UNIVERSITY OF WARSAW | FACULTY OF ECONOMIC SCIENCES

WORKING PAPERS
No. 25/2024 (461)

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WARSAW 2024

ISSN 2957-0506

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Awareness and Impact of Energy Labels on Purchases of Household Appliances in the EU*

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Abstract

This paper examines Eurobarometer survey data from 27,438 individuals across 28 EU Member States in 2019 to evaluate the awareness and impact of EU Energy Labels. Specifically, we analyze the role of socioeconomic characteristics such as age, gender, education, financial stability, and political engagement. Our results suggest that individual characteristics have a greater effect on the influence of labels on purchase decisions than on label awareness. However, significant heterogeneity across countries persists even after controlling for individual characteristics. Using our model, we conduct three exercises in which we assume a policymaker can either increase label awareness among all unaware individuals or target those with specific characteristics, and we demonstrate the resulting impact on the share of people whose purchases are influenced by the label. The findings reveal that even when label awareness is at its highest level, it does not necessarily translate into substantially higher influence on purchasing decisions in some countries. Additionally, at the country level, certain socioeconomic and political variables are positively correlated with label awareness.

Keywords: European Green Deal; Ecodesign Directive; Energy-efficiency.

JEL Classification: D12; Q41; Q48; C83

*Authors acknowledge grant No. 2021/43/P/HS4/03115 co-funded by the National Science Centre and the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 945339. All errors are our own.

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1. Introduction

In response to the urgent need to combat climate change, the European Union (EU) adopted policies in order to achieve carbon neutrality by the middle of this century. The transition to cleaner and more energy-efficient sources is guided by a package of policy initiatives called the European Green Deal. Implementing various directives and regulations, this strategy aims to improve energy efficiency, and eco-design of products.

At the heart of the EU's initiatives to reduce energy consumption in household appliances and industrial machines are the Energy Labeling Regulation and the Ecodesign Directive. The former requires products to display an energy efficiency label, while the latter sets minimum energy efficiency standards for specific products, excluding less efficient ones from the EU market. Additionally, energy efficiency building standards have been a common policy tool in Europe for over four decades.

The EU's regulations on energy efficiency are crucial, given that end-use energy efficiency could reduce global CO_2 emissions by about 35% by 2050, despite a projected significant increase in the world's GDP. In 2022, EU households contributed approximately 26% of the EU's total final energy consumption. Of this, 13.9% was due to lighting and electrical appliances, while space and water heating comprised 78.4% (Eurostat, 2024). Therefore, it is vital to focus on the adoption of energy-efficient technologies in households and design policies that promote such technologies.

In this paper, we analyze data from a Eurobarometer survey commissioned by the European Commission (EC), which includes responses from 27,438 individuals across 28 EU Member States in 2019. We examine respondents' awareness of the EU Energy Labeling scheme and its impact on household appliance purchases, utilizing a comprehensive set of demographic variables. We first present a descriptive analysis to explore label awareness and its impact at both the national and NUTS levels. Subsequently, we employ econometric models to identify the key socioeconomic determinants of label awareness and their influence on household appliance purchases. Using the model, we compute the probability of awareness and the conditional probability of being influenced at the country level, which we compare to the respective response shares derived from survey data. Given the significant heterogeneity in country-specific effects, we also try to analyze the role of socioeconomic and political factors to account for these differences. Finally, we conduct three counterfactual exercises assuming that a policymaker can increase label awareness to assess the impact on the unconditional probability of being influenced.

Subsequently, we model the probability of awareness of energy labels and the conditional probability of being influenced by these labels in household appliance purchases as functions of individuals' socioeconomic characteristics. We then estimate the impact of these characteristics on label awareness and influence using a sample selection model.

Our findings reveal that individual characteristics—such as gender, age, education, financial stability, social class, political interest, and recognition of the EU as the authority

responsible for labeling—significantly affect both awareness and influence, with a stronger effect observed on the latter. Specifically, women, middle-aged individuals, and those with higher levels of education are more likely to recognize and consider the EU energy label. In contrast, older adults and students are less influenced by the labels. Middle-class individuals show greater responsiveness to the label, while those with low political interest are less likely to act on it. Moreover, digital channels are found to be more effective than traditional media in promoting label awareness. Recognizing the EU as the institution behind the label also positively impacts both awareness and influence, underscoring the importance of providing clear information on EU energy policies and initiatives aimed at reducing energy consumption.

Survey data reveals geographic variations across the EU, where high label awareness does not necessarily translate into an equally high impact on purchase decisions for almost all countries. The comparison between estimated probabilities and the response shares derived from survey data suggests that, while individual factors significantly influence the extent to which the EU energy label impacts purchasing decisions, their impact on label awareness is limited. Additionally, country-specific factors—such as energy prices, views on freedom and human rights, and perspectives on the EU—positively correlate with label awareness, but not with the influence of labels on purchasing decisions. The impact of targeted information campaigns aimed at increasing awareness varies across countries, depending on the proportion of individuals they reach. However, the findings reveal that even when label awareness is at its highest level, it does not necessarily translate into substantially higher influence on purchasing decisions in some countries.

The paper is organized as follows. Section 2 reviews the relevant empirical literature. Section 3 describes the institutional background pertinent to energy-efficiency regulations. Section 5 introduces our empirical model. Section 6 presents our empirical findings, and finally Section 7 concludes.

2. Literature Review

The existing literature on the energy efficiency labeling of household appliances is extensive, primarily focusing on their effectiveness, environmental impact, and the design and implementation of relevant policies. This review centers on the studies that examine the factors influencing the adoption of energy-efficient appliances.

Empirical studies in this area often utilize data from three primary sources. One group comprises observational data, including residential energy-usage monitoring reports and retail sales data for household appliances. Another group involves survey data from public and private entities, along with questionnaires developed by researchers. The third group focuses on experimental data.

Among the first group, there are studies aimed at assessing the adoption of energy-efficiency behaviors across countries. For example, Mills & Schleich (2012) analyzes the

relationship between household energy usage and household characteristics using data from the Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe (REMODECE) project, which surveyed households in ten EU countries and Norway. They found that households with young children tend to adopt energy-efficient technology more frequently than those with a predominantly elderly population. Additionally, they identified a positive correlation between higher education levels and a preference for energy savings for environmental reasons, although this effect varied across countries.

This group also includes research examining how energy policies influence consumers' adoption of energy-efficient appliances, particularly focusing on minimum energy performance standards and labeling schemes (Bjerregaard & Møller, 2019; Huse et al., 2020; Schleich et al., 2021). For example, Bjerregaard & Møller (2019) assess the quantitative impact of the 2010 EU energy label revision on monthly sales (2005-2017) of high and low-efficiency cold appliances in Danish markets. Their findings reveal that sales of high-efficiency appliances increased by 55% following the announcement of the change and by 42% upon implementation. While the announcement had no effect on low-efficiency appliance sales, the implementation led to a 45% decrease in online sales for these products.

Additionally, some studies in this group also explore the influence of the information provided on energy labels on consumer decisions related to energy efficiency. Particularly, Houde (2018) uses transaction data of refrigerators in the United States to study how consumers respond to energy efficiency certification that provides a simple binary-star rating related to energy use. The study incorporates refrigerator features and consumer demographics, including household size, income, education level, home-ownership status, type of housing, political orientation, and age of the household head. He concludes that while a basic certification can guide some consumers toward considering energy efficiency, it may deter others from seeking out more detailed energy information. As a result, the overall effect of certification on energy consumption remains uncertain.

Regarding the second group, several studies focus on examining the characteristics consumers prioritize when purchasing electrical appliances, the differences between consumer profiles, and the factors that influence their purchasing behavior. For example, Gaspar & Antunes (2011) collected both qualitative and quantitative data through a combination of consumer interviews and surveys. The findings reveal that consumers consider cost as their most important attribute, followed by quality and energy consumption, all of which positively correlate with the consideration of energy efficiency class during their decision-making process. They also conclude that environmental attitudes serve as negative predictors of energy efficiency class consideration while certain environmental behaviors act as positive predictors. Consumer profiles revealed differences based on gender, age, and whether the purchaser was accompanied when making purchasing decisions. The results suggest that women prioritized environmental factors, especially energy and water consumption, and searched more for information regarding energy efficiency class, while men focused more on technology, accessories, and functionality. Respondents accompanied

by others were more likely to consider energy efficiency and be influenced by store staff toward energy-efficient options.

Vázquez et al. (2023) also identified consumer segments in Spain through a questionnaire employing ordinal scales to measure attitudes toward labels and environmental concerns among 3,000 respondents. The study categorized consumer groups based on their awareness, attitudes, and consideration of sustainability labels in the purchase of commonly used household products, including energy. This study followed latent class cluster analysis (LCCA) methodology and provided characteristics associated with each segment. For example, they concluded that young individuals, women, educated people, and environmentally aware individuals are the most influenced by certificates. This study, along with the previous one, supports the conclusion that women are more likely to adopt energy efficiency labels or certificates.

Using an online questionnaire, Brown et al. (2023) studied the domestic consumer attitude and behavior towards energy in Ireland, by considering a demographic profile following variables such as province, location, residence type, age, gender, employment status, and annual income bracket. The main findings reveal that most domestic energy consumers are concerned about carbon footprints and fossil fuel dependency, with younger individuals feeling more concerned. However, few have adopted low-carbon systems, as high costs remain a major barrier to energy-efficient technologies.

Psychological factors are also often considered in questionnaire-based studies (Schuitema et al., 2020; Z. Wang et al., 2019; Waris et al., 2021; Zhang et al., 2020). For instance, studies grounded in the theory of planned behavior seek to explain the adoption of energy-efficient technologies as a result of individual intentions, which are influenced by three key beliefs: the perceived difficulty of performing the behavior, the perceived consequences of the behavior, and the perceived approval of others. Additionally, the perceived credibility of the authority behind certificates and labels, along with individuals' cognitive involvement (the ability to process information and strive for ideal outcomes) and affective involvement (the experience and achievement of specific emotional states), are also relevant factors in shaping attitudes toward adopting energy-efficient products.

For instance, J. Wang (2023) examines the influence of an energy-efficiency labeling program alongside three subsidy schemes in the Chinese refrigerator market, utilizing data from a general social survey. His findings indicate that these initiatives have successfully encouraged the selection of energy-efficient refrigerators, although the impact of each subsidy program varies.

In recent years, the third group has experienced a significant increase, particularly those studies based on Discrete Choice Experiments (DCE). This type of experiment has become an often-used research method for studying consumer behavior due to its capacity to reveal trade-offs made when choosing among multiple alternatives. Most of these studies aim to elicit consumer preferences for energy labels to understand factors influencing the consumer response to distinct levels of energy efficiency performance.

For example, Jain et al. (2018) and Zha et al. (2020) conducted DCEs in India and China, respectively, quantifying the attributes that consumers consider when choosing two electrical appliances through a mixed logit model specification. Jain et al. (2018) analyzed consumer preferences for refrigerators and air conditioners, whereas Zha et al. (2020) focused on refrigerators and washing machines. The first study found that the share of consumers placing a positive value on the highest energy efficiency category was higher in air conditioners than in refrigerators. They also observed that consumers differentiate between the categories of energy efficiency in air conditioners but not in refrigerators, a finding corroborated by market data. The second study concluded that the energy label program in China is effective with consumers showing a higher willingness to pay for refrigerators than for washing machines.

Li et al. (2013) also examine the consumers' refrigerator choices by employing a hypothetical choice experiment. They analyze the influence of a mail-in rebate on their willingness to pay for an Energy Start-labeled refrigerator in the US. The authors found that the offer of a rebate creates uncertainty about the quality of Energy Start-labeled refrigerators. Consequently, consumers could be willing to pay less for such refrigerators. In another paper based on a stated-choice experiment involving approximately 3,600 German households, Andor et al. (2019) concludes that willingness to pay for electricity-using durables is influenced by consumer cognitive reflection, in other words, it depends on the ability to override an automatic and intuitive response to employing an analytical reasoning about its correctness. Specifically, this study reveals that consumers with lower cognitive reflection place a lower value on energy efficiency compared to those with higher scores.

The effects of changes in the EU efficiency energy labeling also have been studied using choice experiments. Specifically, Faure et al. (2021) analyzed how the rescaled A to G labeling scheme (previous scheme: A+++ to D) affects the valuation of top-rated refrigerators. Results suggest that the rescaled labeling scheme increases this valuation when it is shown alone. However, when it is shown simultaneously with the previous scheme, no positive effects are found from introducing a rescaled scheme.

Some experiments have been conducted to investigate the impact of displayed information on consumers' willingness to pay for energy-efficient appliances. The literature addresses various aspects, including future energy consumption of electrical appliances in monetary terms, the economic value of saving energy, physical energy use, and associated carbon dioxide emissions. Some additional studies have examined factors such as the comparability, quantity, and presentation format of the information provided (Blasch et al., 2019; Davis & Metcalf, 2014; Newell & Siikamäki, 2013; Waechter et al., 2015; Zhou & Bukenya, 2016).

Concerning the influence of personal financial and credit market factors, Berkouwer & Dean (2022) identified credit constraints as a major barrier for low-income households in adopting energy-efficient technologies, based on evidence from randomized field

experiments in Kenya. Additionally, Park & Woo (2023) suggested that the payback period—the time required to recover the initial costs of energy efficiency investments—affects consumer decisions to invest in energy-efficient home appliances.

In summary, recent literature on energy efficiency labeling primarily seeks to explain variations in adoption levels of labels by examining socio-demographic and psychological profiles, environmental concerns, consumer willingness to pay for energy-efficient appliances, and the complexity and informativeness of labeling schemes. These studies involve econometric analyses using survey data, observed market data, questionnaires, as well as experimental data. The effectiveness of energy labels is demonstrated in some countries for specific products, although in some studies there are no clear effects. Finally, the literature we reviewed above clearly indicates that there has been substantial progress in identifying key social and economic characteristics that contribute to the effectiveness of energy labels. At the same time, however, the limited presence of variables associated with political issues in recent studies is notable. Therefore, it remains unclear how, for example, ideological beliefs, political participation, and interest in political matters at the local, national, and supranational levels influence the adoption of energy policies. Including such variables could yield valuable insights, particularly within the dynamic European political context. Furthermore, most of the studies reviewed focus on assessing the influence of labels on consumer purchasing decisions, with limited attention to the preceding phenomenon of awareness of the labels. Identifying the factors underlying these two independent yet related phenomena could provide valuable input for the design and evaluation of energy-efficiency public policies.

