Material Interest vs. Partisan Identity as Drivers of Opposition to Carbon Taxes

Alice Lépissier*[1], Chloé Boutron[2], Erick Lachapelle[3], Matto Mildenberger[4], and Kathryn Harrison[5]

[1]Brown University, Providence RI, USA
[2]Institute for Climate Economics (I4CE), Paris, France
[3]Université de Montréal, Montréal QC, Canada
[4]University of California, Santa Barbara CA, USA
[5]University of British Columbia, Vancouver BC, Canada

November 27, 2022
Latest version

Abstract

Carbon taxes hold the promise of delivering cost-effective emissions reductions, but at the steep price of significant political opposition. Indeed, citizens often oppose carbon taxes even when the revenues from these taxes, which are returned to taxpayers via tax cuts or dividends, leave them better off financially (Douenne and Fabre, Mildenberger et al.). Previous work by the coauthors found that most Canadians underestimated the value of their carbon tax rebates, and that these perceptions were significantly influenced by partisanship and partisan communication (Mildenberger et al.). In this paper, we turn to the cost side of the equation, and examine the impact of various factors on public perceptions of costs and support for carbon pricing policies. We analyze the effect of urban or rural residence, consumption of transportation and home heating fuels, and of partisanship, on the perceived impact by taxpayers of carbon taxes on their household budgets, and of the impact of actual and perceived costs on the public's appetite for carbon pricing initiatives. We draw on a unique panel survey tracking support for carbon pricing over time in five Canadian provinces. We find stronger opposition to carbon pricing among those who drive to work and spend more on transportation fuels. However, Conservative party supporters overestimate the impact of carbon pricing on gas prices by more than other parties' voters. Moreover, perceived price changes better explain carbon tax opposition than do actual changes in the price of gasoline and other fuels. These findings offer a more nuanced picture of citizens' understanding, and misunderstanding, of a high profile climate policy in the context of partisan contestation.

*Postdoctoral Fellow, Brown University. Corresponding author: alice_lepissier@brown.edu. PRELIMINARY DRAFT. PLEASE DO NOT CITE OR CIRCULATE WITHOUT THE AUTHORS' PERMISSION. Note: citations are not complete.

Contents

Declarations

Data availability All supporting data are available through a Harvard Dataverse replication archive at [URL].

Code availability All the code to replicate the analysis is available through a GitHub repository at https://github.com/walice/Carbon-Cost-Exposure.

1 Introduction

Carbon taxes are one of the most commonly discussed policy instruments to curb greenhouse gas emissions (GHG). Not only have economic analyses demonstrated their superior cost-effectiveness, but they can also be readily applied to virtually all emitting sources across an economy, including small emissions sources at the household and individual consumer level. However, consumers tend to dislike carbon taxes because of the highly visible costs they impose. While an elegant solution to the problem of rising concentrations of GHG in the atmosphere, carbon taxes have the unfortunate feature of foregrounding immediate and concentrated costs on consumers while backcasting the largely diffuse benefits they provide in terms of a more stable future climate. The visible costs they impose on some of the most important consumer expenditures like energy have led some politicians to frame carbon taxes as unfair to families and the working class, fueling substantial opposition in virtually every area where they have been proposed (Mildenberger, 2020; Rabe, 2018).

In response to such challenges to the political acceptability of carbon taxes, a number of scholars and policy proponents have advocated for the use of carbon dividends, or rebates to citizens, as a means of bolstering public support for this policy (Baker III et al., 2017; Klenert et al., 2018; Lobby, 2018). Long advocated by renowned climate scientist James Hansen (2015), this "fee and dividend" approach is based on the idea that public concern around costs can be alleviated with the direct provision of material benefits to consumers. The logic is straightforward, and assumes that individuals will rationally respond to their material self-interest when they realize that the costs of the carbon tax (i.e. the "fee") are offset by the benefits it provides (i.e. the "dividend"). To be sure, a number of survey experiments find support for the logic behind the fee and dividend approach (Nowlin et al., 2020; Carattini et al., 2018; Beiser-McGrath and Bernauer, 2019; Dolsak et al., 2020; Baranzini et al., 2017). Moreover, others suggest that public support for carbon tax and dividends can be strengthened with explanations of how these policies actually work (Carattini et al. 2019; Carattini et al., 2017). However, real world experience with carbon tax and dividends has produced limited evidence that such an approach can actually transform public opposition into support. Even when correcting for information asymmetries, some members of the public maintain policy preferences that are more in line with their ideological and partisan commitments than with their material self-interest (Mildenberger et al., 2022).

In this study, we draw on a unique panel survey of public attitudes to carbon pricing in five Canadian provinces. Over the period from February 2019 to July 2022, we collected data on public perceptions of carbon taxes, rebates, and energy prices, along with socio-political characteristics, allowing us to examine the role of political identities and material self-interest in shaping preferences for carbon taxes.

We find that voting for Conservatives is associated with an increase of 31 percentage points in the probability of opposing carbon taxes, relative to voters from other parties. This result persists even after controlling for income, geography, education, and carbon costs. Moreover, our analysis suggests that, compared to other voters, Conservatives overestimate the impact that carbon taxes have on their gas expenditures by $402 a month. This paper suggests that opposition to carbon pricing is mediated by partisan preferences, and that variation in political positions and subjective perceptions of carbon costs explains carbon tax opposition better than changes in actual carbon costs.

The paper proceeds as follows. In section 2, we review the mixed empirical evidence on the public's attitudes to carbon taxes. Section 3 presents the 7-wave survey of Canadians that was conducted. Section 4 introduces the approach used in this paper, and section 5 presents our findings. We proceed to identify and extract relevant dimensions of analysis in section 5.1, model opposition to carbon taxes as a function of material and subjective factors (section 5.2), before digging deeper into the determinants of the *perceived* costs of carbon pricing policies (section 5.3), and finally evaluating the importance of these features in predicting whether an individual is likely to support or oppose carbon taxes (section 5.4). We offer some concluding remarks in section 6.

2 Explaining support for carbon taxes

A large body of research suggests that the perception of policy consequences is decisive when members of the public form an opinion on public policy (Drews and van den Bergh 2016; Lubell & Vedlitz, 2006; Kallbekken et al., 2013). A key dimension through which members of the public evaluate policies relates to their expected personal costs, with several studies providing evidence that opposition to carbon taxes reflects consumers' rational resistance to additional monetary costs. Findings from focus groups conducted in Europe highlight the greater visibility of costs relative to benefits as a key factor explaining public skepticism toward environmental tax reform (Dresner et al., 2006). Survey experiments commonly find that support for carbon taxes decreases as a function of the tax level (Beiser-McGrath and Bernauer, 2019; Brännlund and Persson, 2012; Jagers et al., 2021; Sælen and Kallbekken, 2011). In a field setting, Schuitema et al. (2010) examine public opinion before and after the implementation of a congestion charge in Stockholm, and show that public expectations of greater financial costs explained greater opposition to the introduction of the policy *ex ante*.

