental taxes is still studied mainly in Economics. Both existing and hypothetical policies are analyzed. After a few studies in the early-1990s showed that carbon taxes often are regressive (Pearson and Smith, 1991; Poterba, 1991), the academic debate about the distributional profile of climate change mitigation policies has occasionally been intense (Lamb et al., 2020). There is some indication that research initially overestimated the degree of regressivity by using annual rather than lifetime income (Wang et al., 2016), or by disregarding how revenues from environmental taxation are used and distributed in the population (Bork, 2006; Büchs et al., 2011). However, most crucial for our purposes is that few studies in this tradition, if any, make clear connections to the potential moderating role of social policies already put in place. This is even more puzzling considering that the OECD already in the mid-1990s referred vaguely to the possibility that increased usage of environmental taxes may require some forms of compensatory measures to make policies equitable (Harrison, 1995).

Social policy and environmental taxes

The relationship between the welfare state and environmental policy is gaining more scholarly attention. After lingering in obscurity within welfare research for many years (Johansson and Koch, 2020), the dynamics of environmental protection and sustainable development now constitute an important sub-field of social policy research (Hvinden and Schoyen, 2022). However, the links made to environmental policy are typically still quite abstract, such as revolving around ideas of the welfare state being a necessary precondition for making eco-friendly societies socially sustainable. Pioneering scholars in the field propose that social and climate policy share objectives in regulating negative externalities of industrialism and market capitalism, which often fail to self-regulate in fair and efficient ways (Gough, 2016; Gough and Meadowcroft, 2011). In this context, climate policy is assumed to borrow strength from the historical legacy of the welfare state in regulating human behavior and producing public goods, thus making it possible to scale up carbon gas mitigation efforts without risking too much social and political opposition (Gough et al., 2008). The relationship between environmental policy and social policy may, therefore, not be plagued by zero-sum conflicts and tradeoffs between climate mitigation and income redistribution (Dryzek, 2008).

Empirical research regarding the existence of such synergies and reinforcing structures between the social and ecological realms of the state is steadily expanding but remains inconclusive. In a cross-national study of 68 countries in 2010, Kerret and Shvartzvald (2012) observed positive effects of the welfare state on environmental parameters expected to have an immediate and acute impact on human health, such as indoor and outdoor air quality, access to clean water and sanitation, the environmental burden of disease, and so forth. No association with social policy was observed in relation to performance indicators whose latency periods supposedly are longer, such as air pollution affecting ecosystems, biodiversity and marine protection, and so on. Using the same data and country sample, Bernauer and Böhmelt (2013) only observed a positive association between the welfare state and a few individual aspects of environmental performance, such as water pollution or forest management. Overall, they concluded that the results of any synergies between social policy and environmental performance are sketchy and far from robust. Koch and Fritz (2014), and more recently Zimmermann and Graziano (2020) report similar results of a weak to non-existent relationship between the two policy areas. All studies above predominantly rely on individual emission statistics or indices of multiple environmental outcome indicators. There is some indication that a more institutional perspective of environmental performance – where the enactment of policies rather than emissions are in focus, provides a stronger empirical link to the ways in which countries have designed their welfare states through social policy (Lim and Duit, 2018).

Economic well-being and poverty are important benchmarks for assessing how socially sustainable environmental policies are in the shift toward eco-social welfare states (Hasanaj, 2023). However, surprisingly few studies have incorporated these aspects in analyses of the welfare state and environmental performance. Both Koch and Fritz (2014) and Zimmermann and Graziano (2020) included the Gini coefficient of disposable income as a measure of overall inequality. However, they did not devote any special attention to developments in the lower segments of the income distribution. One possible reason for this omission could be that environmental taxes on household consumption are still relatively modest, especially in comparison with other forms of taxation, such as income or capital gains taxes. Upon initial examination, it might therefore appear reasonable to assume that the potential impact of environmental taxes on poverty and economic well-being is small, if not negligible. However, evading environmental taxes is exceedingly challenging, regardless of a household's position in the income distribution. As these taxes are levied on consumption, a significant number of households will probably face substantial risks of slipping into poverty due to even minor price increases on goods and services. It is also reasonable to expect that many of these vulnerable households simultaneously confront additional social risks, such as unemployment, long-term illness, or old age.

While most citizens are exposed to social risks to some degree, the likelihood of becoming unemployed (OECD, 2000), suffering from long-term illness (Conti et al., 2010), or experiencing economic vulnerabilities in old age (Ebbinghaus et al., 2019) is closely linked to educational attainment. Those with lower education typically carry the highest poverty risks. Poverty attributed to environmental taxes is therefore likely to involve a socio-economic gradient tied to education. Depending on how countries have organized their social policies, we expect that the welfare state not only reduces economic vulnerabilities associated with environmental taxes in the population as a whole, but also dampens educational differences in poverty risks related to environmental taxes. As mentioned earlier, our attention is directed toward two main types of redistributive policies – contributory social insurance and means-tested social assistance – that exist in nearly all welfare states. These two programs differ in their distributional profiles and are likely to affect poverty in different, but potentially complementary, ways.

Social insurance is provided in response to various contingencies in life (i.e. unemployment, illness, or retirement) for which the employer or employee has made certain contributions. Compensation is either flat-rate or earnings-related, and considered an essential part of the bundle of rights and duties associated with the advent of social citizenship and the expansion of welfare states in the post-World War II period (Marshall, 1950). Due to the contributory character of social insurance, not all people who suffer from a particular contingency receive compensation. Analyses on the socio-economic distribution of contributory benefits are rare, particularly in comparative research. This becomes even more apparent if the focus is shifted from actual recipients to persons eligible for benefits (Nelson and Nieuwenhuis, 2021). Nonetheless, it is reasonable to assume that social insurance coverage decreases the further down we go in the income distribution, as precarious employment and other obstacles that may create difficulties in fulfilling qualifying conditions are likely to become more prominent. For similar reasons, it is reasonable to expect that social insurance coverage varies by educational level, being less complete among those with only elementary forms of schooling.