We contribute to this body of literature by studying differences among the 28 EU Member States regarding awareness of the EU Energy Labeling scheme and its impact on purchases of household appliances. We explain these differences by examining the socio-economic attributes of respondents and identify the factors that contribute to the disparities at the country level, including political aspects. In addition, this paper offers valuable insights into the potential impact of increasing awareness of label influence, providing an important input for policy design.

3. Institutional Background

The EU is committed to advancing an Energy Union to support its climate goals, as demonstrated by initiatives such as the European Green Deal, which aims for climate neutrality by 2050 (European Commission, 2019b). Energy efficiency is a crucial element in this endeavor by allowing to moderate energy demand. A key aspect of the EU's energy efficiency strategy is Energy Labeling, which enables consumers to make informed appliance choices based on energy consumption, while also motivating manufacturers to develop more energy-efficient products.

The current energy labeling framework in the EU evolved from proposals dating back

to the 1990s (Schleich et al., 2021). The first energy labeling initiative emerged in 1992 introducing seven energy efficiency classes from A to G, with A in green color representing the best energy performance and G in red color the worst (European Council, 1992). Directives gradually implemented labeling for refrigerators, freezers, and their combinations (European Commission, 1994; European Parlament and European Council, 1996), washing machines (European Commission, 1995), and dishwashers (European Commission, 1997).

In 2003, Directive 2003/66/EC (European Commission, 2003) introduced classes A+ and A++ to address substantial differences in energy efficiency among appliances within the highest class. These discrepancies arose from the energy efficiency improvements seen in certain products.

Seven years later, Regulation (EU) 1060/2010 established A+++ as a new energy efficiency class and revamped the label display, assigning different shades of green to each A class. Additionally, a new Energy Efficiency Index (EEI) was introduced, leading to the rescaling of energy efficiency classes. For instance, the EEI for refrigerating household appliances was defined as a metric comparing the Annual Energy Consumption of a tested household refrigerating appliance to its Standard Annual Energy Consumption based on factors such as storage volume and type of appliance (European Commission, 2010).

Ecodesign legislation, such as Directive 2009/125/EC (European Parlament, 2009) and Regulation (EU) 2016/2282 (European Commission, 2016), complement energy labeling by setting mandatory minimum requirements for energy performance and material use throughout a product's lifetime. Thus, Ecodesign requirements aim to force out the least efficient energy-related products from the EU and European Economic Area (EEA), while energy labeling classifies the products permitted for sale to influence consumer choices towards options that offer greater energy savings (European Commission, 2024a).

Nowadays, the energy labeling regulation is framed by Regulation (EU) 2017/1369, which maintains the same scope as Regulation (EU) 1060/2010 while enhancing provisions for the accuracy and comparability of label information (European Commission, 2017). The updated regulation returned to a simpler A-G scale with an initially empty A class allowing room for future improvements in energy efficiency. For instance, an electric appliance previously graded A+++ could now be classified as a C class, even though it is just as energy efficient as before. These updated labeling adjustments entered into force in 2021 for five product groups such as fridges and freezers, dishwashers, washing machines and washer-dryers, electronic displays, and lighting (European Commission, 2019a).

Furthermore, the regulation introduced the European Product Registry for Energy Labeling (EPREL), a new database where manufacturers and importers must register their products and provide detailed technical documentation for compliance monitoring endeavors. This central database enhances market oversight and facilitates digital access to energy labels and product information (European Commission, 2017).

The new labels for the mentioned product groups display a QR code with a link

to EPREL, along with other five elements: energy efficiency class of this product model, energy efficiency classes, energy consumption, an indication of additional non-energy parameters (i.e. noise emissions, water consumption, capacity, repairability or reliability class, etc.), and reference to the regulation (European Commission, 2024b).

The decision-making process for energy-efficient products is a participatory process involving stakeholders (including industry, consumer organizations, environmental NGOs, etc.) and EU Member States. It involves consultations with stakeholders, expert discussions on the impacts of measures, and final scrutiny by the European Parliament and Council (European Commission, 2019a).

4. Data

The present study uses data from Eurobarometer 91.4, a survey conducted by the European Commission across the member states of the EU. The survey relied on a multistage sampling procedure to select 27,438 respondents aged 15 years and older, who underwent face-to-face or computer-assisted interviews between May 9th and May 25th, 2019.

The survey consisted of three modules focusing on European attitudes towards trade and EU trade policy, EU energy policy, and discrimination within the EU. The variables most relevant to this study are derived from the second module, which examines respondents' perspectives on various aspects of energy policy. These include the EU's responsibilities in energy-related matters, awareness of the EU Energy Labeling scheme, the influence of the EU Energy Label on the purchase of household appliances, and priorities for EU energy policy over the next decade. Additionally, the study incorporates relevant variables from other modules, such as respondents' main sources of information and internet usage, to analyze how exposure to different media channels influences label awareness. A set of demographic variables from the survey data is also included in the analysis.

4.1 Definition of key variables

This study focuses specifically on responses to two questions in the Eurobarometer 91.4 survey. The first variable of interest measures respondents' awareness of the EU Energy Label, which is a prerequisite for assessing its influence on appliance choices. The second variable records whether the EU Energy Label influenced respondents' appliance purchases. Those who reported being influenced by the label were further asked to specify whether financial reasons, environmental reasons, or both drove their decision. Table 1 lists the permissible responses for the original version of these two variables.

These questions were transformed into binary variables with "1" denoting "yes" and "0" representing "no". It is important to note that the "no" option includes the "DK" answer for both variables (values 4 in question (1) and value 5 in question (2)) as well as the "inapplicable" option (value 9 in question (2)). The latter corresponds to respondents

who did not recognize the EU Energy Label (values 3 or 4 in question 1), thus making it impossible for them to be influenced by the label.

Table 1: Admissible answers for key variables

Variable	Question	Values	Description
(1)EU Energy Label Awareness	Do you recognise the following label? One answer only.	1	Yes, and you know what it stands for
		2	Yes, but you don't know what it stands for
		3	No, you have never seen it
		4	Do not know (DK)
(2)EU Energy Label Influenced Choice of Electric Appliances	Did the EU energy label influence the choice of your purchase of electric appliances (fridges, washing machines, dishwashers, televisions...)? One answer only	1	Yes, it has helped you purchase a more energy-efficient appliance, your main reason being to save money
		2	Yes, it has helped you purchase a more energy-efficient appliance, your main reason being to select more environmentally friendly appliances.
		3	Both (to save money and to select more environmentally friendly appliances)
		4	No, it has not influenced your purchase choice
		5	Do not know (DK)
		9	Inapplicable (not 1 or 2 in EU Energy Label Awareness)

We incorporate socioeconomic variables such as gender, age, education, marital status, number of children, difficulties in paying bills during the last year, social class self-assessment, size of community, left-right political placement, political interest, country, NUTS codes, and NUTS levels in our study.[1] All of these variables are categorical. Some variables have been recoded to combine certain responses into broader categories.[2] The variables age and number of children were converted from numeric to categorical formats. Additionally, the NUTS codes and NUTS levels were recoded to standardize NUTS level 1 regions across all countries, as the survey measured countries at varying NUTS levels. Upon code verification, it was determined that the NUTS classification compatible with all countries in the survey corresponds to the 2010 version.

Additionally, four other variables related to the EU energy policy module were examined. The first variable measures the extent to which respondents agree that the EU should facilitate consumers' choice of energy sources and suppliers. The second variable assesses whether respondents associate energy policy with reducing energy consumption across the EU, such as insulating homes or purchasing energy-efficient products. The third variable captures respondents' views on the importance of clear information as a priority for the EU's energy policy over the next decade. Finally, the study considers which social institution respondents recognize as responsible for the energy label, including the EU,

[1]The Nomenclature of Territorial Units for Statistics (NUTS, from the French *Nomenclature des Unités Territoriales Statistiques*) is a geographical classification that divides the economic territory of the European Union (EU) into regions at three levels: NUTS 1, 2, and 3, moving from larger to smaller territorial units. Above NUTS 1 is the 'national' level of the Member States. The NUTS is governed by Regulation (EC) No 1059/2003 of the European Parliament and Council (26 May 2003) and is regularly updated. Source: Eurostat.

[2]For instance, in the case of social class, we bundled the responses "Other," "None," "Don't Know (DK)," and "Refusal (Ref)" into a single category.

national governments, industry and private businesses, and consumer organizations.

In our analysis of the determinants of individual awareness of the EU energy label, we include two additional variables. The first is the 'Main Information Sources' variable, which identifies where respondents primarily obtain information about globalization and international trade, serving as a proxy for the channels through which they access general information, including energy efficiency policy. The response categories 'Other,' 'None,' and 'DK' were combined into a single category. The second variable, 'Internet Use,' measures the frequency of respondents' internet access.

As we demonstrate below, even after controlling for observable differences, substantial heterogeneity remains across countries in terms of awareness and influence of the labels. To explain these country-specific differences in label awareness and influence, we incorporate additional data from the European Values Study (EVS), Eurostat, and the Manifesto Research on Political Representation project (MARPOR).

4.2 Descriptive analysis

To begin our analysis of the Eurobarometer data, we first calculated the percentage of respondents in each country who reported being aware of the EU Energy Label. Among those who indicated awareness, we then calculated the percentage who reported being influenced by the label in their purchasing decisions. Figure 1 displays the proportion of respondents in each of the 28 EU Member States who reported awareness of the label. Based on these country-specific results, we find that approximately 90.81% of respondents reported being aware of the EU Energy Label.

We have classified the countries in the dataset into two groups based on the average awareness level: above-average (AA) and below-average (BA) countries. The above-average group consists of fifteen countries, with the Netherlands having the highest proportion of respondents aware of the label, closely followed by Luxembourg, Germany, and France. The below-average group comprises thirteen countries, primarily from Eastern and Southern Europe. Notably, Cyprus, Lithuania, Malta, and Greece have the lowest share of respondents reporting awareness of the EU Energy Label.

Figure 1: Percentage of respondents declared being aware of the EU Energy Label by country

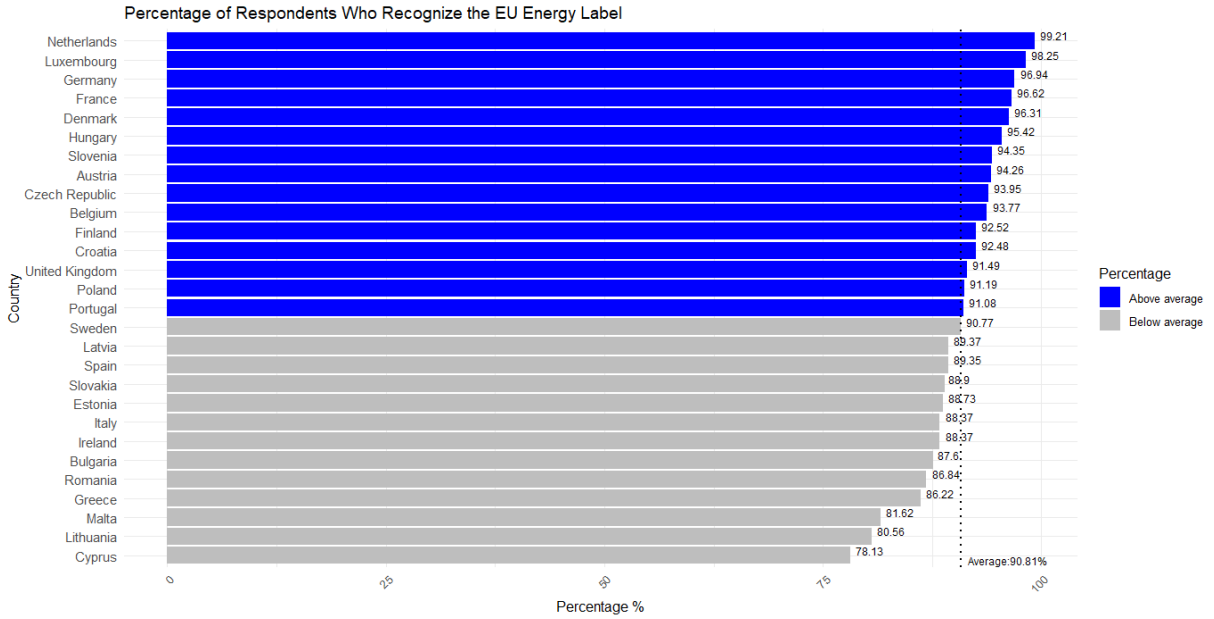


Figure 2 presents the percentage of respondents who reported being influenced by the EU Energy Label when purchasing electric appliances, with the EU average at 80.69%. Similarly, we have classified the countries into above-average and below-average groups based on this measure.