Other research has identified differential cost exposure among different population segments as key to explaining public opposition. In this vein, scholars have shown that individuals are more likely to oppose carbon taxes if they own a car (Thalmann 2004; Hsu et al. 2008; Baranzini and Carattini 2017; Carattini et al. 2017). Similarly, political opposition to carbon taxes often has emerged in rural communities in which residents have fewer transportation alternatives to personal vehicles (Peet and Harrison 2012; Senit 2012). The 2018 "Gilets Jaunes" who violently protested an increase in France's carbon tax were principally residents of exurbs that were not well serviced by metropolitan transit and commuter rail (Algan et al. 2019; Depraz 2019; Boyer et al. 2020).

At the same time, there is evidence that citizens' opposition is motivated by misperception of their financial interests. Hammars and Jager (2006) find a negative impact on support for carbon taxation only among the subset of vehicle owners who distrust government. Some have speculated that opposition reflects exaggerated perceptions of the impact of carbon taxes on consumer prices, particularly when simultaneous price increases occur for unrelated reasons (Harrison 2013; Chubb 2014; Bureau et al. 2015, Karapin 2020). Such exaggerated notions of a policy's costs may be overcome with experience, as evidenced in places where support for carbon taxes and fees rebounds after members of the public are able to better perceive and connect material benefits with the policy (Schuitema et al., 2010; Murray and Rivers, 2015; Mildenberger et al., 2016). However, other studies suggest that misperceptions concerning carbon taxes are shaped by partisan campaigns, which have often focused on energy prices (Thalmann 2004; Anderson et al. 2019; Davidovic et al. 2020, Mildenberger et al. 2021). Partisan opponents of the British Columbia carbon tax typically referred to it as a "gas tax" (Harrison 2012), while the Premier of Ontario, who opposed the federal government's imposition of a tax and dividend, passed a law requiring that gas pumps display an image that conveyed an increasing, and arguably exaggerated, contribution of the carbon tax to fuel prices (Benzie 2020).

Although not a major focus of carbon pricing research, previous studies suggest that higher transportation costs, not surprisingly, depress individuals' support for carbon taxation of motor fuels. In a study of a Swiss green tax referendum, Thalmann (2004, 206) found that each additional motor vehicle owned by a household decreased support by 21% for environmental taxes that increase the price of motor fuels. Baranzini and Carattini (2017, 206) and Carattini et al. (2017, 112) found similar negative impacts of vehicle ownership at the time of subsequent Swiss carbon tax referenda. In Norway, Kallbekken and Saelen (2011) examined both vehicle ownership and motor fuel consumption and found only the latter significant.

There are also indications that citizens weigh the cost of adapting to a carbon tax in forming their opinions. Kallbekken and Saelen (2011, 2971) found stronger opposition to carbon taxation among those who reported that driving was a "necessity." In Canada, Hsu et al. (2008, 3617) found that Vancouver residents who commute by driving were less likely to support a hypothetical gasoline tax increase, though distance driven did not have a significant effect on support. Thalmann (2004) found that those living in urban centers were more supportive of an environmental tax than their rural counterparts, which may reflect greater availability of transit. Peet and Harrison (2012) found that opposition to British Columbia's carbon tax emerged among rural and Northern residents, as an "axe the tax" campaign emphasized that they rely more on driving and need larger vehicles than their urban counterparts. Rural opposition also was a factor in France in 2008 (Senit 2012), and a decade later the "Gilets Jaunes" who violently protested an increase in the French carbon tax were principally residents of exurbs not well serviced by metropolitan transit and commuter rail (Algan et al. 2019; Depraz 2019; Boyer et al. 2020).

While these findings suggest that voters rationally calculate the impact of a carbon tax on their self-interest, other studies suggest that voters' perceptions of their interests are not always accurate. Beck et al. (2016) find that greater rural opposition to the British Columbia carbon tax did not in fact correspond to higher costs in rural communities. Harrison (2013, 12) reported that a market-driven surge in gasoline prices in the months leading up to the 2008 implementation of British Columbia exacerbated public opposition to the tax by prompting consumers to exaggerate the impact of the tax on prices. A similar surge in gasoline prices in France in 2018 preceded the Gilets Jaunes protests against that country's carbon tax (Bureau et al. 2015, 42). Karapin (2020, 151, 160, 162) finds a relationship between gasoline prices and support for carbon pricing in British Columbia and California.

In addition to economic self-interest, there is evidence that ideology influences public attitudes toward carbon taxes. In a comparative study of environmental taxes, Davidovic et al. (2020, 686) reported that respondents on the left of the ideological spectrum were willing to pay 29% more for environmental taxes than all other respondents. Thalmann (2004, 196) found that people affiliated with a left-of-center or an ecological party were 35 to 45% more supportive of environmental tax propositions in Switzerland than voters affiliated with center-right parties. Mildenberger et al. (2021) found that supporters of the Conservative Party of Canada were up to eight times more likely to oppose the Canadian federal carbon tax than Liberal party supporters.

Although these findings may reflect ideological differences concerning taxation or environmental values, an alternative explanation is that people receive selective or even incorrect information from their party or other affinity groups. Parties opposed to carbon pricing or taxation have often exaggerated the costs and downplayed the benefits of such policies to their party followers (Rabe 2018; Mildenberger et al. 2021).

With respect to other demographic characteristics, Kotchen et al. (2017) in the U.S. and Rotaris and Danielis (2019) in Italy find that income has a positive effect on the willingness to pay for a carbon tax. However, income is also likely to have a positive effect one's ability to pay for an additional car. This might explain why Thalmann (2004) finds a slightly negative effect of income on support for environmental taxes. Rotaris and Danielis (2019) find people who identify as male tend to be less willing to pay for a carbon tax than people identifying as female after control'ing for factors such as environmental awareness. Thalmann (2004, 206) finds that people aged 60 and over were more opposed to environmental tax propositions in Switzerland than younger voters. Kotchen et al. (2017), Rotaris and Danielis (2019) Thalmann (2004) and Hsu et al. (2008, 3617) find that education has a positive effect on willingness to pay for environmental or carbon taxes. Not surprisingly, Kotchen et al. (2017, 3), Rotaris and Danielis (2019), and Levi (2021, 7) find that people who do not believe that climate change is happening are significantly less supportive of a carbon tax. Levi (2021, 2) indeed notes that accepting climate science and concern about climate change are prerequisites to support costly climate policies such as carbon taxes.