Social assistance is financed out of general tax revenue and usually comes into play when social insurance fails to provide a decent standard of living, for example, because of insufficient contribution records.[1] Benefits are means-tested, and they often do not reach as high up the income distribution as social insurance. Previous research shows that hardly any European country provide social assistance at levels sufficient to lift households above commonly applied poverty thresholds (European Commission, 2022; Nelson, 2013; Van Mechelen and Marchal, 2013). A few studies, however, report that social assistance is successful in reducing harsher forms of financial vulnerabilities, such as material deprivation (Israel and Spannagel, 2019; Nelson, 2012).

Based on these institutional differences between social insurance and social assistance, we can formulate the following hypotheses regarding social policy:

Hypothesis 1: Higher degrees of income replacement in social insurance reduce the probability of being poor due to environmental taxes on household consumption, but foremost at higher poverty thresholds.

Hypothesis 2: Higher degrees of income replacement in social assistance reduce the probability of being poor due to environmental taxes on household consumption, but foremost at lower poverty thresholds.

In relation to educational differences in poverty risks linked to environmental taxes, we can formulate the following hypotheses:

Hypothesis 3: Higher degrees of income replacement in social insurance reduce potential socio-economic gradients in the probability of being poor due to environmental taxes on household consumption, but foremost at higher levels of education.

Hypothesis 4: Higher degrees of income replacement in social assistance reduce potential socio-economic gradients in the probability of being poor due to environmental taxes on household consumption, but foremost at lower levels of education.

Data

As noted above, this study combines household-level data from EU-SILC and country-level data from SPIN for 26 European countries, including Belgium, Bulgaria, Cyprus, Czechia, Denmark, Estonia, Germany, Greece, Spain, Finland, France, Croatia, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, the Netherlands, Poland, Portugal, Romania, Slovakia, Sweden, Slovenia, and the United Kingdom.

EU-SILC is an anonymized social survey, and our analyses are approved by the European Commission (Eurostat).[2] We used the 2015 EU-SILC cross-sectional sample, where the number of surveyed households range from 2939 in Iceland to 17,985 in Italy. The average response rate was 71.2%, being lowest in Denmark (36.6%) and highest in Romania (92.5%). Due to missing data, the analyses of Germany, Ireland, Portugal, and Slovenia were based on EU-SILC data from 2010.

Imputation of environmental tax expenditures into EU-SILC

Unfortunately, comparative data on the distribution of environmental taxes among households is not readily available. Nor does EU-SILC include any information about the consumption of households. To overcome these problems, we imputed environmental tax expenditures into EU-SILC using a combination of national tax revenue data from Eurostat and data from the European HBS.[3] The main reason why the empirical analyses could not be based on HBS directly was missing data on core household-level background variables for several countries.

Eurostat's definition of an environmental tax includes excess taxes on consumption with a verified adverse impact on the environment (excluding value-added tax and land taxes). In their tax revenue data, Eurostat categorizes environmental taxes into four primary groups: energy, transport, pollution, and utilization of natural resources. These taxes are also separately documented for households and industries. In our study, we only used tax revenues from households. We matched each environmental tax base in the Eurostat Tax Revenue Statistics Database with the most closely related consumption items in HBS (see Appendix Table 3 for details). Subsequently, we included the environmental tax revenues sourced from Eurostat into HBS as tax expenditures. This process involved distributing national tax revenues to each household in HBS, based on each household's respective proportion of total national consumption for each tax base.

The next step involved integrating this HBS environmental tax expenditure data into EU-SILC through an imputation technique based on predictive mean matching.[4] For every household in EU-SILC, we employed regression methodology to create a small subset of nearest neighbors from the donor data set (i.e. HBS). From this subset of donors, one nearest neighbor was randomly selected, and its tax expenditures were assigned to the corresponding EU-SILC household. For our specific objective, subsets comprising the 10 nearest neighbors yielded the most precise imputations. The predictive mean matching procedure was executed separately for each country.

The accuracy of imputed data can be assessed in different ways, commonly including an inspection of mean scores. For most countries, the imputed tax expenditures in EU-SILC were over- or underestimated by less than 3%. Three countries (Greece, Slovenia, and Poland) had slightly larger errors between 4% and 6% (Figure 4 in the Appendix). Another and perhaps more meaningful evaluation involves comparisons of mean scores at different levels of household disposable income. The over- or underestimation of imputed tax expenditures in EU-SILC was less than 1.3% in all income deciles except the first, where the underestimation was slightly less than 4% (Figure 5 in the Appendix). These less accurate imputations in the first income decile should hardly affect the analyses performed below, since households located in the lowest income quintile will be defined as poor even in the absence of any environmental taxes.

Dependent variable

The dependent variable identifies households that are pushed into poverty by environmental taxes. It is based on the counterfactual assumption of what poverty would look like in the absence of environmental taxes on household consumption. Behavioral effects are not considered. Poor households that were above the poverty line in the absence of environmental taxes (i.e. after environmental tax expenditures have been added to household disposable income) received a score of 1. All other households received a score of 0. Similar types of counterfactual analyses are common in studies of the redistributive effects of separate social transfers and benefits (Nelson, 2004; Pedersen, 1999).

The definition of poverty thresholds is often somewhat arbitrary. In this study, we used four different relative poverty lines, set at 70%, 60%, 50%, and 40% of the median disposable income in each country. The relative perspective is often used in poverty research of affluent countries and is considered a valid approach to analyze adequate income standards necessary for social participation (Townsend, 1979). The 60% threshold is analogous to the so-called 'at-risk-of-poverty' threshold agreed upon by the EU member states and commonly used by the European Commission to monitor social inclusion outcomes. The square root equivalence scale was used to adjust incomes (and environmental tax expenditures) to household size. The square root scale is used to calculate the key figures on poverty and income inequality published by the well-renowned Luxembourg Income Study (LIS).

Household-level independent variables

At the household level, we included the following variables.

Educational attainment: Highest education obtained by the household member responding to the household questionnaire (i.e. household head), separated into primary (International Standard Classification of Education, ISCED 0–2), secondary (ISCED 3 and 4), and tertiary levels (ISCED 5–8).

Main activity: Self-reported main activity status of the household head, categorized into employed, unemployed, student, retired, or not in the labor force.

Sex: Biological sex of the household head.

Household type: Separated into single persons, couples without dependent children, single parents, and couples with children.