Figure 2: Percentage of respondents indicating the influence of EU Energy on Electric Appliance Choice by Country

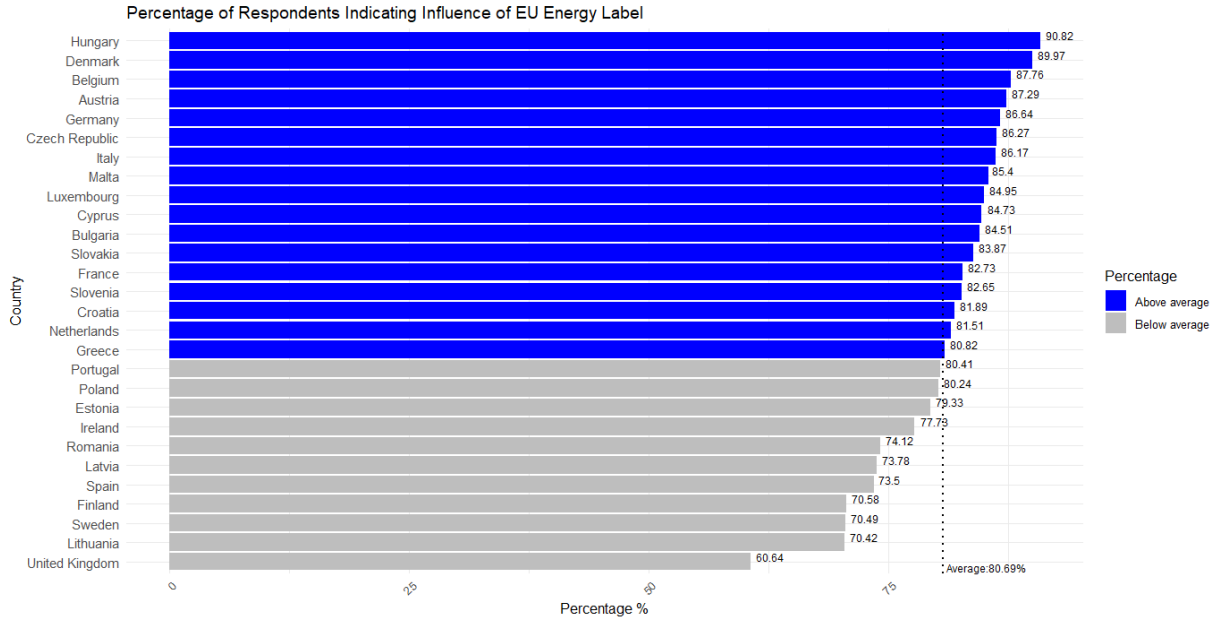
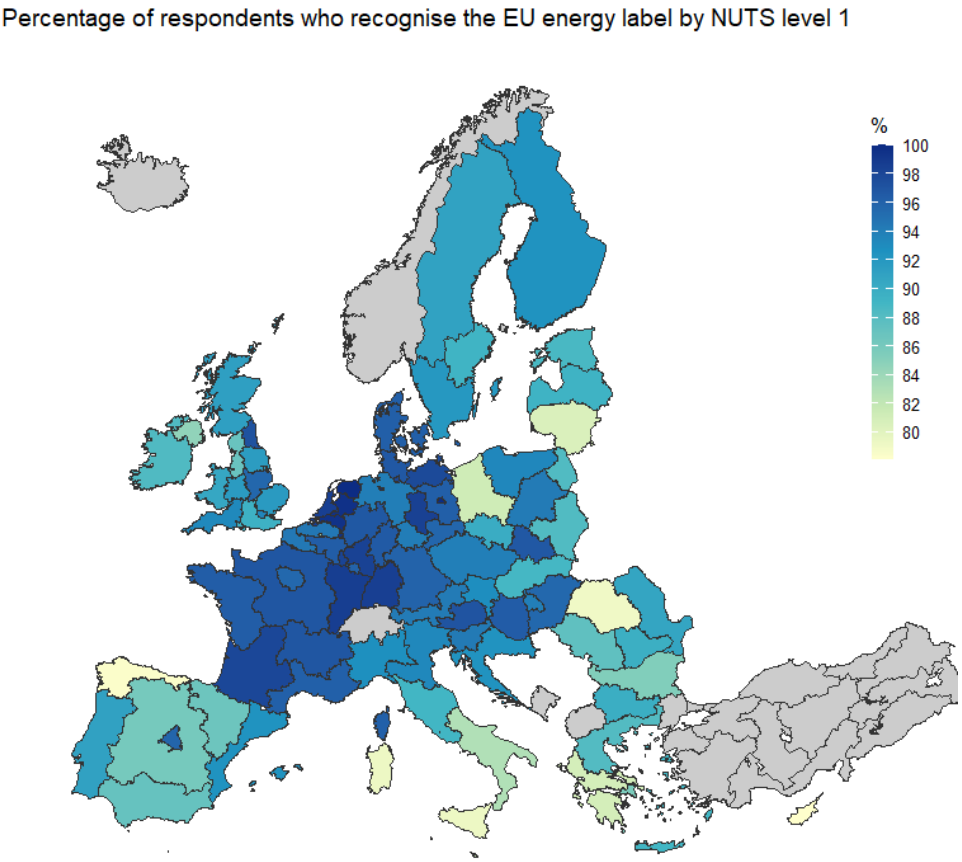


Table 2 presents the summary statistics of the variables used in the empirical analysis for the above-average and below-average country groups identified earlier. The distribution of most socio-demographic variables is similar for both groups regarding both

awareness and influence. However, there are notable differences, such as in the variable "difficulties paying bills," where individuals in below-average countries report struggling to pay bills more frequently than those in above-average countries.

In Figure 3, we present the percentage of respondents who reported being aware of the EU label by NUTS region, where darker shades correspond to higher levels of awareness. The regions with the highest levels of awareness are located in Germany (5 regions) the Netherlands (4 regions) and one region in France (Est), while the regions with the lowest levels of awareness are more diverse, including areas in Belgium, Italy, Malta, Poland, Greece, Lithuania, Romania, Spain, and Cyprus.

Figure 3: Percentage of respondents who recognise the EU Energy Label by NUTS Regions Level 1



In Figure 4, we present the percentage of respondents at the NUTS level 1 who reported that the EU energy label influenced their decision-making. Among the top ten regions, four are located in Germany, two in Hungary, and one each in France, Belgium, Bulgaria, and Denmark. In contrast, the ten regions with the lowest percentage of influence are predominantly from the United Kingdom, which accounts for nine regions, with one additional region in Romania. Notably, the South West England region in the United Kingdom has the lowest reported percentage of influence within the EU, at 53.01%.

Table 2: Descriptive statistics for key variables by country groups

Variable	Category	Sample	Influence		Sample	Awareness	
			AA	BA		AA	BA
(1)Gender	Man*	11,483	46.59	44.83	12,492	46.18	44.72
	Woman	13,539	53.41	55.17	14,946	53.82	55.28
(2)Age	15 - 22 years*	1,714	6.83	6.88	1,874	6.91	6.73
	23 - 38 years	5,355	21.19	21.72	5,570	20.62	19.91
	39 - 54 years	6,750	27.81	25.71	7,083	25.78	25.86
	55 - 73 years	8,803	35.47	34.73	9,738	35.55	35.42
	74 years and older	2,400	8.7	10.95	3,173	11.15	12.08
(3)Age When Stopped Education	Up to 15 years*	2,845	10.74	12.33	3,615	12.55	13.95
	16-19 years	11,009	46.58	40.06	11,973	42.54	45.01
	20 years and older	9,099	34.35	39.44	9,537	36.09	33.1
	Still Studying	1,549	6.42	5.84	1,676	6.3	5.87
	No full-time education	204	0.95	0.6	250	1.26	0.47
	Ref + DK	316	0.96	1.73	387	1.26	1.6
(4)Marital Status	(Re-)Married*	13541	54.87	52.97	14,673	51.63	55.78
	Living with partner	3,160	12.94	12.15	3,321	13.59	10.25
	Single	3,993	16.06	15.81	4,314	16.04	15.33
	Divorced or separated	2065	7.93	8.74	2,243	8.91	7.26
	Widow	2,113	7.61	9.71	2,712	9.16	10.78
	Ref + Other	150	0.59	0.62	175	0.68	0.59
(5)Number of children	None*	18,758	75.5	74.15	20,843	75.96	75.97
	One	3,122	12.15	12.97	3,296	11.75	12.34
	Two	2,411	9.87	9.28	2,514	9.58	8.65
	Three	505	1.76	2.41	537	1.98	1.93
	Four or more	226	0.71	1.19	248	0.74	1.11
(6)Difficulties Paying Bills	Most of the time*	1,718	7.7	5.59	2,054	5.31	10.19
	From time to time	5,835	24.08	22.17	6,538	18.8	30.09
	Almost never/never	17,124	66.5	71.39	18,467	74.43	58.43
	Ref	345	1.73	0.85	379	1.46	1.28
(7)Social Class	Working class*	6,252	20.91	31.21	7,233	23.54	29.87
	Lower middle class	3,723	15.05	14.62	4,070	15.39	14.14
	Middle class of society	12,193	52.09	43.61	13,068	48.35	46.73
	Upper middle class	1,824	8.28	5.77	1,889	8.64	4.7
	Higher class	147	0.59	0.59	157	0.76	0.34
	Other+None+Ref+DK	883	3.08	4.21	1,021	3.33	4.21
(8)Size Of Community	Rural area*	7,017	27.03	29.59	7,840	26.84	30.74
	Small urban area	8,072	35.19	27.79	8,831	34.92	28.78
	Large urban area	9,933	37.78	42.63	10,767	38.25	40.48
(9)Left-Right Political Placement	Left*	6,541	27.99	23.33	7,082	28.06	23.01
	Centre	8,551	33.9	34.59	9,313	35.31	32.23
	Right	5,834	23.08	23.67	6,354	23.15	23.16
	DK/Ref	4,096	15.03	18.41	4,689	13.47	21.59
(10)Political Interest Index	Strong*	4,356	18.07	16.4	4,644	16.85	17.03
	Medium	12,723	52.19	48.8	13,701	50.41	49.34
	Low	3,999	16.32	15.46	4,387	16.4	15.47
	Not at all	3,944	13.42	19.33	4,706	16.34	18.16
(11)Main Information Source	TV*	10,696	43.4	41.75	12,059	43.35	44.7
	Newspapers/magazines	2,971	12.62	10.73	3,167	14.43	7.95
	Radio	1,114	4.13	4.94	1,245	4.32	4.81
	Internet websites	5,619	21.63	23.72	5,794	21.26	20.94
	Online social networks	2,071	8.09	8.56	2,185	6.99	9.17
	Close ones	1,154	4.99	4.04	1,278	4.5	4.85
	Other + None + DK	1,397	5.13	6.27	1,710	5.16	7.57
(12)Internet Use	Everyday/almost everyday*	18,970	75.43	76.4	19,900	75.72	68.55
	Often/sometimes	2,431	10.68	8.24	2,649	9.78	9.5
	Never/no access	3,213	11.99	14.14	4,311	12.76	19.39
	No Internet access at all	408	1.9	1.22	578	1.74	2.56
(13)Facilitate Energy Choice	Totally agree*	13,304	52.63	53.99	14,429	49.77	56.1
	Tend to agree	9,030	36.39	35.62	9,929	37.81	34.17
	Tend to disagree	1,512	6.44	5.44	1,648	6.95	4.84
	Totally disagree	458	2.07	1.46	496	2.27	1.24
	DK	718	2.47	3.48	936	3.21	3.67

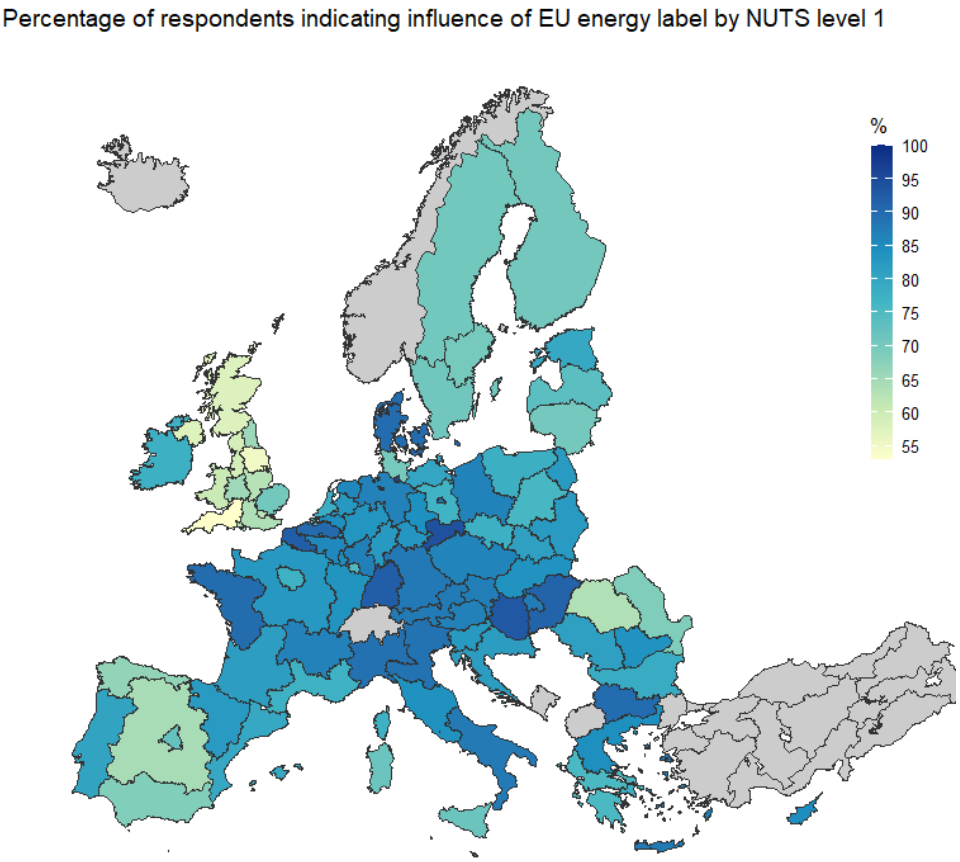
Table continues on the next page

Table 2: (Continued) Descriptive statistics for key variables by country groups

Variable	Category	Sample	Influence		Sample	Awareness	
			AA	BA		AA	BA
(14)Purchasing energy-efficient products	Not mentioned*	17,716	67.57	75.73	19,614	69.52	73.93
	Mentioned	7,306	32.43	24.27	7,824	30.48	26.07
(15)Energy issue: Clear Information	Not mentioned*	18,425	73.13	74.41	20,294	73.89	74.05
	Mentioned	6,597	26.87	25.59	7,144	26.11	25.95
(16)EU Energy Label - Responsibility	The government*	2,045	9.13	6.71	2,218	9.69	6.09
	The European Union	12,990	52.96	50.32	13,479	48.95	49.35
	Industry	2,884	10.74	12.72	3,036	9.14	13.47
	Consumer organisations	2,827	12.64	9.25	2,987	13.35	7.82
	DK	4,276	14.52	21.01	5,718	18.88	23.28
(17)EU Energy Label - Awareness	Never see it + DK	0	0	0	2,416	5.51	12.9
	Yes	25,022	100	100	25,022	94.49	87.1
(18)EU Energy Label Influence	No + DK + Never seen it	4,828	14.73	26.26	7,244	22.09	31.77
	Yes	20,194	85.27	73.74	20,194	77.91	68.23

AA and BA represent countries with an above-average and below-average percentage of individuals, respectively who are aware of or influenced by the energy label. * denotes the reference category for each variable in the models discussed in Section 6.1.