3 Data

This study draws on a unique survey of attitudes towards carbon pricing for respondents in five Canadian provinces. The data were collected in seven waves spanning February 2019 to July 2022. The longitudinal aspect of the survey allows us to track support for carbon pricing policies over time. The survey-takers were asked a variety of questions about their attitudes towards climate change and their opinions on the use of carbon pricing measures as policies to mitigate emissions. Respondents were also asked a host of demographic questions, questions about their political identity, and questions aimed at capturing their knowledge of climate change.

Moreover, survey participants were asked to provide information on their monthly expenditures on energy bills, such as gasoline and home heating costs. Information on other proxies for costs of carbon pricing policies include whether the person drives to work, the number of vehicles owned, and whether the place of residence is rural or urban–thought to represent costs associated with transport. Another set of survey questions aimed to uncover the nature of energy costs associated with a household, such as the size of the home, what the main source of energy is, and whether respondents owned or rented their home.

Finally, the survey asked respondents to estimate, to the best of their knowledge, the increase in various energy bills due to the passage of carbon pricing policies. All five of the Canadian provinces represented in this survey had some form of carbon pricing policy over the course of the study period. Saskatchewan and Ontario were subject to a federal carbon tax-and-dividend scheme, British Columbia and Alberta enacted a carbon tax in their own province, and Quebec runs a provincial emissions trading program. Participants were instructed to provide an estimate of the dollar amount of how much their monthly energy bills and gasoline costs increased per month as a direct result of carbon pricing. We thus obtain various granular measures of the perception of the costs incurred by households due to taxing carbon.

4 Methods

In this paper, we seek to understand the drivers of citizens' attitudes towards carbon pricing, as a function of the objective and subjective costs incurred by households as a result of increasing the price of fossil-based energy sources.

First, we conduct exploratory data analysis in section 5.1 to uncover patterns in opinions on carbon pricing, and to identify relevant dimensions of analysis. We use Principal Component Analysis (PCA) to reduce the dimensionality of the data and to represent data on public opinions towards carbon pricing in a more interpretable manner. PCA is a technique that represents data that have many predictors in a lower-dimensional space. The data are projected along the dimensions that explain the greatest proportion of variance in the sample, that is, on predictors that are likely to be important in determining the public's attitudes towards carbon pricing. We thus use PCA to extract important features in the survey data.

After identifying patterns of variation in the data, we model public attitudes towards carbon taxes as a function of material self-interest and ideological positions in section 5.2. Given that the real-world implementation of carbon pricing policies is often met with resistance, despite the promise of fee-and-rebate systems, we seek to better understand how members of the public conceptualize the impact of carbon taxes on their own household budget. Consequently, we focus primarily on analyzing the drivers of opposition to carbon pricing policies as a dependent variable. We construct the outcome variable as a binary predictor that takes a value of 1 if respondents indicated that they somewhat oppose or strongly oppose carbon taxes, and a value of 0 if respondents answered that they somewhat support or strongly support the enactment of carbon taxes in their province as a way to reduce GHG emissions.

We use Ordinary Least Squares (OLS) to estimate linear probability models of the determinants of opposition to carbon taxes, as a function of political identities, the subjective perception of carbon pricing-related costs by respondents, proxies for the actual costs that carbon taxes impose on households, and a set of socio-economic controls. The baseline model is a regression of carbon opposition on socio-political identities. We then augment this sparse model with, in turn, explanatory variables that describe the perception that respondents have of costs, and then with predictors that capture the tangible costs associated with an increase in the price of carbon energy. Subsequently, we estimate a full model that includes all predictors, and we evaluate the performance of each model.

Then, we turn to analyzing the drivers of the perceived impact by taxpayers of carbon taxes on their household budgets in section 5.3. It is difficult for members of the public to accurately estimate the true cost of carbon pricing policies on their overall economic well-being. Often, there is an informational asymmetry between what policy-makers anticipate costs will be, as the result of careful and considered economic analysis, and what ordinary citizens expect the costs to be. Moreover, extant research suggests that politicians can, and often do, manipulate the way in which information on carbon taxes is presented. Therefore, we concentrate on the subjective perceptions that taxpayers have of the impact of carbon taxes on their household budget. Survey respondents were asked separately about their best guess of the impact of carbon pricing on their monthly household expenditures, including gasoline and diesel costs, heating costs, and the overall impact of carbon pricing on their energy bills. We estimate three linear models using OLS of the effect of partisanship and different proxies for material costs on, separately, perceived increases in monthly gasoline/diesel expenditures on the one hand, and perceived increases in monthly home energy bills.

Finally, we use machine learning techniques to investigate the performance of our explanatory variables in predicting support or opposition to carbon taxes in section 5.4. We use a decision (classification) tree to identify the conditions under which taxpayers are expected to support or oppose carbon pricing policies. Decision trees allow us to partition the feature space into various subgroups for analysis. In other words, they estimate the conditional average effect of predictors on the likelihood of support/opposition to carbon pricing. Decision trees are appropriate tools for analysis in cases where a large number of explanatory variables are likely to be predictive of the outcome variable in highly non-linear and complex ways. Given that the particular combination of factors that dictate whether an individual taxpayer supports or opposes carbon pricing is likely to have some idiosyncrasies, decision trees allow us to follow the particular sequence of variables that can predict an individual's attitude to carbon taxes.

It should be noted that the sample used to conduct the regression analysis consists of individuals from the more recent waves of the survey. Missing data in wave 7 was imputed with data from earlier waves in the survey for attributes that are time-invariant, such as the primary language spoken at home. When the variables capture responses that are likely to vary over time, such as average monthly electricity bills, the data imputation procedure only used observations from wave 6. Then, the analysis is run on a complete sample of wave 7: these are the respondents in wave 7 who have participated in all waves (1 through 7) starting in February 2019, and includes new participants who joined after (but stayed throughout). Thus, we treat the sample as essentially cross-sectional, and leave to further research the task of analyzing trends over time.

5 Findings

5.1 Identifying clusters of support or opposition to carbon taxes

The determinants of the attitudes of members of the public towards carbon taxes include the material impacts that the carbon taxes have on their households, but citizens' understanding of these impacts is mediated through a variety of socio-political and economic identities. The factors which lead to approval of carbon taxes thus exist and correlate in a multi-dimensional space. Systematic variation in approval/opposition to carbon taxes will exist along a multitude of dimensions, which complicates our goal of extracting meaningful information from the data collected in the survey.