Birth country: Defined as the country of residence of the mother at the time of the household head's birth. Three geographical areas were considered: country of the survey, EU, and non-EU. Eurostat does not provide more detailed geographical areas in the EU-SILC files for scientific use.

Dwelling type: Distinguishing between detached houses, semi-detached houses, and apartments.

Age: Age of the household head in years.

Social policy variables

There is an ongoing discussion in research on how to conceptualize and measure the welfare state and social policy (Clasen and Siegel, 2007). EU-SILC includes information about transfers and benefits received by households. However, similar to social expenditure data from the national accounts, survey-based entitlement data may vary across countries for various reasons besides how social policies are regulated, not least because of differences in household needs (Kangas and Palme, 2007). Another problem in EU-SILC is lack of comparability due to inconsistencies in the classification of incomes between countries (Goedemé and Trindade, 2020). Income variables in EU-SILC are also categorized mainly according to contingencies rather than the underlying principles determining eligibility (e.g. whether benefits are based on contributory principles or not).

The SPIN data used in this study are based on model family data collection techniques, which often are utilized to overcome the problems associated with expenditure or survey-based entitlement data (van Oorschot, 2013). Model family analyses are not only used in academia (Bradshaw et al., 1993), but also by international organizations to monitor various social inclusion outcomes (Browne et al., 2019). In principle, the procedures involved in collecting model family data on social policy are fairly simple, yet often time-consuming to exercise on a large scale. First, a set of model (or typical) families are defined, which are assumed to be similar across countries on a range of relevant background characteristics, such as age and number of family members, work and contribution histories, earnings level, and so forth. Second, eligibility for benefits and levels of entitlement are established with reference to existing social policy legislation and regulative frameworks, under the assumption that the model families suffer from a certain contingency (i.e. unemployment, illness, or retirement).

In the SPIN database, entitlements are calculated net of taxes and expressed as a percentage of an average production worker's net wage.[5] Except for pensions, SPIN uses two model families: a single person and a dual-parent family with two children. For pensions, a single person and a couple are used. While in paid work, all model families were assumed to earn an average production worker's wage. As compensation in unemployment and sickness insurance may differ over the duration of benefit receipt, entitlements reflect an average of income replacement during the first week and 26 weeks.[6] For pensions, benefits reflect those received during a whole year. Our index of income replacement in social insurance is simply the sum of income replacement in unemployment insurance, sickness insurance, and old-age pensions, divided by three. It should be noted that the degree of income replacement in social insurance does not only reflect how benefit formulae are defined but also the number of waiting days, duration, and how benefits are taxed (Birnbaum et al., 2017).

The SPIN database also includes data on social assistance, which has been frequently used in research (Bahle et al., 2011; Biegert, 2017; Nelson and Fritzell, 2014; Noël, 2019). SPIN social assistance data assumes that the single-person and dual-parent model families not only lack work income but also income from contributory social insurance. Besides the standard rates of means-tested social assistance, the benefit package includes housing-related benefits, child benefits, and any refundable tax credits for which the model families are eligible. Although national coordination of social assistance has strengthened in Europe, benefit scale rates are still set locally in a few countries. While within-country differences tend to be small, SPIN data on social assistance in countries with regional policy frameworks are based on regulations from the capital area.

Lump-sum payments to meet occasional needs or supplements to account for special needs are not considered. The social assistance benefit packages of the single-person and dual-parent model families are averaged and expressed as a percentage of an average production worker's net wage. Similar to old-age pensions mentioned earlier, benefits are calculated for a whole year.

Methodological considerations

Since our dependent variable is binary, we analyzed the data using logistic regression with cluster-robust standard errors. While the cluster option accounts for the nested structure of our data (i.e. households are nested within countries), the robust specification adjusts for heteroscedastic disturbances that are often present in multiple regressions using cross-national data (Lemieux, 1976). Following common procedures in income distribution research, all analyses use household sampling weights multiplied by the number of household members.

Although households are sampled at random in each country, the countries included in our study certainly are not. Some would say that inferential statistics of between-country associations are uninformative in such instances (Ebbinghaus, 2005). However, there is an often-unspoken agreement in quantitative cross-national research that standard errors and levels of statistical significance remain relevant (Schmidt-Catran et al., 2019), not least because error terms in regression models not only originate from sampling but also from measurement errors and omitted variables (Babones, 2013). Nonetheless, inferences about country-level associations are certainly conditional on the observed sample. Thus, we use significance testing of parameter estimates more as a heuristic device of uncertainty rather than as a means to generalize findings to some imaginary super-population of countries (Berk and Freedman, 2003).

Having a relatively small number of cases at the country level restricts the possibility to test for competing macro-level explanations in cross-national research (Goldthorpe, 1997). There is no simple solution to this problem since we only have data for a single cross-section. To the extent possible, we control for other covariates at the country level by adding them one at a time to the statistical regression (see sensitivity analyses below). This estimation strategy has been previously used in this journal (Ferrarini et al., 2016). Nonetheless, the results should be interpreted cautiously, not least due to the risk of omitted variable bias.

Results

We begin by presenting our data descriptively. Figure 1 shows environmental tax expenditures as percentage of household disposable income by income decile and as an average of the 26 European countries included in the study. As a reference, we also show the two countries with the highest (Denmark) and lowest (Luxembourg) scores. The regressive profile of environmental taxes is highly visible. Environmental taxes constitute on average 3.2% of disposable income in the first income decile, falling steeply to 1.5% in the third income decile. Thereafter, the relative size of environmental tax expenditures declines at a more moderate pace for each subsequent decile. The only exception to this