Figure 4: Percentage of Respondent Indicating Influence of EU Energy Label on Electric Appliance Choice by NUTS Regions Level 1



5. Econometric Model

In this section, we examine the determinants of individuals' awareness of the EU Energy Label and their responses regarding the label's influence on their decision-making. In the dataset, responses about whether the label influenced individuals' purchases are only

recorded for those who reported being aware of the label. Therefore, we consider a two-stage Heckman selection model as an appropriate framework to simultaneously analyze the determinants of awareness and influence. Respondents indicate whether they recognize the EU Energy Label in the first stage. In the second stage, individuals aware of the label report whether it influenced their choice of electric appliances. As noted earlier, both questions are coded as binary variables after transforming the original responses.

The first stage 'awareness' (selection) equation is specified as follows:

$$s = \begin{cases} 1 & \text{if } \mathbf{X}\alpha + \nu \geq 0 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

where $s = 1$ indicates that an individual reports being aware of the EU Energy Label. We aim to explain this response using a set of socio-economic characteristics of the respondents, which have been converted to categorical variables as discussed earlier. These variables are denoted by X, and ν represents unobserved consumer characteristics.

The 'influence' equation is specified similarly as:

$$y = \begin{cases} 1 & \text{if } \mathbf{Z}\beta + \varepsilon \geq 0 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

where $y = 1$ indicates that the respondent reported being influenced in their purchase decisions for electric appliances by the EU Energy Label. We aim to explain these responses using a vector of categorical variables $\mathbf{Z}$, which represent the socio-economic characteristics of the respondents. The unobserved respondent characteristics are denoted by ε. We assume that ε follows a standard normal distribution and satisfies the condition $E(\varepsilon|\mathbf{Z}) = 0$. Assuming that the error terms from both equations, ν, and ε, are drawn from a multivariate normal distribution, one can show that:

$$E(y|Z, s = 1) = \mathbf{Z}\beta + \rho\lambda(\mathbf{X}; \hat{\alpha}) \tag{3}$$

where $\lambda(\mathbf{X}; \hat{\alpha})$ denotes the hazard function (inverse Mills ratio), which can be written using the estimates from the first stage model as follows:

$$\lambda(\mathbf{X}; \hat{\alpha}) = E(\nu|\mathbf{X}\alpha > -\nu) = \frac{\phi(\mathbf{X}\hat{\alpha})}{\Phi(\mathbf{X}\hat{\alpha})}. \tag{4}$$

Thus, we estimate the following 'influence' equation in the second stage:

$$y = \begin{cases} 1 & \text{if } \mathbf{Z}\beta + \rho\lambda(\mathbf{X}; \hat{\alpha}) + \omega \geq 0 \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

Here, we exploit the fact that the error term ε can be decomposed into the sum of two terms and written as $\varepsilon = \rho\lambda(\mathbf{X}; \hat{\alpha}) + \omega$, where ω has a zero mean conditional on Z by

construction.

The vector of variables included in the awareness equation **X** includes all the variables from the 'influence' equation **Z** and two additional variables about the main information source of the respondents and their internet use. We assume that these variables impact 'awareness' but not 'influence' giving us the necessary exclusion restrictions required for identification of the model.

The models specified in Equations (1) and (2) are also estimated independently, ignoring the connection between them, using simple probit regressions allowing us to assess the importance of the corrections for sample selection bias that should arise due to our use of the Heckman methodology.

6. Empirical Results

In this section, we present the results from the estimation of the Heckman sample selection model, organized into four parts. First, we examine the estimated parameter values to identify the factors driving label awareness and influence. Second, we compute the estimated probabilities of label awareness and influence on purchasing decisions (conditional on awareness) at the country level, while holding all other categorical variables at their baseline levels. We then discuss the differences in country-specific levels of awareness and influence revealed by the estimates. In the third subsection, we explore the heterogeneity in these country-specific effects using additional country-level information. Finally, in the fourth subsection, we conduct three thought experiments in which we adjust the level of awareness among different groups of individuals and assess the implications for changes in the influence of labels on purchasing decisions, particularly in countries with below-average awareness levels.

6.1 Determinants of Energy Label Awareness and Influence

In Table 3, we present the estimates from the Probit models in columns two and three, and the estimates from the Heckman sample selection model in columns four and five, using country-specific fixed effects. In columns six and seven, the estimates from the Heckman sample selection model are provided with NUTS region-level fixed effects. Coefficients are reported for each category and are interpreted relative to the reference level of each variable[3].

The Probit model suggests that women are more likely to recognize the label, whereas the estimates in the Heckman models are positive but not statistically significant. Nonetheless, across all models, being a woman significantly increases the likelihood of being influenced by the label when making purchasing decisions.

Individuals aged between 23 and 54 years are consistently estimated to be significantly more likely to be aware of and influenced by the label across all models. In contrast, older

[3]The reference category is indicated with a star in Table 2.

age groups (74 years and older) are significantly less likely to be aware of and influenced by the label in the Probit model. However, in the Heckman models, the negative effect of older age is significant only in the influence equation.

Individuals with 16 or more years of education are more likely to recognize and be influenced by the label. Conversely, those who are still studying are estimated to have a lower likelihood of being influenced. This category likely includes a diverse group, ranging from young students in school to individuals pursuing advanced degrees, such as doctoral programs.

In terms of marital status, all categories, except for those living with a partner, are less likely to recognize and be influenced by the label, with most coefficients being significant compared to married individuals.

The number of children in a household also affects consumer behavior. Having one or two children significantly increases the probability of incorporating the label into purchasing decisions, compared to having no children as the reference level. However, it is important to note that most survey respondents fall into the reference category, indicating a substantial disparity between this group and other categories.

Most survey respondents are individuals who rarely experience financial difficulties. They show a significant increase in both the probabilities of label awareness and influence, compared to those who frequently struggle with bills. Individuals who face difficulties paying bills from time to time exhibit significant positive coefficients only for label influence.

The Heckman models reveal a strong positive relationship between self-identification as middle-class and the probability of being influenced by the label in purchasing decisions. However, the awareness coefficients for the lower-middle and middle-class categories are negative and not statistically significant.

Individuals living in small urban areas are more likely to be influenced by the label than those in rural areas. Additionally, individuals living in large urban areas exhibit a significant positive coefficient for influence only at the NUTS level.

The political orientation coefficients do not show a significant effect relative to left-leaning individuals (the reference category). Interestingly, individuals who refuse to disclose their political position or who are unsure, are more likely to be aware of the labels, but at the same time significantly less influenced by them. Furthermore, individuals with medium, low, or no political interest are significantly less likely to be influenced, with the strongest effect observed in those with low or no interest. Individuals with no political interest are also significantly less likely to recognize the label.

In our model, we include variables related to information sources exclusively as explanatory variables for label awareness. Our results indicate that traditional media may be less influential compared to digital sources, even though most survey respondents identified TV as their main source of information. Internet use, ranging from "Often/sometimes" to "no access at all," reduces the probability of label awareness across all models, particularly in the categories "never/no access" and "no access at all". This underscores that

limited internet access is a substantial barrier to label awareness. However, it is important to note the number of individuals reporting no internet access is significantly low.

As for attitudes toward the EU's role in facilitating energy choices, the results do not provide definitive conclusions. However, individuals who associate the EU's energy policy with reducing energy consumption —such as through home insulation or purchasing energy-efficient products— are more likely to recognize and incorporate the label into their purchasing decisions, with strong evidence supporting the latter. Additionally, those who believe that providing clear information on energy issues should be a priority for the EU over the next decade are more likely to be impacted by the label compared to those who do not share this view.

Finally, considering the EU to be responsible for the label positively influences both awareness and influence, whereas considering the industry to be responsible only significantly affects awareness. Individuals who do not recognize the organization behind the label are less likely to both identify and consider the label in their purchasing decisions.

Table 3: Probit and Heckman Models Estimates

Variable	Category	Probit		Heckman Country		Heckman NUTS	
		Awareness	**Influence**	**Awareness**	**Influence**	**Awareness**	**Influence**
(1)	Woman	0.0489*	0.1104***	0.0382	0.1005***	0.0412	0.1001***
		(0.026)	(0.020)	(0.026)	(0.020)	(0.026)	(0.020)
(2)	23 - 38 years	0.1823**	0.1345***	0.1738**	0.1194**	0.1894**	0.1247**
		(0.075)	(0.052)	(0.075)	(0.051)	(0.075)	(0.052)
	39 - 54 years	0.1579**	0.2475***	0.1483*	0.2384***	0.1710**	0.2445***
		(0.080)	(0.056)	(0.079)	(0.055)	(0.080)	(0.055)
	55 - 73 years	0.0146	0.0415	0.0151	0.0626	0.0239	0.0706
		(0.083)	(0.058)	(0.082)	(0.056)	(0.083)	(0.057)
	74 years and older	-0.3166***	-0.2054***	-0.2984***	-0.0940	-0.3035***	-0.0951
		(0.090)	(0.065)	(0.090)	(0.064)	(0.090)	(0.065)
(3)	16-19 years	0.1921***	0.1580***	0.1758***	0.1063***	0.1759***	0.1074***
		(0.037)	(0.033)	(0.037)	(0.032)	(0.037)	(0.032)
	20 years and older	0.2912***	0.3182***	0.2644***	0.2511***	0.2635***	0.2573***
		(0.045)	(0.036)	(0.045)	(0.036)	(0.046)	(0.036)
	Still Studying	0.0501	-0.1041*	0.0341	-0.1356**	0.0312	-0.1267**
		(0.085)	(0.062)	(0.084)	(0.060)	(0.085)	(0.061)
	No full-time education	-0.1002	-0.0432	-0.1061	-0.0305	-0.0363	-0.0036
		(0.112)	(0.106)	(0.111)	(0.103)	(0.113)	(0.104)
	Ref + DK	-0.1331	0.0891	-0.1659*	0.0936	-0.1038	0.0952
		(0.090)	(0.086)	(0.089)	(0.084)	(0.093)	(0.085)
(4)	Living with partner	-0.0407	-0.0617*	-0.0434	-0.0548	-0.0444	-0.0535
		(0.049)	(0.034)	(0.049)	(0.033)	(0.050)	(0.034)
	Single	-0.1594***	-0.3166***	-0.1577***	-0.2894***	-0.1550***	-0.2808***
		(0.046)	(0.033)	(0.045)	(0.032)	(0.046)	(0.033)
	Divorced or separated	-0.0736	-0.2181***	-0.0715	-0.2082***	-0.0889*	-0.2113***
		(0.049)	(0.036)	(0.049)	(0.035)	(0.049)	(0.036)
	Widow	-0.1424***	-0.1803***	-0.1278***	-0.1345***	-0.1329***	-0.1294***
		(0.040)	(0.037)	(0.040)	(0.036)	(0.040)	(0.036)
	Ref + Other	-0.4887***	-0.3739***	-0.4639***	-0.3070***	-0.4166***	-0.3363***
		(0.137)	(0.113)	(0.136)	(0.110)	(0.141)	(0.111)
(5)	One	-0.0005	0.0925***	-0.0024	0.0894***	-0.0022	0.0936***
		(0.047)	(0.034)	(0.047)	(0.033)	(0.047)	(0.034)
	Two	0.0317	0.0722*	0.0187	0.0701*	0.0421	0.0692*
		(0.057)	(0.039)	(0.057)	(0.039)	(0.058)	(0.039)
	Three	-0.0922	0.0442	-0.1239	0.0461	-0.0826	0.0605
		(0.101)	(0.075)	(0.100)	(0.073)	(0.102)	(0.074)
	Four or more	-0.1855	-0.0662	-0.1905	-0.0503	-0.1865	-0.0341
		(0.129)	(0.102)	(0.129)	(0.099)	(0.130)	(0.100)
(6)	From time to time	0.0734	0.1215***	0.0647	0.0981**	0.0644	0.0988**
		(0.046)	(0.041)	(0.046)	(0.040)	(0.047)	(0.040)
	Almost never/never	0.2420***	0.2207***	0.2292***	0.1720***	0.2265***	0.1726***
		(0.046)	(0.040)	(0.046)	(0.039)	(0.047)	(0.040)
	Ref	0.2491**	-0.0358	0.2314**	-0.0765	0.1891	-0.0646
		(0.116)	(0.086)	(0.114)	(0.084)	(0.116)	(0.085)
(7)	Lower middle class	-0.0126	0.1327***	-0.0095	0.1180***	-0.0018	0.1264***
		(0.040)	(0.032)	(0.040)	(0.031)	(0.040)	(0.031)
	Middle class	-0.0414	0.1515***	-0.0439	0.1386***	-0.0380	0.1390***
		(0.033)	(0.025)	(0.033)	(0.025)	(0.033)	(0.025)
	Upper middle class	0.0195	0.1397***	0.0146	0.1313***	0.0232	0.1363***
		(0.072)	(0.047)	(0.071)	(0.046)	(0.072)	(0.046)
	Higher class	-0.2278	0.0362	-0.2925	0.0451	-0.2852	0.0546
		(0.183)	(0.131)	(0.180)	(0.129)	(0.182)	(0.130)
	Other+None+Ref+DK	0.0173	0.0330	0.0193	0.0264	0.0380	0.0321
		(0.063)	(0.052)	(0.062)	(0.051)	(0.063)	(0.051)
(8)	Small urban area	0.0341	0.0580**	0.0273	0.0499**	0.0271	0.0500**
		(0.032)	(0.026)	(0.032)	(0.025)	(0.033)	(0.026)
	Large urban area	0.0526	0.0530**	0.0509	0.0396	0.0678**	0.0455*
		(0.032)	(0.025)	(0.032)	(0.024)	(0.033)	(0.025)
(9)	Centre	-0.0296	0.0183	-0.0216	0.0175	-0.0193	0.0128
		(0.035)	(0.026)	(0.034)	(0.026)	(0.035)	(0.026)
	Right	-0.0383	-0.0210	-0.0292	-0.0174	-0.0252	-0.0201
		(0.038)	(0.029)	(0.037)	(0.028)	(0.038)	(0.028)
	DK/Ref	0.0664	-0.0990***	0.0768*	-0.1045***	0.0723*	-0.0974***
		(0.041)	(0.032)	(0.040)	(0.031)	(0.041)	(0.031)