Principal Components Analysis (PCA) is useful to provide a graphical "snapshot" of a multivariate phenomenon in two dimensions, because it is a transformation of the data in a lower dimensional space. The so-called "principal" components are those that explain the highest amount of variation in the data. Figure 1 below displays the bi-plot of the first two principal components (PC). Together, these two PCs explain 24% of the variance in the data. Observations are colored according to whether they correspond to respondents who support or oppose carbon taxes (our dependent variable). The PCA model was estimated using explanatory variables only, which means that the model was "blind" to the outcome.

Some key patterns are immediately apparent. First, the principal components are clearly able to discriminate between two clusters that correspond broadly to support of carbon pricing on the one hand, and opposition to carbon pricing on the other. This suggests that the multivariate distribution of the predictors of carbon pricing approval is different from the (other multivariate) distribution of the drivers of opposition to carbon pricing. In other words, we are likely to explain opposition to carbon taxes differently than support for them.

It should be noted that `support` and `oppose` are each coded as binary (0-1) variables, but they are not the inverse of each other. The points on the graph represent different survey respondents, with those indicating that they support or strongly support carbon taxes (i.e. `support=1`) represented in yellow, and the individuals who answered that they oppose or strongly oppose (i.e. `oppose=1`) carbon pricing policies in blue.

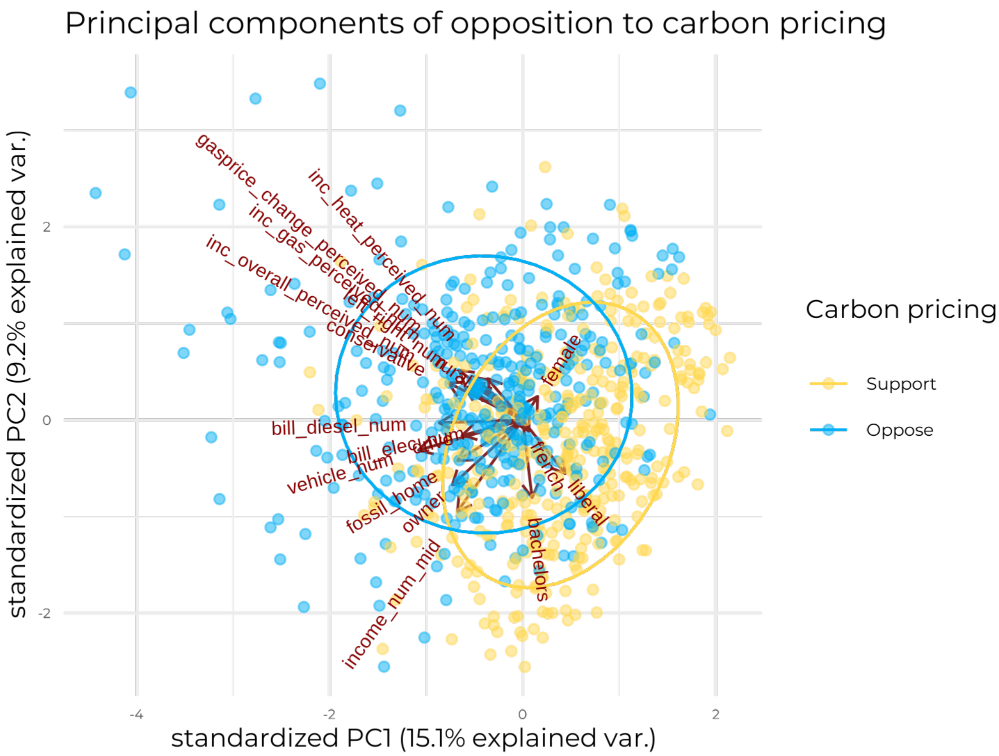

Figure 1: Projection of the data on the first 2 principal components. The data have been standardized to have a mean of 0 and variance of 1 before performing PCA.

The red arrows represent the loadings of each variable along the first and the second principal components, that is, how strongly a characteristic correlates with that PC. The yellow cluster contains most of the survey-takers that support carbon taxes, along the first PC. The variables that explain most of the variance in that direction correspond to characteristics of identity or demographics, such as `female`, `french`, `liberal`, and `bachelors` (all dummy variables), rather than to economic attributes. Support for carbon pricing can best be explained by a combination of gender, cultural, partisan, and educational identities.

By contrast, the variables that move along the same PC as opposition to carbon pricing are all related to costs, with the exception of the variable `conservative` (a dummy variable).

This interpretation coheres with research on the political economy of climate change which suggests that barriers to progress in reducing carbon emissions exist because the costs of climate mitigation can be highly visible and fall on a smaller group of stakeholders (e.g., the "Gilets Jaunes"), whereas the benefits of emissions abatement (e.g., a clean atmosphere) are more diffuse. Therefore, this paper analyzes the cost-side of the equation, and focuses mostly on the drivers that explain why survey respondents answered that they oppose carbon pricing.

Moreover, the angles of the vectors (red arrows) indicate how the variables correlate with each other (and with each PC). Vectors that move in diametrically opposite directions are negatively correlated with each other.[1] Dummy variables corresponding to `french` and `liberal` are strongly negatively correlated with factors that capture the perceptions of costs due to carbon pricing. Variables that include the label "`perceived`" indicate that the survey questions were specifically about respondents' subjective perceptions. For more information, please refer to the codebook in appendix A.

Unsurprisingly, liberals and conservatives move in opposite directions.[2] This suggests that citizens' opinions on carbon pricing are mediated through their ideological positions, and that each partisan identity on the left-right spectrum interacts differently with individuals' own socio-political and cultural identities, and their economic situations.

Finally, vectors that have a very small angle between them are strongly correlated with each other, while vectors that are close to a straight angle are not correlated (i.e., they are orthogonal to each other). We can distinguish two groups of variables that account for most of the variance in opposition to carbon pricing. On the one hand, there is a group of variables (those positively correlated with PC2 in figure 1) that captures *perceptions* of increased household costs as a result of carbon pricing policies; and the indicator variable for Conservatives is very close to that group. In fact, this vector is difficult to tell apart from the variable that captures participants' best guess for how much more they thought their household paid (in dollars) as a result of a carbon pricing policy in their province. This suggests that the perception of increased economic costs due to carbon pricing is strongly

[1]For example, the gender pay gap in Canada is illustrated on figure 1 by the vectors `female` and `income_num_mid`–an indicator variable corresponding to identifying as female, and the numerical mid-point of various household income brackets, respectively–pointing close to diagonally to each other, suggesting that these variables are strongly inversely correlated.