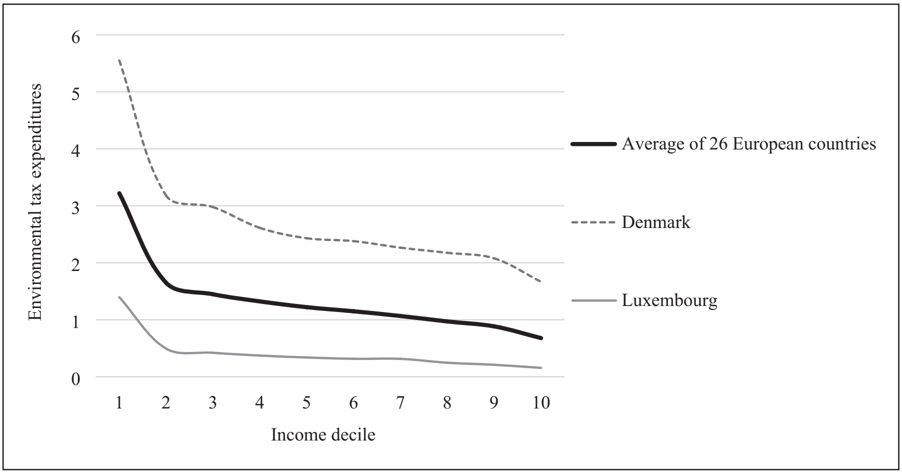

Figure 1. Environmental tax expenditures as percentage of household disposable income by income decile. Source: Eurostat tax revenue statistics, HBS, and EU-SILC (own calculations). Data for Germany, Ireland, Portugal, Slovenia, and the United Kingdom are from 2010.

pattern is in the tenth (and last) decile, where the decline in environmental tax expenditures (as percentage of household disposable income) is somewhat steeper. As a reference point, it is worth noting that the EU at-risk-of-poverty threshold is located around the lower end of the third income decile.

Figure 2 shows environmental tax expenditures as a percentage of household disposable income on the vertical axis, and the proportion of individuals in households who are relative income poor due to environmental taxes (using the 60% poverty threshold) on the horizontal axis. A subtle pattern emerges, indicating that higher tax expenditures correspond with a larger share of individuals ending up in poverty. This positive association persists, although somewhat weakened when excluding Denmark from the analysis. Compared to other European countries, Denmark is an exceptional case with extreme scores on both dimensions. Notably, the relatively weak country-level association between environmental tax expenditures and relative income poverty indicates that social policy may play an important moderating role. Had the correlation been very strong, there would be little remaining variation for social policy to account for.

Regression analysis

For the regression analysis, we included the degree of income replacement in social insurance and social assistance as separate variables at the country level in each model, while employing a larger selection of variables at the household level. Table 1 shows the regression results, with coefficients expressed as log odds. Positive (negative) coefficients indicate higher (lower) poverty risks due to environmental taxes. At the household level, we only show the regression coefficients for educational attainment (the full regression results are available in the Appendix, Table 4).

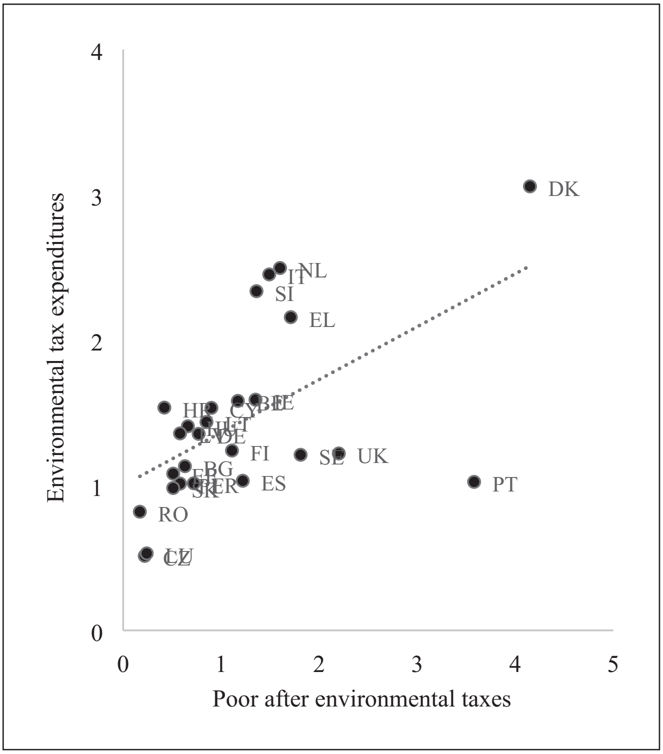

Figure 2. Percentage share of individuals in each country that belong to households that are relatively income poor due to environmental taxes (horizontal axis), and size of environmental tax expenditures as percentage of household disposable income (vertical axis).Source: Eurostat tax revenue statistics, HBS, and EU-SILC (own calculations).

Data for Germany, Ireland, Portugal, Slovenia, and the United Kingdom are from 2010. Poverty measured in relation to the EU at-risk-of poverty threshold (i.e. less than 60% of median income).

BE: Belgium; BG: Bulgaria; HR: Croatia; CY: Cyprus; CZ: Czechia; DK: Denmark; EE: Estonia; FI: Finland; FR: France; DE: Germany; EL: Greece; HU: Hungary; IE: Ireland; IT: Italy; LV: Latvia; LT: Lithuania; LU: Luxembourg; NL: Netherlands; PL: Poland; PT: Portugal; RO: Romania; SK: Slovakia; SI: Slovenia; ES: Spain; SE: Sweden; UK: United Kingdom.

We ran separate regressions for each of the four poverty thresholds (40%, 50%, 60%, and 70%). The negative coefficient of the social insurance variable is statistically significant at the 70% poverty threshold. It retains direction and statistical significance also at the two lower poverty thresholds of 60% and 50%, albeit the association becomes somewhat weaker before finally disappearing at the lowest 40% poverty threshold. For social assistance, we observe the opposite. No association at higher poverty thresholds of 50%, 60%, and 70%, but a statistically significant negative coefficient at the lowest 40% poverty threshold. The results thus support our hypotheses of a diminishing return of social insurance at lower poverty thresholds (Hypothesis 1), where instead social assistance kicks in and becomes important for the likelihood of individuals to end up in poverty after paying environmental taxes (Hypothesis 2).

Table 1. Logistic regressions of being relatively income poor due to environmental taxes on household consumption in 26 European countries.