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Table 3: Probit and Heckman Models Estimates

Variable	Category	Probit		Heckman Country		Heckman NUTS	
		Awareness	**Influence**	**Awareness**	**Influence**	**Awareness**	**Influence**
(10)	Medium	0.0046	-0.0679**	0.0013	-0.0662**	-0.0016	-0.0700**
		(0.039)	(0.029)	(0.039)	(0.029)	(0.040)	(0.029)
	Low	-0.0106	-0.2037***	-0.0036	-0.1942***	-0.0077	-0.2058***
		(0.047)	(0.035)	(0.047)	(0.034)	(0.047)	(0.035)
	Not at all	-0.2278***	-0.3321***	-0.2058***	-0.2844***	-0.2104***	-0.2920***
		(0.046)	(0.036)	(0.046)	(0.035)	(0.046)	(0.035)
(11)	Newspapers/magazines	0.0260		0.0279		0.0283	
		(0.047)		(0.047)		(0.047)	
	Radio	-0.0826		-0.0767		-0.0579	
		(0.059)		(0.057)		(0.058)	
	Internet websites	0.2917***		0.2909***		0.2906***	
		(0.045)		(0.044)		(0.045)	
	Online social networks	0.0976*		0.0835		0.0797	
		(0.056)		(0.055)		(0.055)	
	Close ones	0.0149		-0.0121		-0.0130	
		(0.058)		(0.057)		(0.058)	
	Other + None + DK	-0.0171		-0.0505		-0.0702	
		(0.047)		(0.046)		(0.047)	
(12)	Often/sometimes	-0.0964**		-0.1128**		-0.1139**	
		(0.045)		(0.044)		(0.044)	
	Never/no access	-0.4269***		-0.4850***		-0.4925***	
		(0.040)		(0.039)		(0.039)	
	No access at all	-0.3470***		-0.4370***		-0.4207***	
		(0.071)		(0.070)		(0.070)	
(13)	Tend to agree	-0.0967***	-0.1116***	-0.0956***	-0.0941***	-0.0925***	-0.0911***
		(0.028)	(0.021)	(0.027)	(0.021)	(0.028)	(0.021)
	Tend to disagree	-0.2121***	-0.1481***	-0.1915***	-0.1176***	-0.1784***	-0.1025**
		(0.055)	(0.042)	(0.055)	(0.041)	(0.056)	(0.042)
	Totally disagree	-0.1573	-0.3951***	-0.1617*	-0.3667***	-0.1582	-0.3553***
		(0.099)	(0.068)	(0.098)	(0.067)	(0.099)	(0.068)
	DK	-0.1316**	-0.3537***	-0.1222**	-0.2952***	-0.1065*	-0.2936***
		(0.059)	(0.054)	(0.058)	(0.052)	(0.059)	(0.053)
(14)	Mentioned	0.0504*	0.1779***	0.0513*	0.1655***	0.0496*	0.1668***
		(0.030)	(0.023)	(0.030)	(0.022)	(0.030)	(0.022)
(15)	Mentioned	0.0224	0.0887***	0.0267	0.0810***	0.0339	0.0853***
		(0.030)	(0.023)	(0.029)	(0.022)	(0.030)	(0.022)
(16)	The European Union	0.3111***	0.1855***	0.3115***	0.1562***	0.3106***	0.1529***
		(0.049)	(0.037)	(0.049)	(0.036)	(0.049)	(0.036)
	The industry	0.2899***	0.0453	0.2889***	0.0130	0.2987***	0.0093
		(0.060)	(0.044)	(0.060)	(0.043)	(0.061)	(0.044)
	Consumer org.	0.0825	0.0510	0.0762	0.0406	0.0842	0.0393
		(0.060)	(0.045)	(0.060)	(0.044)	(0.061)	(0.044)
	DK	-0.6595***	-0.3648***	-0.6586***	-0.2303***	-0.6628***	-0.2416***
		(0.048)	(0.040)	(0.048)	(0.041)	(0.049)	(0.041)
	Constant	1.3201***	0.6626***	1.3551***	0.7791***	1.2418***	0.7880***
		(0.105)	(0.084)	(0.104)	(0.083)	(0.105)	(0.084)
	Rho			-0.7614***		-0.7370***	
				(0.098)		(0.091)	
	Country/NUTS effects	yes	yes	yes	yes	yes	yes
	Observations	27,438	25,022	27,438	25,022	27,438	27,438

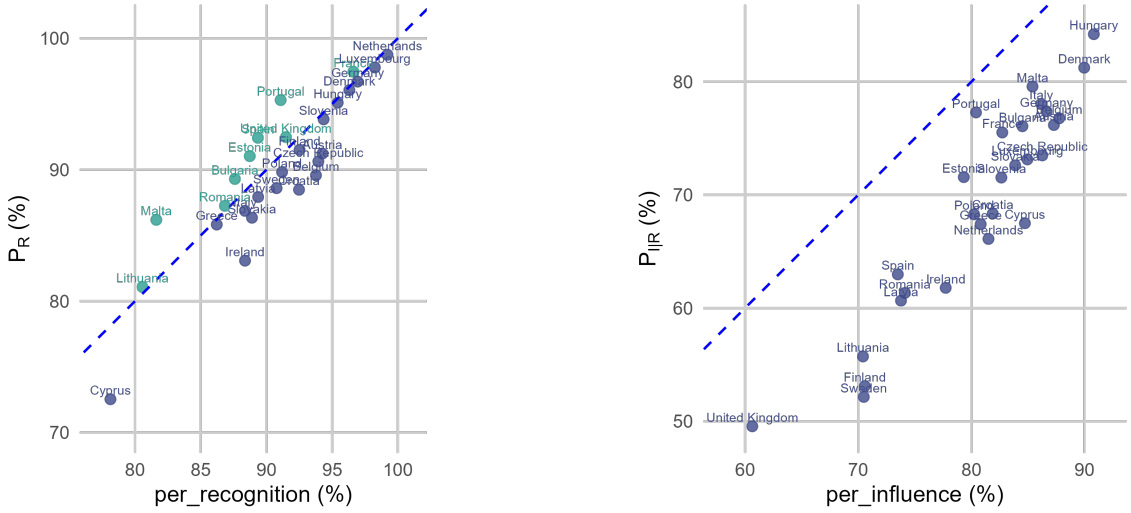
*** p<0.01, ** p<0.05, * p<0.1 - Standard errors in parentheses

6.2 Model Predictions vs. Survey Responses

We use the estimated Heckman model with fixed effects at the country level to estimate the probabilities of awareness and influence attributable solely to being from a specific geographic area (with all other variables in the models set to the base level). Specifically, two types of probabilities were estimated: the probability of recognizing the label (P_R) and the conditional probability of considering it in purchases, given its awareness ($P_{I|R}$). We graphically assess the differences between these estimated probabilities and the awareness and influence percentages derived from survey data, as presented in subsection 4.2.

Figure 5 compares P_R with the awareness percentage and $P_{I|R}$ with the influence percentage. Points on the 45-degree line indicate that the inclusion of individual characteristics does not change the country-level probabilities derived directly from survey responses. Figure (a), where most observations are on or near the 45-degree line, suggests that country-specific factors drive the differences in label awareness, which cannot be explained by the individual characteristics included in our regressions.

In contrast, figure (b) shows that all observations fall below the 45-degree line, while still exhibiting considerable variation across countries. This indicates that individual characteristics play a significant role in explaining label influence within each country. However, heterogeneity across countries remains due to other factors, which we discuss in the next section.

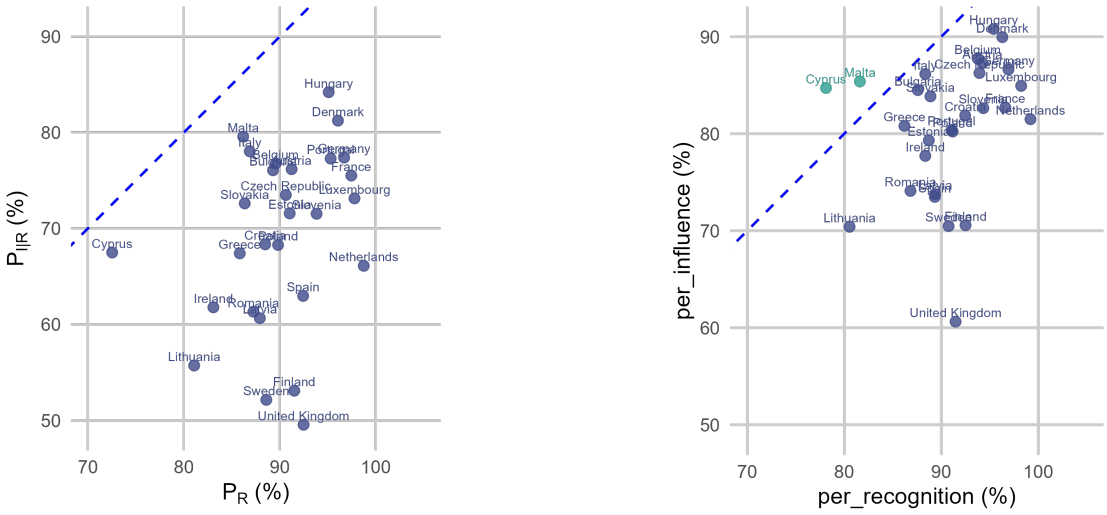


(a) (b)

Figure 5: Comparing Probability vs Percentage: Label Influence and Awareness

Figure 6 provides a comparative analysis of label influence and awareness, displaying the estimated probabilities (a) and survey percentages (b). Figure (b) shows that only in Cyprus and Malta does the influence percentage exceed the awareness percentage. In all other countries, a higher percentage of people recognize the label than are influenced by it when making purchase decisions. It is worth mentioning that, as discussed in subsection 4.2, the influence percentage is calculated only for those who reported recognizing the label.

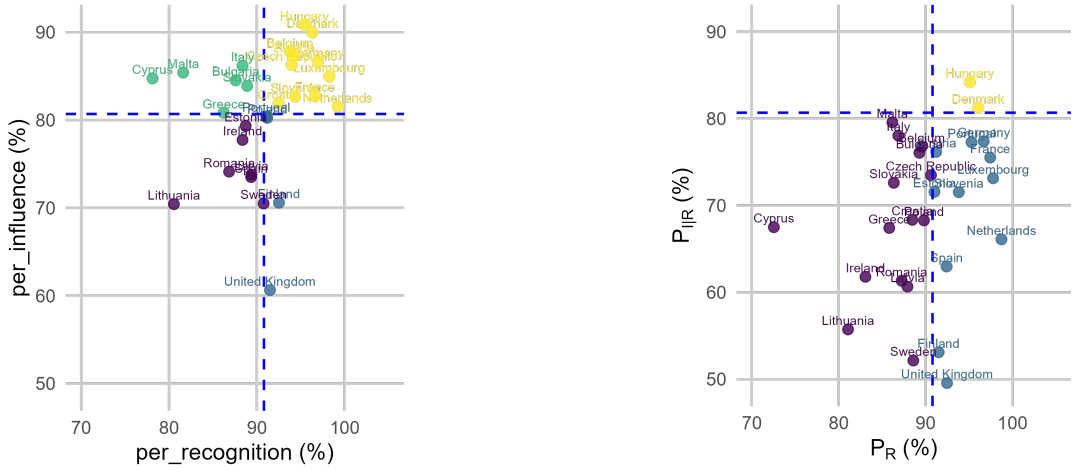
After controlling for individual characteristics, all countries fall below the 45-degree line in Figure (a). The probability of influence is more widely dispersed, ranging from 49.6% to 84.2% on the vertical axis, highlighting again the key role of individual characteristics for label influence. Heterogeneity across countries persists due to other factors.



(a) (b)

Figure 6: Comparing Label Influence vs. Awareness: Probabilities and Percentages

The quadrant-based comparison shown in Figure 7 provides a more detailed analysis of the impact of individual characteristics by country, using the average influence and awareness percentages as reference lines. This figure presents the awareness-influence positioning of countries under two scenarios: (a) based on survey data reflecting individual characteristics and (b) probabilities derived from the regression model, representing a hypothetical individual with baseline characteristics across all countries.



(a) (b)

Figure 7: Quadrant-Based Comparison of Label Influence vs Awareness

The survey data initially place countries across all four quadrants, with the majority —eleven countries— concentrated in Quadrant 1, characterized by high awareness and high influence. The remaining quadrants contain six, seven, and four countries, respectively. However, when examining country positions using the probabilities estimated from

the regression model, significant shifts are observed. Notably, only Hungary and Denmark remain in Quadrant 1, suggesting that awareness and influence are less dependent on individual factors in these countries. In contrast, Belgium, Croatia, and the Czech Republic, initially located in this quadrant, moved to Quadrant 3, indicating that individual characteristics significantly affect both label awareness and influence in these nations. The remaining countries that were initially in Quadrant 1 (Austria, France, Germany, Luxembourg, the Netherlands, and Slovenia) shifted to Quadrant 4, demonstrating that while individual factors strongly influence label impact, they play a lesser role in shaping awareness.