[2]Again, it should be noted that these variables are not the same. The survey measured the party preference of respondents among the major Canadian parties, which also includes the Green Party, the Bloc Québécois, the People's Party, and the NDP. Therefore, zero for the `liberal` (`conservative`) variable corresponds to indicating a party preference for Conservatives (Liberals) *or any of the other parties* (or no preference at all).

associated with being a Conservative.

On the other hand, there appears to be a separate and unrelated group of variables (those negatively correlated with PC2) that correspond to *material* costs commonly associated with carbon pricing policies. Carbon taxes seek to reduce GHG emissions by increasing the marginal cost of emitting carbon pollution, and thus are designed to make activities that are carbon-intensive more expensive, such as driving a car with a diesel or gasoline engine, or using fossil fuels as the primary source of energy to heat a home. This group of variables includes respondents' monthly dollar expenditures in gasoline or diesel (`bill_diesel_num`), their average monthly electric bill (`bill_elec_num`), the number of vehicles that they own (`vehicle_num`), whether they own their home (`owner`), and whether the main energy source for heating, hot water, and cooking in their home is a fossil fuel (`fossil_home`).

The partisan identities (for both Conservatives and Liberals) appear to have little correlation with economic conditions over which individuals have less of a choice, such as their annual income. Indeed, it seems plausible that the distribution of annual income would be roughly the same for Conservatives as for Liberals. However, partisan identities and the *perceived* costs of carbon pricing move along the same axis in a low-dimensional representation of the feature space that explains the most amount of systematic variation in the survey data. While Conservative ideologies move in the same direction as the perception that carbon pricing increases costs, Liberal political identities do the opposite. The fact that distinct clusters appear for support and opposition to carbon pricing indicates that this representation of the feature space (i.e., how these factors relate to the outcome, and each other) will explain the variation in attitudes towards carbon pricing. In sum, it appears that what survey respondents perceive as the costs of carbon pricing are not the same as the actual costs occasioned by such policies; and that this misunderstanding of the true costs is related to political ideology. We now turn to modeling how the perceived versus actual costs of carbon pricing shape preferences for carbon taxes.

5.2 Modeling attitudes towards carbon pricing as a function of perceived and actual costs

We first estimate a baseline model ($\mathcal{M}_{1a}$) of the determinants of opposition to carbon pricing, where we conceptualize the dependent variable *oppose* as a dummy variable which takes a variable of 1 if respondents answered that they "somewhat oppose" or "strongly oppose" carbon taxes; and 0 if they answer that they "somewhat support", "strongly support", or if they are "not sure" about carbon taxes. We estimate a sparse model that contains socio-economic characteristics (education level and annual household income) and variables on partisanship. The baseline model also contains a dummy for whether participants live in a rural area or not. As such, the baseline model captures to some extent the way that the various identities of survey participants–social, cultural, economic, and political–impact their opinions on carbon pricing policies.

We estimate a linear probability model (LPM) using Ordinary Least Squares (OLS), which allows us to directly interpret coefficient estimates as average marginal effects. For comparison, we also provide results for a LPM model ($\mathcal{M}_{1b}$) which uses support for carbon taxes as the outcome variable. The baseline model of opposition (support) to carbon pricing as a function of economic and social identities includes a dummy for whether the respondent indicates a Conservative (Liberal) Party preference. Regression results are presented in table 1.

In both models, partisan preferences and political identities are highly statistically significant. Compared to other parties, voting Conservative is associated with an increase of 35 percentage points in the probability of opposing carbon pricing ($p < 0.01$), holding education, income, and geography constant. A similar effect is at play for Liberal Party voters and the probability that they support carbon taxes (an increase of 26 percentage points ($p < 0.01$), *ceteris paribus*). We find that rural Conservatives in Canada who register the highest on the left-right ideological spectrum (i.e., they are as conservative as can be), who have less than a high school education, and earn less than $20,000 a year have an approximately 86% chance of opposing carbon taxes.[3]

The coefficient on the dummy variable indicating whether a respondent lives in a rural area[4] is signed according to expectations in both the model for opposition and the model for support of carbon pricing, and is significant at the 1% level. One potential explanation for this coefficient is that living in a rural or remote area would increase the need to drive–and the potential to suffer adverse effects due to increased carbon prices–and so might lead to an increase (decrease) in carbon tax opposition (support), holding the other factors constant.

The models also suggest that there might be some interesting heterogeneous treatment effects of the role of education on public attitudes towards carbon pricing, but that those heterogeneous treatment effects reveal different dynamics according to whether we are seeking to explain opposition or support for carbon taxes. This further reinforces our impression

[3] To see this, compute $\hat{\pi}_i[opposition = 1] = \hat{\beta}_0 + \hat{\beta}_1 \cdot education_i + \hat{\beta}_2 \cdot income_i + \hat{\beta}_3 \cdot rural_i + \hat{\beta}_4 \cdot left\_right_i + \hat{\beta}_5 \cdot conservative_i = 0.04 + \hat{\beta}_1 \times 0 + \hat{\beta}_2 \times 0 + 0.092 \times 1 + 0.37 \times 1 + 0.353 \times 1 = 0.855$.

[4] The dummy on rurality also includes small towns and remote areas; compared to respondents who indicated that they lived in small or large cities, or in suburbs adjacent to a large city.

Table 1: Determinants of support for or opposition to carbon pricing

	Oppose (dummy)	**Support (dummy)**
	$\mathcal{M}_{1a}$	$\mathcal{M}_{1b}$
Education: High school	0.128*	0.003
	(0.076)	(0.078)
Education: Some college	0.090	0.064
	(0.073)	(0.075)
Education: College	0.010	0.165**
	(0.075)	(0.077)
Education: Graduate or prof. degree	−0.075	0.229***
	(0.079)	(0.082)
Income: $20,000-$40,000	0.077	−0.008
	(0.050)	(0.052)
Income: $40,000-$60,000	0.088*	0.015
	(0.050)	(0.052)
Income: $60,000-$80,000	0.046	−0.010
	(0.051)	(0.053)
Income: $80,000-$100,000	0.032	−0.010
	(0.050)	(0.051)
Income: $100,000 and over	0.079*	−0.025
	(0.048)	(0.049)
Rural (dummy)	0.092***	−0.084***
	(0.026)	(0.027)
Left-right: 0-1 (1 is far right)	0.370***	−0.485***
	(0.055)	(0.054)
Conservative (dummy)	0.353***	
	(0.025)	
Liberal (dummy)		0.262***
		(0.028)
Constant	0.040	0.558***
	(0.081)	(0.084)
N	1666	1666
Adj. R-squared	0.205	0.145
AIC	2046.131	2156.451