	Poverty threshold			
	40%	50%	60%	70%
Country level				
Social insurance	–2.061	–1.650*	–1.904*	–2.017**
	(1.154)	(0.778)	(0.786)	(0.739)
Social assistance	–1.217*	–0.482	–0.417	–0.013
	(0.578)	(0.632)	(0.600)	(0.565)
Household level				
Education (reference primary)				
Secondary	–0.355*	–0.380**	–0.345**	–0.254*
	(0.156)	(0.097)	(0.094)	(0.115)
Tertiary	–0.334	–0.659**	–0.701**	–0.688**
	(0.232)	(0.173)	(0.129)	(0.163)

Log odds and cluster robust standard errors in parentheses. All models include activity status, sex, household type, birth country, dwelling type, and age at the individual level.
$^{*}p < 0.05$; $^{**}p < 0.01$.

The results also reveal a socio-economic gradient in the link between environmental taxes and poverty. Households where the head has attained tertiary education are least likely to be relatively income poor due to environmental taxes, followed by households where the head only has a secondary degree. Households where the head at best has primary schooling are most likely to be poor after environmental taxes. The coefficient for tertiary education loses statistical significance at the lowest (40%) poverty threshold, which probably reflects that there, statistically speaking, are few highly educated households at the bottom of the income distribution.

In Table 2, we investigate the extent to which social policy moderate these educational differences in poverty attributed to environmental taxes. We do this by estimating a set of regression models that include cross-level interactions between income replacement in social insurance (or social assistance at the 40% poverty threshold) and educational attainment of the household head (the full regression results are found in Appendix Table 5).[7] Interaction terms always need to be interpreted together with the main coefficients, which can be tricky. For ease of interpretation, we, therefore, visualize the results using predicted probabilities.

Figure 3(a) and (b) shows the predicted probabilities of being relatively income poor due to environmental taxes. The predictive probabilities are calculated separately for households with different levels of educational attainment and at varying degrees of income replacement in social insurance (or social assistance at the 40% poverty threshold). All predictions are within the range of observed levels of income replacement (45%–95% for social insurance and 0%–60% for social assistance).[8] All other variables are held at their sample means. Due to the limited size of environmental taxes in relation to disposable income, the predicted probabilities may seem remarkably low.[9] However,

Table 2. Logistic regressions of being relatively income poor due to environmental taxes on household consumption in 26 European countries (cross-level interactions).

	Poverty threshold			
	40%	50%	60%	70%
Country level				
Social insurance	–2.134	–1.012	–1.085	–1.247
	(1.230)	(0.909)	(0.788)	(0.785)
Social assistance	–1.906**	–0.453	–0.381	0.016
	(0.738)	(0.643)	(0.620)	(0.583)
Household level				
Education (reference primary)				
Secondary	–0.536**	0.082	0.601*	0.804**
	(0.164)	(0.277)	(0.255)	(0.207)
Tertiary	–0.812**	0.276	–0.131	–0.607**
	(0.186)	(0.300)	(0.214)	(0.153)
Interactions				
Social insurance × Secondary education		–0.775	–1.628**	–1.850**
		(0.515)	(0.451)	(0.347)
Social insurance × Tertiary education		–1.616**	–0.959**	–0.106
		(0.588)	(0.377)	(0.330)
Social assistance × Secondary education	0.864*			
	(0.354)			
Social assistance × Tertiary education	1.824*			
	(0.723)			
Prob > χ^2 (interactions)	0.024	0.015	0.001	0.000

Log odds and cluster robust standard errors in parentheses. All models include activity status, sex, household type, birth country, dwelling type, and age at the individual level.
*$p < 0.05$; **$p < 0.01$.

in relative terms, there are striking differences in probabilities between educational levels.

Assuming that the degree of income replacement in social insurance is set at the lowest level observed in our sample of countries, the predicted probability of being relatively income poor (70% poverty threshold) due to environmental taxes is 0.65% for households where the head has a tertiary degree. For households where the head only completed secondary education, the predicted probability is more than twice as large, or 1.60%. Notably, this difference in poverty risks between secondary and tertiary education approaches zero (i.e. no difference) at higher levels of income replacement in social insurance (see Figure 3(a)). A similar, albeit somewhat weaker, moderating role of social insurance is observed at the 60% poverty threshold (see Figure 3(b)), before disappearing altogether at the 50% poverty threshold (see Figure 3(c)).

Irrespective of the poverty threshold used in the empirical analysis, income replacement in social insurance seems unable to reduce the excess poverty risks associated with primary education. If anything, the difference in poverty risks between those