Quadrant 2 is notably empty after the regression analysis. All six countries originally in this quadrant —Bulgaria, Cyprus, Greece, Italy, Malta, and Slovakia— move to Quadrant 3, suggesting that individual characteristics predominantly shape influence levels without significantly altering awareness rates. Most countries (fifteen in total) are now in Quadrant 3, representing both low awareness and low influence.

Ireland, Latvia, Lithuania, Romania, and Sweden remain in Quadrant 3, indicating persistent challenges in both awareness and influence in these countries that appear unrelated to individual characteristics. Poland is the only country to shift from Quadrant 4 to Quadrant 3, indicating individual factors affect awareness without significantly influencing label impact. Conversely, Estonia and Spain transition from Quadrant 3 to Quadrant 4, suggesting that individual factors negatively affect awareness while influence remains relatively stable. Finally, Finland, Portugal, and the United Kingdom remain in Quadrant 4, indicating that individual characteristics have limited effect within these national contexts.

6.3 The Role of Socio-Economic and Political Factors

This subsection examines the potential correlations between estimated probabilities and various socioeconomic and political variables at the country level. It aims to deepen the understanding of factors shaping the EU energy label awareness and influence of the EU energy label when making purchase decisions. Figure 8 presents scatterplots for several relevant variables including (1) real GDP per capita; (2) electrical energy price; (3) energy imports dependency; (4) PISA score; (5) right-left position; (6) favourable mentions of freedom and human rights in the Lower House; and (7) positive EU perspective in the Lower House[4].

Higher GDP per capita is associated with a higher standard of living, better education, and more access to information, all of which can lead to an increased probability of recognizing the EU energy label. In addition, individuals in wealthier countries may also

[4]Data on GDP per capita, electricity prices, and energy import dependency are obtained from the Eurostat database. PISA scores are sourced from the OECD PISA 2018 Database. The variables for the right-left position, favourable mentions of freedom and human rights in the Lower House, and positive perspective in the Lower House are derived from the 2023a version of the Manifesto Research on Political Representation project (MARPOR).

be more environmentally conscious, leading to a higher probability of considering energy labels in purchasing decisions. The scatterplot comparing probabilities with 2019 GDP per capita levels shows a positive correlation between GDP per capita and label awareness. However, the correlation with label influence reveals a negative slope, suggesting that in countries with higher living standards, financial concerns are less pressing, and therefore, the labels may not influence on purchasing decisions considerably. In these contexts, the importance of cost savings through the adoption of energy-efficient products may be reduced, leading to lower conditional probabilities of label influence.

It is expected that higher energy prices could increase public interest in energy efficiency, thereby boosting awareness of energy labels. Consumers facing high energy prices might be more motivated to consider the EU Energy Label as they seek to reduce energy costs by opting for more efficient products. The scatterplot presents the electrical energy price for the first half of 2019 and confirms a statistically significant positive correlation between energy prices and awareness probability. However, it does not establish a clear link between energy prices and the probability of being influenced by the label. For example, despite the United Kingdom's high energy prices, its probability of influence is the lowest.

Energy prices are closely linked to a country's dependency on energy imports since a high dependency could lead to higher energy prices. Countries with significant energy import dependency might have stronger policies promoting energy efficiency and awareness, potentially increasing both label awareness and influence of energy-efficient products. The analysis finds a positive correlation between energy import dependency and influence probability, but this correlation does not hold for awareness probability. For instance, despite high dependency levels, Malta and Lithuania report low probabilities of label awareness, suggesting that factors other than import dependency may play a more crucial role in awareness.

The relationship between education and label awareness is explored using the aggregate PISA score, which encompasses reading, mathematics, and science. Higher scores reflect better education systems, which might lead to higher public label awareness and influence because people could understand the long-term benefits of using energy-efficient products. The data shows a positive correlation between PISA scores and label awareness, but no significant correlation is found between PISA scores and the probability of label influence. For instance, countries with high PISA scores like Finland, the United Kingdom, and Sweden report some of the lowest probability of considering the label in purchases.

Political variables also may play a crucial role in shaping both awareness and influence. A right-left political orientation variable was constructed, reflecting the political leanings of the Parliamentary Lower House by taking into account the most recent elections before 2019[5]. Higher values of this variable correspond to a more right-leaning orientation. We

[5]This variable was constructed using the "rile" variable from the 2023a version of the Manifesto Research on Political Representation project (MARPOR). The "rile" score represents a political party's position on the right-left spectrum based on the coding of quasi-sentences in political party election pro-

hypothesize that left-leaning populations and governments are more likely to prioritize environmental issues and energy efficiency, potentially leading to increased awareness and influence of the label. While the scatterplot shows a positive correlation between a left-leaning orientation and label awareness, this correlation does not extend to label influence, suggesting that political ideology may impact awareness more than actual purchasing behavior.

Freedom and human rights are foundational to democratic societies, contributing to economic growth and fostering an environment where individuals are more likely to demand their rights and be aware of their duties, including those related to sustainability. Countries with strong democratic institutions may implement more transparent and effective policies that promote energy efficiency, leading to higher awareness of the EU Energy Label. The scatterplot reveals a statistically strong correlation between favourable mentions of freedom and human rights and label awareness, indicating that societal openness and democratic values enhance awareness. However, the impact of these variables on label influence is not significant.

Finally, the perception of the organization responsible for the label is critical to the effectiveness of labeling systems, highlighting the importance of public trust and confidence in the institutions behind labeling initiatives. The scatterplots illustrate that a positive perspective on the EU among political parties of the Lower House [6] is positively correlated with both awareness and influence probabilities, with the correlation being particularly strong for awareness.

grams or manifestos, which reflect positions on issues such as security and defense, civil rights, economic ideology, support for the welfare state, and law and order (Lehmann et al., 2023). The Right-left position for each country was calculated through the summa of the rile score for each party multiplied by its absolute seat count divided by the total number of seats in the Lower House of the national parliament, which is the lower chamber in each country's bicameral system

[6] A positive perspective on the EU refers to favorable mentions of the European Community/Union by political parties election programs, which may include support for country's desire to join or remain a member, advocacy for the expansion of the European Community/Union, endorsement of increasing the EU's competencies, and the promotion of expanding the powers of the European Parliament. (Lehmann et al., 2023).

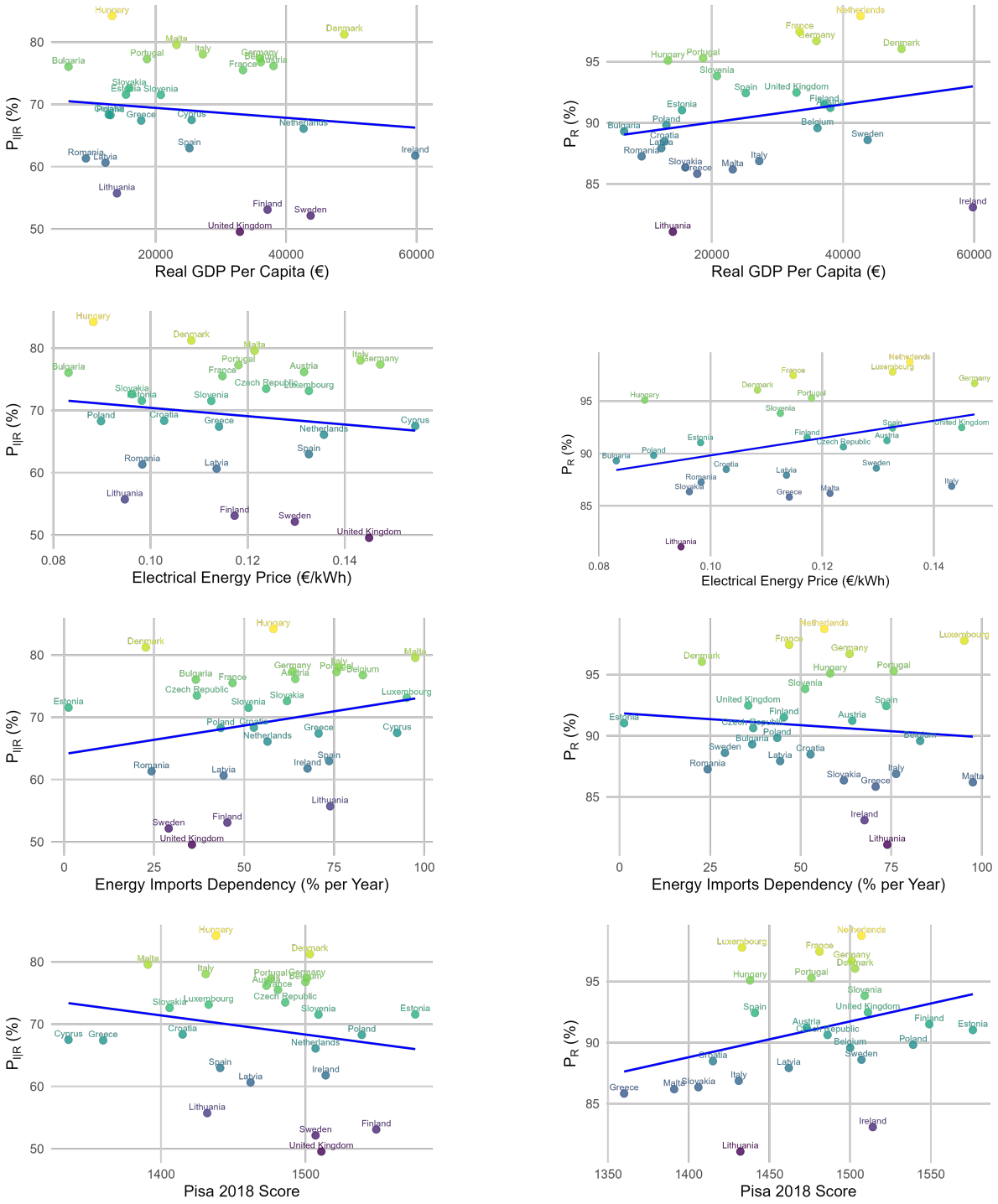


Figure 8: Correlations between the conditional probability of considering the EU Energy Label and the probability of recognizing the EU Energy Label with economic, social, and political variables. (Figure continues on the next page)

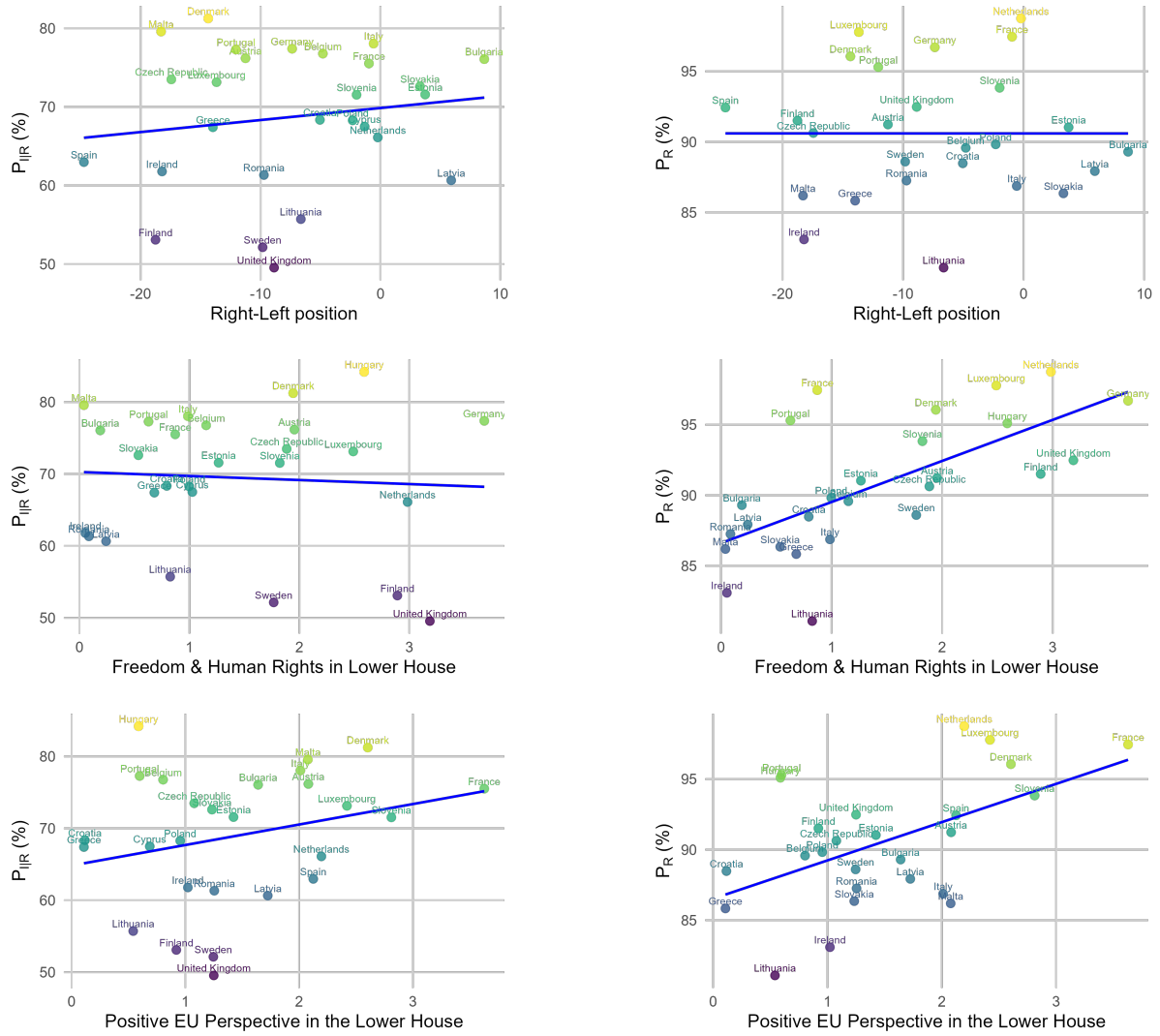


Figure 8: Correlations between the conditional probability of considering the EU Energy Label and the probability of recognizing the EU Energy Label with economic, social, and political variables

6.4 Impact of Targeted Increases in Label Awareness on Label Influence in Purchasing Decisions

This subsection examines the impact of three independent increases in awareness on the unconditional probability of being influenced (P_I). The first scenario refers to a campaign that does not target specific groups but aims to reach the entire population, ensuring that all respondents become aware of the label. The second scenario targets respondents who are less likely to be aware. The third scenario focuses on respondents who, although initially unaware, share characteristics with those who are highly influenced by the label. In all three scenarios, awareness is increased by raising the probability of awareness to 99% for the targeted group[7]. Subsequently, P_I and the $P_{I|R}$ at the individual level are estimated using the Heckman model presented in Table 3 (Columns 5-6).