***p < .01; **p < .05; *p < .1
Standard errors are reported in parentheses. The reference levels for the categorical variables are: Education: less than high school, Income: Less than $20,000. The sample consists of respondents who have provided an answer for all survey waves (1 to 7). The linear probability models are estimated with OLS.

obtained from the PCA analysis that the samples for opposition and support of carbon pricing have distinct multivariate distributions in terms of the factors that shape preferences for carbon taxes, and supports the methodological approach of studying these phenomena separately. The reference level for the categorical variable on education is "less than high school". In model $\mathcal{M}_{1b}$, the coefficient estimate for those with graduate degrees (compared to those with less education) suggests that highly educated people tend to support carbon taxes as climate policy instruments. This would cohere with a notion that knowledge and information increase citizens' understanding of the scientific consensus on climate change, and the concomitant need for stringent mitigation policies. This conjecture is supported by the fact that the highest education level "graduate degree" has a negative parameter estimate (though statistically insignificant) in the model for opposition, while high school graduates[5] tend to voice greater opposition (*ceteris paribus*) to carbon taxes. The marginal effects need to be interpreted with care, and we leave other researchers to examine the role of education on preferences for taxation.

However, the baseline models presented in table 1 have a low R-squared and little explanatory power. As such, they are sparse models that need to be augmented with additional predictors, a task that we now turn to. We seek to investigate how material self-interest and ideological positions shape attitudes towards carbon taxes. We thus estimate three additional models that include: respondents' subjective perceptions of the costs of carbon pricing ($\mathcal{M}_2$), a set of proxies for the tangible costs that carbon pricing imposes on households ($\mathcal{M}_3$), and a full model ($\mathcal{M}_4$).[6] In all cases, the dependent variable is the dummy for opposition to carbon taxes; and we reproduce the baseline model $\mathcal{M}_{1a}$ in the first column of table 2.

The model with perceived costs ($\mathcal{M}_2$) includes two categorical variables for the subjective perceptions of how much respondents believed that carbon taxes increased their monthly household expenditures on heating their homes and on their monthly costs for gasoline/diesel. We also include two continuous variables for the perceived increase in overall costs due to carbon pricing (respondents were asked to provide their best guess for the dollar amount by which the carbon pricing policy in their province had increased their overall energy budget); and the perception of increased gas prices in general. These variables are for the most part highly statistically significant. The coefficients on perceived gas prices, and on perceived increases in gas expenditures as a direct result of carbon pricing, suggest that these perceived costs increase the likelihood that the public will oppose carbon pricing. However, we cannot

[5] Compared to more educated people *and* those who did not graduate high school.

[6] Various specifications for the models of perceived costs and actual costs were investigated, and the final specifications for models $\mathcal{M}_2$ and $\mathcal{M}_3$ were chosen using goodness-of-fit measures such as adjusted R-squared and, where appropriate, Aikake's Information Criterion.

disentangle dynamic effects over time, and we cannot know if an increase in the price of gasoline/diesel is the result of a carbon tax, or if it is a secular trend. The exogenous effect of increases in gas prices on opposition to carbon taxes is a topic for further research.

Model $\mathcal{M}_3$ contains a set of proxies designed to capture the material exposure that households have in terms of costs imposed by carbon pricing policies that are designed to make the consumption of fossil fuels more expensive. We include predictors that are likely to increase a household's carbon costs through two main channels: transit and residence. Carbon taxes are likely to make the cost of gasoline–and thus of carbon-powered transportation–more expensive. Proxies for a pricing policy-related increase in transit costs include the number of vehicles owned, the number of kilometers driven per year, and whether a respondent drives to work. We also include an interaction term between those last terms. Of those, only the coefficients on the interaction and the number of vehicles owned are positive and statistically significant. One additional vehicle in a household's fleet is associated with a 10 percentage point increase in the likelihood of opposing carbon pricing ($p < 0.05$), holding everything else constant.[7]

Carbon cost exposure measures related to residence include whether a respondent owns their home, the size of their home, and dummies for whether the main energy source for heating, water, and cooking is derived from fossil fuels. Of those, the indicator variable for whether the main source of heating for the home is carbon-based is substantively and statistically significant. Compared to respondents who do *not* use diesel, heating oil, natural gas, propane or butane to heat their homes, the respondents who used these carbon-intensive fuel sources to heat their spaces were 17 percentage points more likely to oppose carbon taxes ($p < 0.01$), holding the other variables in the model fixed. By contrast, the fossil fuel dummies on the primary energy source for hot water heating and the stove were statistically insignificant. This is plausible because the cost of heating a home is typically a greater share of a household's budget for energy bills compared to hot water and cooking costs.

Finally, we combine proxies for perceived costs and actual costs and estimate the full model reported in $\mathcal{M}_4$. In all models, the dummy variables for being a Conservative and living in a rural area, which are positively associated with an increased probability of opposing carbon taxes, retain their substantive and statistical significance. Further work is needed to evaluate the marginal conditional effects of Conservative partisan identity and of rural identity by, e.g., adding interaction terms to the model. All the (significant) parameter estimates in the

[7]Note: the coefficient estimate on yearly kilometers needs to be transformed to make interpretation easier, for example by multiplying kilometers driven by 1,000 and evaluating the marginal effect of an additional 1,000 km driven per year.

perceived costs model ($\mathcal{M}_2$) remain statistically significant in the full model, and all increase in substantive magnitude.[8] In other words, when we condition on tangible material factors that would increase households' costs as a result of a carbon tax, the impact of perceptions and subjective understandings of costs on the general public's opposition towards green taxes increase. Therefore, this suggests that perceived price changes better explain carbon tax opposition than do actual changes in the price of gasoline and other fuels.