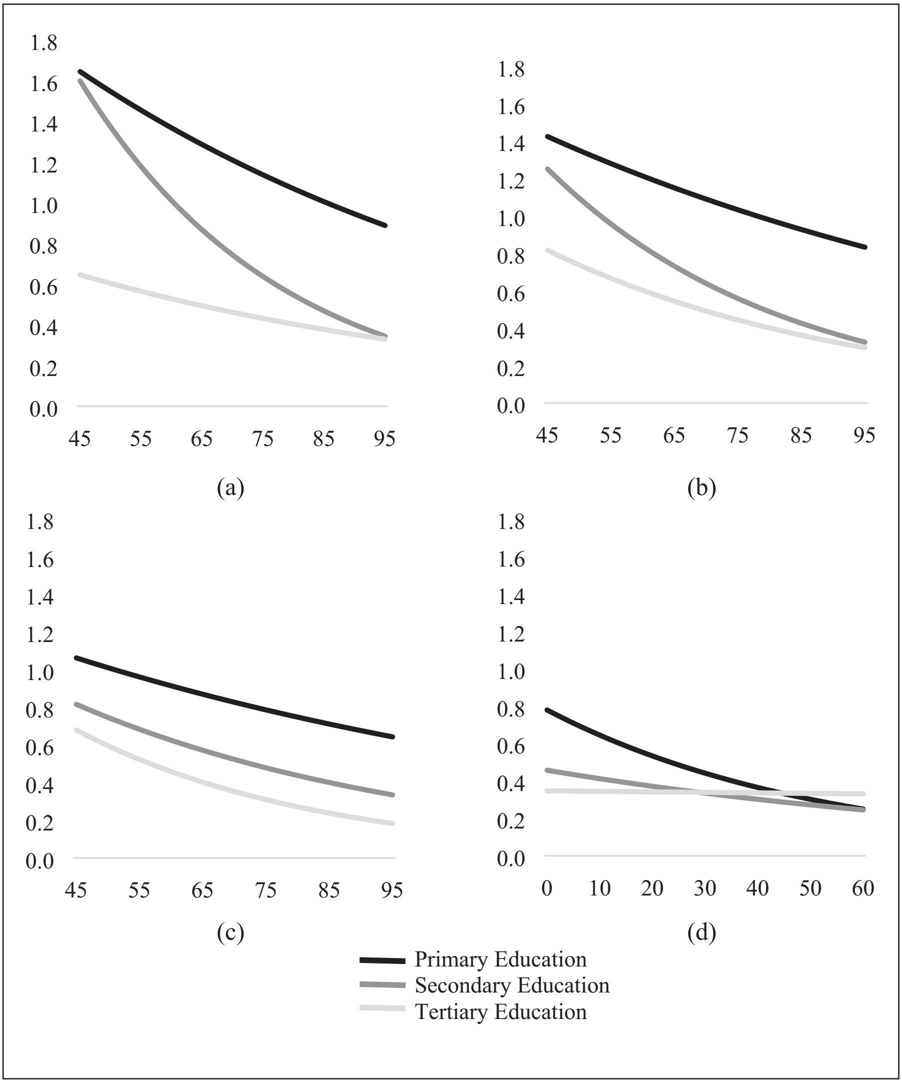

Figure 3. Predicted probabilities (shown as percentages) of being relatively income poor due to environmental taxes (vertical axis) at different degrees of income replacement in social insurance and social assistance (horizontal axis). (a) 70% poverty threshold, social insurance; (b) 60% poverty threshold, social insurance; (c) 50% poverty threshold, social insurance; and (d) 40% poverty threshold, social assistance.
Predictions are based on the regressions in Table 2.

with primary and secondary education seems to increase at higher degrees of income replacement in social insurance (see especially Figure 3(a) and (b)). The results thus support the third hypothesis, as social insurance foremost seems to reduce differences in poverty risks attributed to environmental taxes at higher levels of educational attainment.

Social assistance seems to do a better job than social insurance in reducing poverty risks among those with very low levels of education, which supports the fourth hypothesis above. Assuming that there is no social assistance program in place, the predicted probability of ending up in poverty (40% threshold) is 0.46% for households where the head has a secondary educational degree (see Figure 3(d)). For households where the head only has primary schooling (or less), the predicted probability is nearly twice as large, or 0.78%. Notably, however, there is no difference in predicted probabilities at higher levels of social assistance. As expected, households where the head has tertiary education are supposedly unaffected by social assistance.

Sensitivity analyses

The likelihood of becoming relatively income poor due to environmental taxes is of course related to how much each country taxes ecologically harmful consumption. We re-ran the regression models with household environmental tax revenue (as a percentage of GDP) at the country level, using the same Eurostat data as for the inclusion of environmental tax expenditures into HBS above. However, our findings and interpretations regarding social policy remained consistent.

To account for cross-country differences in economic affluence and the overall size of the welfare state, we added macro-level controls one at a time for GDP per capita (logged) and social expenditures as a percentage of GDP, both sourced from the OECD. The main results were robust to the inclusion of these controls.

EU-SILC includes information concerning the level of urbanization of the local geographical area in which households live. Unfortunately, however, this variable was missing for some countries. Nonetheless, we re-ran the analyses with urbanization included (distinguishing between densely populated areas, intermediate areas, and thinly populated areas). Although four countries were excluded due to missing data, the size and standard errors of the educational attainment coefficients remained largely unchanged. The results of the sensitivity analyses above are available from the authors upon request.

To address the issue of asymmetric confidence intervals, which can occur in regressions based on a relatively small set of higher-level units (i.e. countries), we employed bootstrapping to generate confidence intervals using 399 replications. This number of bootstrap samples is recommended as a minimum for testing statistical significance at the 0.05 level (Davidson and MacKinnon, 2000). The results from bootstrapping did not alter interpretations of the main findings (more details can be found in the Appendix, Table 6).

Concluding discussion

Concurrently with mounting scientific evidence of global warming and the intensified urgency to combat greenhouse gas emissions and other environmental challenges through collective action, there is growing interest about the interplay between environmental policy and social policy in shaping economic inequalities. In this study, we analyzed if the welfare state provides a buffer against regressively distributed environmental taxes and associated poverty risks. The empirical analyses indicate that the welfare state shields households from such vulnerabilities. Social insurance and social assistance also seem to reduce differences in poverty risks associated with educational attainment, albeit in different ways.

As hypothesized, social insurance seems foremost to reduce poverty risks related to environmental taxes higher up the income distribution, whereas social assistance is more effective at the lower end of the income spectrum. These complementary dynamics of social policy were mirrored in the ways benefits reduce educational disparities in poverty risks. The results suggest that social insurance primarily reduces the difference in poverty risks related to environmental taxes between households with secondary and tertiary education, while social assistance plays a more important role in protecting those with the lowest degrees (i.e. primary education).

Our strictly European sample places restrictions on the possibility to generalize our findings on a global scale. It should not be taken for granted that our results are transferrable to less advanced economies. Consumption patterns in low- and middle-income countries may be very different from those observed in the high-income countries covered in this study. Depending on the type of fuel being taxed, and on how revenues are recycled into the economy, the distributional impact of environmental taxes on household consumption may be more or less proportional to income, or even progressive in some low- and middle-income countries (Speck, 1999). A related caveat is that we only analyzed the direct expenditures of environmental taxation for households. We thus left out possible indirect expenditures resulting from environmental taxes on industries, which often are assumed to be carried over to households in terms of higher consumer prices (Serret and Johnstone, 2006). To the extent that consumption patterns of these commodities do not deviate substantially from those that determine the distribution of household expenditures analyzed in this study, we have most likely underestimated the poverty risks attributed to environmental taxes, and thus potentially also the role of the welfare state in counterbalancing such adverse distributive outcomes.

Throughout this article, we have intentionally referred to our findings avoiding making causal claims, given the cross-sectional nature of our data. As new waves of cross-national data become available, we hope that our analytical approach of linking social and environmental policy can pave the way for more causally oriented studies on how the welfare state buffers against new poverty risks that may arise as countries step up their climate policy ambitions. The findings presented in this study indicate that traditional forms of social protection, originally introduced to protect citizens from vagaries appearing in labor markets, are relevant in this regard. Social insurance and social assistance should, therefore, be considered integral parts of any reformulation of the welfare state that encompasses ambitions to mitigate climate change and protect the environment.