[7]We set the probability of awareness at 99%, instead of 100%, to avoid numerical issues in the subsequent estimation of both conditional and unconditional probabilities of being influenced.

□ **Widespread awareness campaign:** In Table 4, we present in the first three columns the awareness probability (P_R), the probability of being influenced conditional on awareness ($P_{I|R}$), and finally the unconditional probability for being influenced (P_I) before the simulated intervention. The next three columns present the same probabilities following an intervention which raises the awareness of the whole population to 99%. The final three columns of the table present the changes in these three probability measures induced by the intervention.

Given that $P_{I|R}$ is defined as P_I divided by P_R, the conditional probability of being influenced equals the unconditional probability when P_R reaches 100%. Thus, increasing P_R to 99% brings $P_{I|R}$ and P_I closer to convergence. In this scenario, the values of these probabilities represent an upper limit of the probability of being influenced in each country. For instance, Austria's post-targeting conditional probability of being influenced, given label awareness, is 87.62%, while its post-targeting unconditional probability is 86.74%. The proximity of these values indicates that the maximum influence is around this range, implying that even with near-universal awareness, label influence in Austria would likely cap at approximately 87%. This information serves as valuable input for designing policies aimed at improving label influence through increased awareness, enabling the anticipation of the maximum probability of influence and using it as a reference point in policy cost-benefit analysis.

Table 4: Probabilities Before and After Raising Awareness Across the Entire Population

Country	**Pre-targeting**			**Post-targeting**			**Absolute Difference**		
	P_R	$P_{I\|R}$	P_I	P_R	$P_{I\|R}$	P_I	P_R	$P_{I\|R}$	P_I
Austria	94.27	86.6	82.15	99	87.62	86.74	4.73	1.02	4.59
Belgium	93.52	87.31	82.32	99	88.49	87.6	5.48	1.18	5.28
Bulgaria	87.42	82.14	73.55	99	85.27	84.42	11.58	3.13	10.87
Croatia	92.49	80.62	75.72	99	82.5	81.68	6.51	1.88	5.96
Cyprus	78.38	79.58	66.29	99	85.48	84.63	20.62	5.9	18.34
Czech Republic	94.24	85.43	81.1	99	86.55	85.68	4.76	1.12	4.58
Denmark	96.19	89.48	86.55	99	90.16	89.26	2.81	0.68	2.71
Estonia	88.79	77.36	70.85	99	80.71	79.9	10.21	3.35	9.05
Finland	92.91	68.54	65.2	99	70.88	70.17	6.09	2.34	4.97
France	96.56	82.34	80.03	99	83.15	82.32	2.44	0.81	2.29
Germany	96.73	86.36	83.88	99	86.95	86.08	2.27	0.59	2.2
Greece	86.23	77.37	69.41	99	81.49	80.68	12.77	4.12	11.27
Hungary	94.97	90.53	86.58	99	91.39	90.48	4.03	0.86	3.9
Ireland	88.2	75.24	68.33	99	78.7	77.91	10.8	3.46	9.58
Italy	88.4	84.04	76.21	99	86.85	85.98	10.6	2.81	9.77
Latvia	89.53	71.57	65.92	99	74.94	74.19	9.47	3.37	8.27
Lithuania	80.38	66.04	57.03	99	72.77	72.04	18.62	6.73	15.01
Luxembourg	98.18	84.63	83.37	99	84.97	84.12	0.82	0.34	0.75
Malta	81.96	81.56	69.48	99	86.17	85.3	17.04	4.61	15.82
Netherlands	99.18	81.5	80.92	99	81.55	80.73	-0.18	0.05	-0.19
Poland	90.42	78.85	72.88	99	81.5	80.68	8.58	2.65	7.8
Portugal	90.39	78.86	73.12	99	81.74	80.93	8.61	2.88	7.81
Romania	86.81	72.09	64.5	99	76.09	75.33	12.19	4	10.83
Slovakia	88.73	82.45	74.63	99	85.11	84.26	10.27	2.66	9.63
Slovenia	94.23	81.57	77.76	99	83.01	82.18	4.77	1.44	4.42
Spain	89.88	70.44	65.62	99	73.95	73.21	9.12	3.51	7.59
Sweden	91.16	69.34	64.42	99	72.15	71.43	7.84	2.81	7.01
United Kingdom	91.59	58.65	55.42	99	61.73	61.11	7.41	3.08	5.69

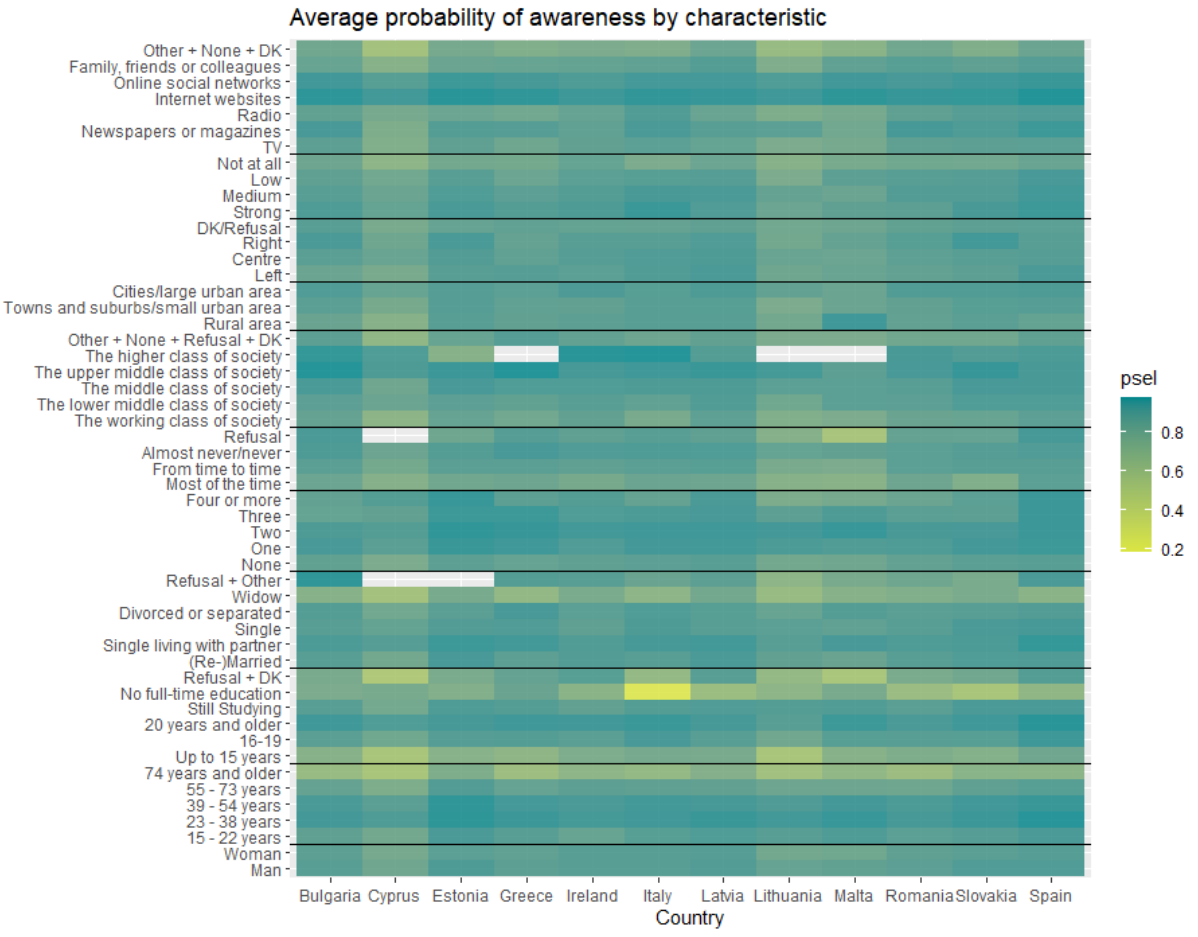
For Pre- and Post-Targeting columns:P_R = average probability of awareness; $P_{I|R}$ = average conditional probability of influence given awareness; P_I = average unconditional probability of influence. All values are percentages.
For absolute differences columns, values represent changes in percentage points.

Overall, the post-targeting change in P_I is associated with the extent of pre-targeting

variation in P_R. Countries where targeting resulted in substantial changes in P_R—such as Cyprus, Lithuania, and Malta—experience the highest positive impact on the unconditional probability P_I. Greece, Bulgaria, and Romania also experience notable increases in P_R, exceeding 10 percentage points, which are similarly reflected in their unconditional probabilities. Conversely, countries with the highest initial awareness - such as Denmark, France, Germany, Luxembourg and Netherlands[8] - show the lowest differences in both P_R and P_I.

☐ **Targeting individuals with a low probability of awareness:** This approach focuses exclusively on countries with awareness rates below 90%, as they present a larger potential for improvement. Figure 9 illustrates a heatmap based on the average probability of awareness by individual characteristics. We use this heatmap to identify demographic groups with the lowest probability of being aware of the label. The demographic factors that correlate with lower awareness change from country to country indicate that such a campaign must be designed differently for each country. Overall, some common factors associated with low awareness of labels are older age, lack of full-time education, and education up to age 15.

Figure 9: Probability of Awareness by Characteristic



[8]In the Netherlands, these variations are negative, as the country reports an average awareness probability slightly exceeding 99% in the pre-targeting phase.

Table 5 provides a detailed breakdown of the relevant demographics by country, excluding Estonia, Ireland, Malta, and Spain, where all demographics exhibit an average probability of awareness above 80%. Consequently, these countries are not included in this targeting exercise.

Table 5: Individual Characteristics with the Lowest Awareness Probability by Country

Bulgaria	**Cyprus**	**Greece**	**Italy**	**Latvia**	**Lithuania**	**Romania**	**Slovakia**
74 years and older	74 years and older	74 years and older	No full-time education	No full-time education	74 years and older	74 years and older	No full-time education
	Education up to 15 years				Education up to 15 years	No full-time education	
	Widow						

The probability of awareness is increased to 99% for all individuals exhibiting at least one of the relevant demographics identified for each country. Table 6 presents the pre- and post-probability measures, as well as the changes induced by the simulated intervention. In this table, we additionally include three columns to summarize the size of the targeted group. Two of these additional columns present the number of individuals who are aware of these characteristics both before and after the intervention. The last column shows the proportion of these individuals within the full sample during the post-targeting phase.

This intervention proves particularly beneficial for countries such as Cyprus and Lithuania, where the proportion of the targeted group within the sample is larger. In contrast, targeting individuals who are less likely to be aware of the labels is less effective in countries such as Italy, Latvia, and Slovakia, where the size of the target group is relatively small.

Table 6: Probabilities Before and After Raising Awareness for Individuals Less Likely to Be Aware

Country	**Pre-targeting**			**Post-targeting**			**Absolute Difference**			**Individuals aware**		
	P_R (%)	$P_{I\|R}$ (%)	P_I (%)	P_R (%)	$P_{I\|R}$ (%)	P_I (%)	P_R	$P_{I\|R}$	P_I	**Before**	**After**	**Sample Share**
Bulgaria	87.42	82.14	73.55	89.78	82.98	75.61	2.36	0.84	2.06	37	62	6.0
Cyprus	78.38	79.58	66.29	90.20	83.69	76.15	11.82	4.11	9.86	72	140	27.8
Greece	86.23	77.37	69.41	91.11	79.25	73.33	4.88	1.88	3.92	66	119	11.7
Italy	88.40	84.04	76.21	88.48	84.07	76.25	0.08	0.03	0.04	0	1	0.1
Latvia	89.53	71.57	65.92	89.58	71.59	65.95	0.05	0.02	0.03	1	1	0.1
Lithuania	80.38	66.04	57.03	89.51	69.64	63.60	9.13	3.60	6.57	126	214	21.3
Romania	86.81	72.09	64.50	88.73	72.84	65.89	1.92	0.75	1.39	34	50	4.8
Slovakia	88.73	82.45	74.63	88.87	82.50	74.74	0.14	0.05	0.11	1	3	0.9

For Pre- and Post-Targeting columns:P_R = average probability of awareness; $P_{I|R}$ = average conditional probability of influence given awareness; P_I = average unconditional probability of influence.
For absolute differences columns, values represent changes in percentage points.

☐ **Targeting individuals who are initially unaware but share characteristics with those who are highly influenced:** Similar to the previous exercise, this targeting approach is limited to countries with awareness rates below 90%. Targeting characteristics are identified by filtering individuals whose P_I values exceed 80%—indicating high influence—and calculating the average probability of influence by characteristic within

this group. Figure 10 illustrates the performance of average P_I values by characteristic, while Table 7 presents the characteristics with the highest P_I values by country. This approach involves categories from at least three variables for targeting in each country.