The explanatory power of the fully augmented model $\mathcal{M}_4$ compared to the baseline model and the individual models of cost drivers is greater, as indicated by the higher adjusted R-squared value. To confirm the superior model performance of model $\mathcal{M}_4$, we conduct F-tests for nested models.[9] These F-tests evaluate whether the more complex model $\mathcal{M}_4$ can be reduced to the sparser forms of models $\mathcal{M}_{1a}$, $\mathcal{M}_2$, or $\mathcal{M}_3$ without sacrificing explanatory power. The goal is to find the smallest possible model that explains the most amount of variability in the sample. Essentially, we test the null hypotheses that the vectors of parameters $\boldsymbol{\kappa}$ and $\boldsymbol{\lambda}$ in the full model $\mathcal{M}_4 : opposition_i \in \{0,1\} = \beta_0 + \sum_j \gamma_j \cdot partisan_i + \sum_k \kappa_k \cdot perceived\_costs_i + \sum_l \lambda_l \cdot actual\_costs_i + \epsilon_i$ are equal to 0. In both cases, we reject the null hypothesis and conclude that the better model of opposition to carbon pricing includes sets of variables related to both perceived and actual costs. Nevertheless, it should be noted that a model of opposition to carbon pricing as a sole function of partisanship and costs only explains a small proportion of the variance in the sample ($R^2 = 0.312$), and that other factors–such as whether politicians use communication campaigns to deliberately misinform taxpayers of the costs of a carbon policy (Mildenberger et al., 2022)–are likely to be needed to provide a full account of the political economy of carbon pricing policies.

[8]Except for the estimated coefficient on the Conservative dummy, where the marginal average effect of Conservative partisan identity decreases slightly.

[9]The use of F-tests for variable selection is only meaningful if the models are estimated on the same sample of observations. Therefore, we subset the sample to complete cases for all the variables contained in model $\mathcal{M}_4$, and refit the sparser models to the data before conducting the F-test.

Table 2: Determinants of opposition to carbon pricing as a function of costs

	Dependent variable: oppose carbon pricing (dummy)			
	Baseline ($\mathcal{M}_{1a}$)	**Perceived costs ($\mathcal{M}_2$)**	**Actual costs ($\mathcal{M}_3$)**	**Full model ($\mathcal{M}_4$)**
Education: High school	0.128* (0.076)	0.165 (0.115)	0.105 (0.311)	0.475 (0.442)
Education: Some college	0.090 (0.073)	0.149 (0.109)	−0.025 (0.306)	0.404 (0.438)
Education: College	0.010 (0.075)	0.086 (0.112)	−0.012 (0.309)	0.414 (0.441)
Education: Graduate	−0.075 (0.079)	0.016 (0.118)	−0.157 (0.313)	0.323 (0.443)
Income: $20,000-$40,000	0.077 (0.050)	−0.005 (0.086)	0.472 (0.434)	
Income: $40,000-$60,000	0.088* (0.050)	0.003 (0.087)	0.642 (0.430)	0.173 (0.179)
Income: $60,000-$80,000	0.046 (0.051)	−0.056 (0.088)	0.391 (0.425)	0.014 (0.170)
Income: $80,000-$100,000	0.032 (0.050)	−0.060 (0.087)	0.402 (0.422)	−0.028 (0.153)
Income: $100,000 and over	0.079* (0.048)	−0.042 (0.083)	0.470 (0.421)	0.034 (0.147)
Rural (dummy)	0.092*** (0.026)	0.112*** (0.038)	0.139** (0.062)	0.161** (0.069)
Left-right: 0-1 (1 is far right)	0.370*** (0.055)	0.294*** (0.081)	0.174 (0.140)	0.218 (0.159)
Conservative (dummy)	0.353*** (0.025)	0.364*** (0.040)	0.373*** (0.066)	0.311*** (0.077)
Perceived inc. heating: $1-$50 per month		−0.123* (0.072)		−0.455* (0.239)
Perceived inc. heating: $50-$99 per month		−0.097 (0.080)		−0.253 (0.250)
Perceived inc. heating: $100 or more per month		−0.134* (0.071)		−0.463* (0.238)
Perceived inc. gas: $1-$50 per month		0.099* (0.057)		0.533*** (0.181)
Perceived inc. gas: $50-$99 per month		0.112* (0.066)		0.474** (0.193)
Perceived inc. gas: $100 or more per month		0.142** (0.066)		0.672*** (0.195)
Perceived increase in overall costs (due to tax)		0.00001 (0.00001)		−0.00000 (0.00001)
Perceived increase in gas prices (cents/liter)		0.006*** (0.001)		0.007** (0.003)
Home owner (dummy)			−0.034 (0.100)	0.038 (0.113)
Home size (square ft.)			0.00000** (0.00000)	0.00000 (0.00001)
Home heating is fossil fuels (dummy)			0.172** (0.079)	0.200** (0.099)
Water heating is fossil fuels (dummy)			0.046 (0.075)	−0.029 (0.093)
Fossil fuel stove (dummy)			−0.010 (0.084)	0.008 (0.098)
Monthly electricity bill			−0.0004 (0.0003)	−0.0004 (0.0003)
Monthly gasoline/diesel bill			−0.0001 (0.0001)	−0.0001 (0.0001)
Drives to work (dummy)			−0.006 (0.094)	0.018 (0.116)
Number of vehicles owned			0.100** (0.041)	0.075 (0.048)
Yearly kilometers driven			−0.00000 (0.00000)	−0.00000 (0.00000)
Home size * fossil home			−0.00000 (0.00001)	−0.00001 (0.00002)
Drives to work * Yearly kilometers driven			0.00001* (0.00000)	0.00001 (0.00000)
N	1666	732	240	193
Adj. R-squared	0.205	0.227	0.304	0.312

5.3 Disaggregating perceptions of the costs of carbon taxes

Our results suggest that the perceptions of the costs of carbon pricing policies on households' budgets are better able to explain patterns of opposition to carbon taxes than actual changes in the price of gasoline and other fuels. We find that partisanship, in particular Conservative political identification, is highly predictive of opposition to carbon pricing policies, even after controlling for energy costs. Therefore, it seems that the variation in the general public's attitudes to carbon taxes is mediated through their subjective understanding of their own political identities and economic conditions.

Consequently, we now turn to briefly examining the determinants of the subjective perceptions of carbon tax-related costs. Survey respondents were asked to provide their best guess of the dollar amount that they expected to pay per month as a direct result of the carbon pricing policies in their province. Respondents were questioned about their subjective estimations of the impact of carbon taxes on their monthly expenditures for heating costs separately from their monthly expenditures on gasoline and diesel, in addition to their perceptions of the impact of carbon taxes on their overall energy costs. This allows us to examine two probable channels through which carbon pricing policies increase taxpayers' energy costs–transit and residence–by making it more expensive to consume carbon-intensive fuels needed for transportation, and those which are used to maintain and heat a home. We present the regression results in table 3.