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Notes

1. Social insurance may occasionally also be financed out of general tax revenue, for example, to cover temporary deficits in the system.
2. The conditions for access to EU-SILC and HBS (including cross-linkages between the data sets) were approved by the European Commission (Eurostat) on 23 October 2022 (research proposal 215/2022-EU-SILC-HBS).
3. HSB microdata is currently not publicly available for other years than 2010 and 2015. The possibilities for longitudinal analyses of changes are thus restricted.
4. Predictive mean matching tends to produce fewer extreme values for imputation and thus more realistic results compared to methods solely based on multiple regression (Rubin, 1986).
5. SPIN data goes back to the 1930s, when wages in the production industry were the only realistic category to use in cross-national research.
6. The decision to calculate benefits for 26 weeks also reflects the long time-series of SPIN-data (Ferrarini et al., 2013). Up to the 1960s, duration of sickness and unemployment insurance was in most countries relatively short and still today remains below 1 year in a few European countries.
7. Note that the confidence intervals for each interaction term is highly dependent on which educational category is used as reference. The Prob $> \chi^2$ test statistic in Table 2 shows that the overall interactions are statistically significant (i.e. less than 0.05) in all regression models.
8. Greece and Italy lacked national social assistance frameworks in 2015, and are thus coded to zero in the statistical analyses. Greece introduced a national framework for means-tested social assistance in 2017. Italy did the same in 2016. Initially the Italian scheme was only targeting families with dependent children, but has in subsequent years been expanded to include additional vulnerable groups.
9. It should be noted that by multiplying our data by population figures, more than six million people were pushed into poverty (60% threshold) by environmental taxes in the selection of countries used in this study.

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Appendix 1

Table 3. Environmental tax bases in European tax revenue statistics and matched expenditure categories in the European Household budget surveys (variable names in parenthesis).

European tax revenue statistics	European household budget survey
Energy, electricity, gas, and other fuels	+ Electricity_ gas and other fuels (HE045) + Fuels and lubricants for personal transport equipment (HE0722)
Transport	+ Transport (HE07) – Fuels and lubricants for personal transport equipment (HE0722)
Pollution	+ Water supply and miscellaneous services relating to the dwelling (HE044) + Refrigerators, fridge, and freezers (HE05311) + Heaters and air conditioners (EUR_HE05314) – Water supply (HE0441)
Use of natural resources	+ Water supply (HE0441)

Table 4. Full model specifications: logistic regressions of being relatively income poor due to environmental taxes on household consumption in 26 European countries.

	Poverty threshold			
	40%	50%	60%	70%
Country level				
Social insurance	–2.061	–1.650*	–1.904*	–2.017**
	(1.154)	(0.778)	(0.786)	(0.739)
Social assistance	–1.217*	–0.482	–0.417	–0.013
	(0.578)	(0.632)	(0.600)	(0.565)
Household level				
Education (reference primary)				
Secondary	–0.355*	–0.380**	–0.345**	–0.254*
	(0.156)	(0.097)	(0.094)	(0.115)
Tertiary	–0.334	–0.659**	–0.701**	–0.688**
	(0.232)	(0.173)	(0.129)	(0.163)
Activity status (reference employed)				
Unemployed	1.407**	0.958**	0.695*	0.484*
	(0.226)	(0.247)	(0.298)	(0.233)
Student	1.633**	1.005**	1.295**	0.450
	(0.401)	(0.244)	(0.288)	(0.301)
Retired	–0.297	0.366	0.321	0.266
	(0.248)	(0.368)	(0.241)	(0.220)
Not in labor force	0.545*	1.020**	0.655**	0.402
	(0.223)	(0.172)	(0.162)	(0.213)
Sex (reference female)	–0.251**	–0.197**	–0.292**	–0.180
	(0.088)	(0.123)	(0.098)	(0.093)
Household type (reference single person)				
Couple	–1.226**	–0.937**	–0.666**	–0.546*
	(0.107)	(0.130)	(0.162)	(0.181)
Single parent	–0.823	–0.018	0.007	0.09
	(0.453)	(0.151)	(0.265)	(0.235)
Dual adults	–1.172**	–1.020**	–0.676**	–0.587**
	(0.186)	(0.192)	(0.239)	(0.194)
Birth country (reference place of survey)				
EU	–0.034	–0.260	–0.175	0.349
	(0.195)	(0.227)	(0.238)	(0.359)
Other	–0.790**	–0.518	–0.404	–0.192
	(0.340)	(0.288)	(0.346)	(0.343)
Dwelling (reference detached house)				
Semi-detached	–0.137	0.031	0.100	0.190
	(0.201)	(0.158)	(0.193)	(0.156)
Apartment	–0.153	–0.027	0.123	–0.019
	(0.129)	(0.100)	(0.121)	(0.127)
Age	–0.002	–0.012*	–0.004	–0.005
	(0.005)	(0.006)	(0.005)	(0.005)

(Continued)

Table 4. (Continued)

	Poverty threshold			
	40%	50%	60%	70%
Constant	–1.800	–1.856	–2.167**	–2.278**
	(0.00)	(0.654)	(0.585)	(0.608)

EU: European Union.Log odds and cluster robust standard errors in parentheses.
*$p<0.05$; **$p<0.01$.

Table 5. Full model specifications: logistic regressions of being relatively income poor due to environmental taxes on household consumption in 26 European countries (interactions).