Figure 10: Probability of Being Influenced by Characteristic

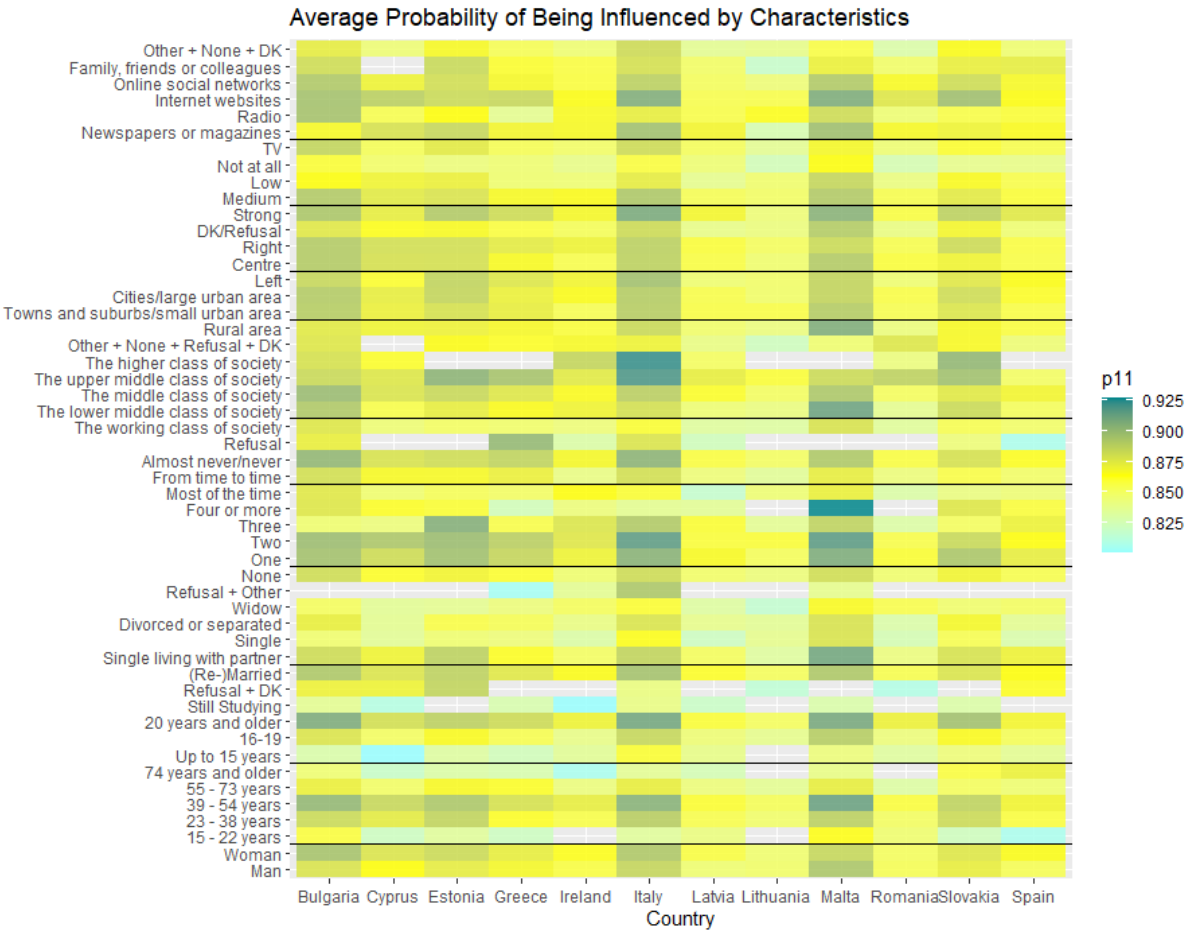


Table 7: Individual Characteristics with the Highest Probability of Being Influenced by Country

Bulgaria	**Cyprus**	**Estonia**	**Greece**	**Ireland**	**Italy**
Education up to 20 years and older	Two children	Three children	The upper middle class of society	The higher class of society	The higher class of society
Almost never-/never Difficulties paying bills	Main information source: Internet websites	The upper middle class of society	Two children	Three children	The upper middle class of society
39 - 54 years	39 - 54 years	Two children	Almost never-/never Difficulties paying bills	Two children	Two children
		One child		The upper middle class of society	Education up to 20 years and older
		39 - 54 years		39 - 54 years	

Latvia	Lithuania	Malta	Romania	Slovakia	Spain
The upper middle class of society	Main information source: Radio	Four or more children	The upper middle class of society	The higher class of society	Strong political interest
Main information source: Newspapers or magazines	Two children	Two children	Main information source: Internet websites	Main information source: Internet websites	Main information source: Family, friends or colleagues
Strong political interest	The upper middle class of society	39 - 54 years	Education up to 20 years and older	The upper middle class of society	One child
		The lower middle class of society		Education up to 20 years and older	

Table 7 presents the probabilities before and after targeting. Among the interventions analyzed, this particular approach results in the least average increase in the P_I across countries. This outcome can be attributed to the pre-existing awareness among individuals with a high probability of being influenced in most countries, leaving only a marginal group to be newly informed. For instance, Estonia exhibits an increment of merely eight individuals in the aware category, while Bulgaria registers an increase of fifty-two individuals, achieving the highest increase in the P_I value among the countries assessed. However, this approach demonstrates superior outcomes in most countries compared to the previous exercise, with the exceptions of Cyprus, Greece, and Lithuania.

Table 7: Probabilities Before and After Raising Awareness for Individuals Less Likely to Be Aware

Country	Pre-targeting			Post-targeting			Absolute Difference			Individuals aware		
	P_R (%)	$P_{I\|R}$ (%)	P_I (%)	P_R (%)	$P_{I\|R}$ (%)	P_I (%)	P_R	$P_{I\|R}$	P_I	Before	After	Sample Share
Bulgaria	87.42	82.14	73.55	91.88	83.15	77.85	4.46	1.01	4.3	548	600	58.1
Cyprus	78.38	79.58	66.29	81.83	80.18	69.65	3.45	0.6	3.36	188	211	41.9
Estonia	88.79	77.36	70.85	89.93	77.63	71.95	1.14	0.27	1.1	341	349	34.8
Greece	86.23	77.37	69.41	87.49	77.67	70.61	1.26	0.3	1.2	224	244	24.0
Ireland	88.2	75.24	68.33	91.13	76.03	71.06	2.93	0.79	2.73	384	419	41.6
Italy	88.4	84.04	76.21	89.7	84.25	77.48	1.3	0.21	1.27	281	296	28.9
Latvia	89.53	71.57	65.92	90.98	72.04	67.25	1.45	0.47	1.33	174	189	18.8
Lithuania	80.38	66.04	57.03	81.8	66.52	58.23	1.42	0.48	1.2	92	108	10.8
Malta	81.96	81.56	69.48	83.99	82.03	71.39	2.03	0.47	1.91	123	133	26.9
Romania	86.81	72.09	64.5	88.63	72.59	66.24	1.82	0.5	1.74	248	278	26.7
Slovakia	88.73	82.45	74.63	90.15	82.73	76.02	1.42	0.28	1.39	342	353	32.6
Spain	89.88	70.44	65.62	91.23	70.91	66.84	1.35	0.47	1.22	269	283	28.2

For Pre- and Post-Targeting columns: P_R = average probability of awareness; $P_{I|R}$ = average conditional probability of influence given awareness; P_I = average unconditional probability of influence.
For absolute differences columns, values represent changes in percentage points.

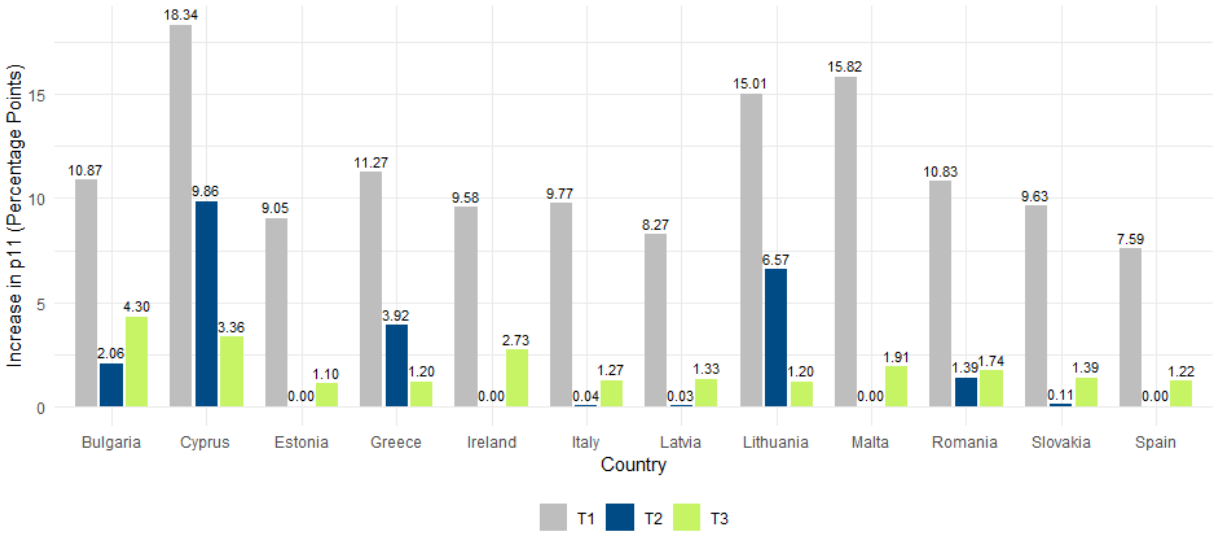
Figure 11 presents the changes in the influence of the labels resulting from our simulation of three targeted advertising campaigns. This figure allows us to compare the effectiveness of each targeting exercise on increasing the influence of labels on purchasing decisions. As would be expected, a campaign without any targeting that tries to reach everyone (T1) yields the highest improvements in the predicted changes in the influence of labels. On the other hand, this would be the most costly campaign to run.

The other two campaigns (T2 and T3) we considered involve reaching a limited number of individuals based on their demographic characteristics, and as a result, will be less

costly. However, their effectiveness is also considerably lower in improving the influence of labels on purchase decisions. When comparing the contribution of the most effective targeting strategy (T2 or T3) to the ideal scenario achieved by T1, countries like Cyprus, Lithuania, Bulgaria, and Greece exhibit the highest contributions, ranging from 34.78% to 53.76%. For instance, in Bulgaria, T3 achieves the most effective result, contributing 40.68% of the maximum potential increase observed in T1. Nevertheless, even with these improvements, the influence probability (P_I) in all these countries remains below 78%, with Lithuania showing the lowest level at 63.6%.

In countries with a significant proportion of the unaware population, targeting campaigns towards those who are less likely to be aware yields significant improvements in the influence of labels. But, for some countries where the size of the unaware consumers is only moderate, targeting those individuals with characteristics that make them most likely to be influenced seems to be a better strategy. A full-fledged comparison of various campaigns must take the cost of such campaigns into account, and we leave such an analysis for future research.

Figure 11: Comparative Contributions of Targeting Actions to Unconditional Probability of Influence by Country



T1: Perfect targeting, T2: Targeting individuals less likely to be aware, T3: Targeting individuals who are highly susceptible to influence but initially unaware

7. Conclusions

We use a Eurobarometer survey of 27,438 individuals across 28 EU Member States commissioned by the European Commission in 2019 to analyze respondents' awareness of the EU Energy Labeling scheme and its impact on household appliance purchases. Our empirical results offer some insights into consumer behavior, which may provide not only important guidance for EU energy policy design concerning energy labeling but also may prove useful in designing campaigns to increase the influence of such labels on purchase

decisions.

Based on the estimated determinants, we identified demographic factors that could be considered in future initiatives designed to enhance label awareness and its influence on purchasing decisions. Gender plays a fundamental role, as women are more likely to recognize and act on labels, suggesting that policy initiatives could benefit from gender-specific communication strategies to address the gap in label awareness and its influence among men. Age and education also emerge as significant factors. Middle-aged individuals and those with more years of education are more likely to be influenced, whereas older adults and students tend to be less influenced. Targeted outreach efforts addressing the specific concerns of these groups—such as the complexity of energy-efficient products or financial constraints—could help overcome these barriers. Educational campaigns, particularly in schools and universities, could promote long-term behavioral change among students.

Financial stability also significantly affects label influence, pointing to the potential of economic incentives —such as subsidies or rebates for energy-efficient products—to boost label influence among those with tighter budgets. Social class and political interest are also important considerations for future policy frameworks. Middle-class individuals are more likely to be influenced by the label while those with low political interest are less likely to recognize or act on them. Additionally, digital information channels could serve as a more effective channel for promoting labels than traditional media and rural and underserved areas could represent opportunities to enhance the impact of labels

The strong positive correlation between recognizing the EU as the institution responsible for labeling and both label awareness and influence underscores the importance of maintaining public confidence in the EU. Clear provision of energy policy information as well as running campaigns aiming to improve the adoption of energy-efficient devices should contribute to keeping the public trust at a high level.

Geographic variations in energy label awareness and influence across Europe have important implications for policy interventions. We conduct three exercises in which we assume that a policymaker can increase label awareness among all unaware individuals or target those with specific characteristics. Using our model, we compute changes in average influence resulting from these interventions. The effects of targeting vary across countries depending on the size of the group that is targeted by the information campaign. These exercises can serve as a basis for cost-benefit analyses of informational targeting. We should, however, note that a high level of awareness is not a guarantee that labels will considerably influence purchasing decisions. Thus, awareness alone is insufficient to drive behavioral change. Policies that extend beyond merely providing information—such as stricter regulations on energy efficiency standards or more visible consumer incentives—may be necessary to address this gap.

The estimated probabilities for awareness, after controlling for individual characteristics, align closely with country-level awareness shares derived from survey data. However,

the estimated probabilities for influence show a wider distribution than the survey data shares. This suggests that individual characteristics have a stronger impact on the degree to which labels affect purchases than on their awareness. Despite this, substantial heterogeneity remains across countries.

Among factors relative to national contexts, socioeconomic and political variables such as Real GDP Per Capita, PISA score 2018, electrical energy price, favourable mentions of freedom and human rights in the Lower House, and a positive perspective on the EU in the Lower House show a positive correlation with label awareness, with significant evidence, particularly for the latter three variables. However, the absence of a significant correlation with label influence suggests that national contexts play a crucial role. This highlights the need to consider both individual and broader national factors in effectively enhancing label influence.

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44/50 Długa St.
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www.wne.uw.edu.pl
ISSN 2957-0506