	Poverty threshold			
	40%	50%	60%	70%
Country level				
Social insurance	–2.134	–1.012	–1.085	–1.247
	(1.230)	(0.909)	(0.788)	(0.785)
Social assistance	–1.906**	–0.453	–0.381	0.016
	(0.738)	(0.643)	(0.620)	(0.583)
Household level				
Education (reference primary)				
Secondary	–0.536**	0.082	0.601*	0.804**
	(0.164)	(0.277)	(0.255)	(0.207)
Tertiary	–0.812**	0.276	–0.131	–0.607**
	(0.186)	(0.300)	(0.214)	(0.153)
Activity status (reference employed)				
Unemployed	1.413**	0.956**	0.692*	0.482*
	(0.227)	(0.248)	(0.298)	(0.234)
Student	1.608**	1.0143**	1.310**	0.463
	(0.398)	(0.244)	(0.289)	(0.299)
Retired	–0.285	0.381	0.330	0.272
	(0.2488)	(0.372)	(0.243)	(0.222)
Not in labor force	0.539**	1.026**	0.652**	0.394**
	(0.218)	(0.173)	(0.163)	(0.213)
Sex	–0.237**	–0.197	–0.289**	–0.174
	(0.087)	(0.122)	(0.098)	(0.092)
Household type (reference single person)				
Couple	–1.226**	–0.944**	–0.675**	–0.555**
	(0.105)	(0.132)	(0.164)	(0.182)
Single parent	–0.821	–0.009	–0.003	0.059
	(0.454)	(0.151)	(0.273)	(0.242)
Dual adults	–1.171**	–1.020**	–0.679**	–0.591**
	(0.184)	(0.189)	(0.237)	(0.192)

(Continued)

Table 5. (Continued)

	Poverty threshold			
	40%	50%	60%	70%
Birth country (reference place of survey)				
EU	–0.015	–0.269	–0.180	0.347
	(0.201)	(0.231)	(0.242)	(0.359)
Other	–0.798*	–0.522	–0.421	–0.216
	(0.336)	(0.293)	(0.345)	(0.341)
Dwelling (reference detached house)				
Semi-detached	–0.135	0.030	0.084	0.164
	(0.203)	(0.151)	(0.195)	(0.163)
Apartment	–0.139	–0.020	0.126	–0.021
	(0.128)	(0.095)	(0.117)	(0.125)
Age	–0.002	–0.012*	–0.004	–0.005
	(0.005)	(0.006)	(0.005)	(0.005)
Interactions				
Social insurance × Secondary education		–0.775	–1.628**	–1.850**
		(0.515)	(0.451)	(0.347)
Social insurance × Tertiary education		–1.616**	–0.959**	–0.106
		(0.588)	(0.377)	(0.330)
Social assistance × Secondary education	0.864*			
	(0.354)			
Social assistance × Tertiary education	1.824*			
		(0.723)		
Constant		–2.252**	–2.662	–2.727**
		(0.671)	(0.619)	(0.653)
Prob > χ^2 (interaction)	0.024	0.015	0.001	0.000

EU: European Union.
Log odds and cluster robust standard errors in parentheses.
$*p < 0.05$; $**p < 0.01$.

Table 6. Logistic regressions of being relatively income poor due to environmental taxes on household consumption in 26 European countries (399 bootstraps).

	Poverty threshold			
	40%	50%	60%	70%
Country level				
Social insurance	–2.538	–1.924*	–1.911*	–1.877*
	(1.412)	(0.987)	(0.792)	(0.958)
Social assistance	–1.354*	–0.174	0.257	– 0.443
	(0.652)	(0.848)	(0.861)	(0.894)
Household level				
Education (reference primary)				
Secondary	–0.347*	–0.316**	–0.270**	–0.279**
	(0.098)	(0.085)	(0.060)	(0.063)
Tertiary	–0.362	–0.633**	–0.672**	–0.591**
	(0.129)	(0.137)	(0.134)	(0.121)

Log odds and bootstrapped (399) cluster robust standard errors in parentheses. All models include activity status, sex, household type, birth country, dwelling type, and age at the individual level.
*$p<0.05$; **$p<0.01$.

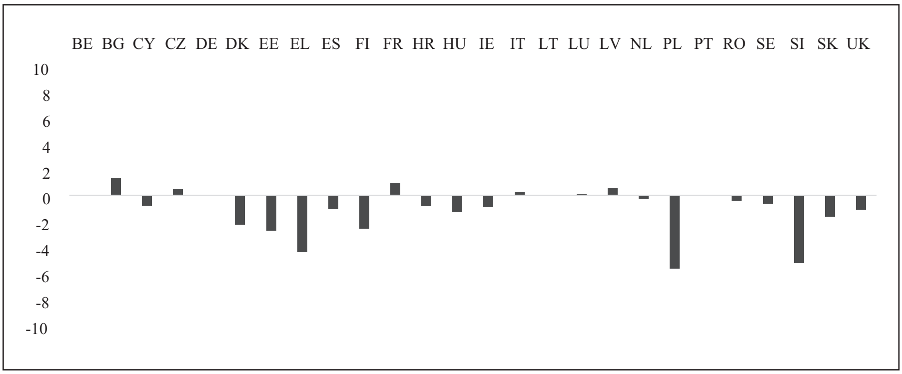

Figure 4. Over/underestimation (%) of environmental tax expenditures in EU-SILC by country, 2015.
Comparisons of mean scores in EU-SILC and HBS. Data for Germany, Ireland, Portugal, Slovenia, and the United Kingdom are from 2010.

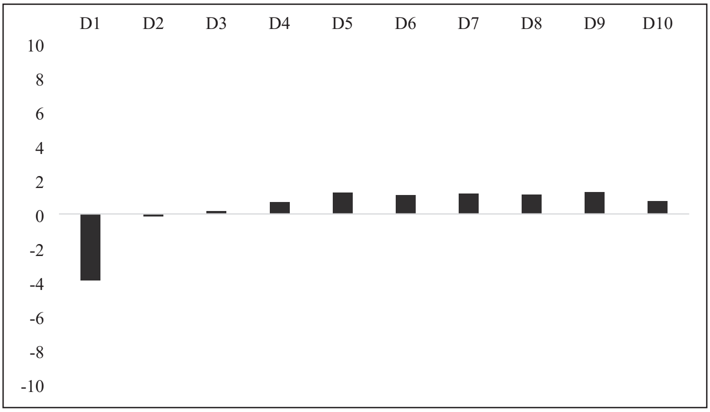

Figure 5. Over/underestimation (%) of environmental tax expenditures in EU-SILC by income decile, averages of 26 countries, 2015.

Comparisons of mean scores in EU-SILC and HBS. Data for Germany, Ireland, Portugal, Slovenia, and the United Kingdom are from 2010.