In the first model, we regress respondents' perceptions of the costs of gasoline due to carbon pricing on the number of vehicles they own, whether they have to drive to work, how far they have to drive, and whether they have less public transport options available to them as a result of living in a rural area. We also include measures of their monthly gas bills, and their belief about the evolution of gas prices in general. In the second column of table 3, we provide the results of a regression of subjective beliefs about heating costs due to carbon taxes on a combination of variables that capture home ownership, primary heating source, heating requirements, in addition to a measure of monthly electricity bills.

In all cases, we control for knowledge by including a categorical measure of how familiar respondents are with their own household's bills; and we control for income, rurality, and Conservative identity. We find that respondents estimate relatively accurately the impact that carbon taxes have on their heating costs. The only statistically significant variables in this regression are home size and monthly energy bills–and both are associated with an increase in the perceptions of carbon policy-related costs for heating, as expected. Partisan identity does not factor significantly in perceptions of heating costs.

By contrast, we find that changes in the perception of gasoline costs (due to carbon pricing) are not well explained by secular changes in gas prices (in cents per liter) or transportation-related needs. Instead, the respondents' subjective understanding of gasoline and diesel costs are mediated by their partisan preferences. We find that Conservative voters overestimate the impact of carbon pricing on their household's gasoline/diesel expenditures by an additional \$402 dollars *per month* compared to voters from other parties, everything else constant ($p < 0.01$).

Table 3: Determinants of the perceptions of the costs of carbon pricing

	Perceptions of costs due to carbon pricing		
	Gasoline costs	**Heating costs**	**Overall costs**
Conservative (dummy)	402.432***	10.011	−193.834
	(121.155)	(20.532)	(602.632)
Rural (dummy)	−54.188		165.108
	(87.007)		(599.883)
Household income	−0.0001	−0.0003	−0.005
	(0.001)	(0.0002)	(0.005)
Household bills: Somewhat familiar	−243.430	26.796	2460.478
	(196.767)	(67.093)	(2093.208)
Household bills: Very familiar	−258.655	26.196	1344.216
	(190.007)	(63.950)	(2050.985)
Number of vehicles owned	−13.850		326.494
	(53.494)		(403.353)
Drives to work (dummy)	100.159		−264.412
	(79.995)		(572.720)
Yearly kilometers driven	0.004		0.011
	(0.003)		(0.021)
Monthly gasoline/diesel bill	0.699***		0.521
	(0.113)		(0.709)
Perceived inc. in gas prices (cents/liter)	5.476		5.902
	(3.396)		(24.066)
Conservative * Monthly diesel bill	−0.560**		
	(0.225)		
Home owner (dummy)		−9.645	−2254.570**
		(25.133)	(984.369)
Home size (square ft.)		0.0002***	−0.011
		(0.00004)	(0.065)
Home heating is fossil fuels (dummy)		−12.075	−714.903
		(20.171)	(639.170)
Monthly electricity bill		0.389***	3.673
		(0.097)	(2.948)
Constant	60.014	67.681	968.710
	(235.250)	(64.562)	(2326.335)
N	330	357	210
Adj. R-squared	0.134	0.092	0.031

***p < .01; **p < .05; *p < .1
Standard errors are reported in parentheses. The dependent variables are continuous. The reference level for the categorical variable is: Household bills: Not familiar. The sample consists of respondents who have provided an answer for all survey waves (1 to 7). The models are estimated using OLS.

Therefore, this suggests that the effect of perceived costs in shaping opposition to carbon pricing is driven largely by gasoline and diesel costs as opposed to heating costs. One conjecture is that gasoline costs are more salient for the general public compared to heating costs, since gas prices/costs are the object of significant contestation in the public arena and that the "gas price at the pump" is used as a lightning rod for incumbent politicians. As such, gas prices are often mistakenly seen by voters as something that politicians can directly and immediately control. Understood in this light, the importance of partisan identity in predicting subjective beliefs about carbon tax-related gasoline costs is also likely to mobilize and shape opposition towards carbon taxes.

In sum, if subjective perceptions of the cost of carbon pricing do a better job of explaining opposition towards carbon taxes, and if the variation in these perceived costs is largely explained by changes in political positions, in particular for gasoline costs, this suggests that opposition to carbon pricing policies is often rooted in ideology, and that resistance against a "carbon tax" is often hostility towards a "gas tax".

5.4 Predicting opposition to carbon taxes

Our analysis has suggested that partisanship and the subjective beliefs about the perceived costs of carbon pricing policies are strong predictors of the public's attitudes towards carbon taxes. In particular, Conservative political identities and the perception of gasoline costs are factors that mobilize strong opposition towards carbon pricing policies.

To evaluate the robustness of these results, we now use supervised machine learning techniques to ascertain whether these variables are able to discriminate between support and opposition to carbon taxes. The Principal Components Analysis that was presented in section 5.1 showed that the sample of opponents of carbon taxes was clearly separate from the sample of supporters of carbon taxes in a two-dimensional representation of the multivariate determinants of public opinion on carbon pricing.

However, the PCA algorithm was "unsupervised", that is, it estimated the principal components without having access to the "class labels" indicating whether a respondent supported or opposed carbon pricing. In other words, it was "blind" to the outcome. Therefore, the graphical analysis of the principal components in order to identify clusters and relevant dimensions of analysis is open to interpretation. We validate the findings of the PCA analysis and the linear regression models by using a decision (classification) tree to evaluate the predictive performance of the variables that were identified as crucial in shaping mobilization for and against carbon pricing policies, notably: partisanship, subjective perceptions of carbon costs, and gasoline (as opposed to heating) costs of energy.

We use decision (classification) trees to partition the feature space into a set of sub-groups that provide the conditions under which a survey respondent is predicted to support or oppose carbon taxes. Decision trees will create "splits" in the data sequentially, by using the most important explanatory variable first. A decision tree model is thus a sequence of variables that are used to split the data sample into either another branch or into a "leaf", i.e., a terminal node that groups the same predictions together. The "best" tree for any given size (number of leaves) is the one that minimizes the misclassification error rate.

Figure 2 displays the "best" tree of size 10 estimated on the sample of our survey respondents. The results of this algorithm support our argument that Conservative partisanship is one of the top determinants of opposition to carbon taxes, even after controlling for other factors. Moreover, the second-most important variables used to split the data are perceptions of the overall energy costs of carbon pricing, and the dummy variable for rurality, which we identified earlier as a substantively important explanatory variable to explain carbon tax opposition, and which remained statistically significant across the regression specifications. Finally, the perception of gasoline costs is also identified by the decision tree as a top variable on which to split the sample, in line with the interpretation that we offer in section 5.3.

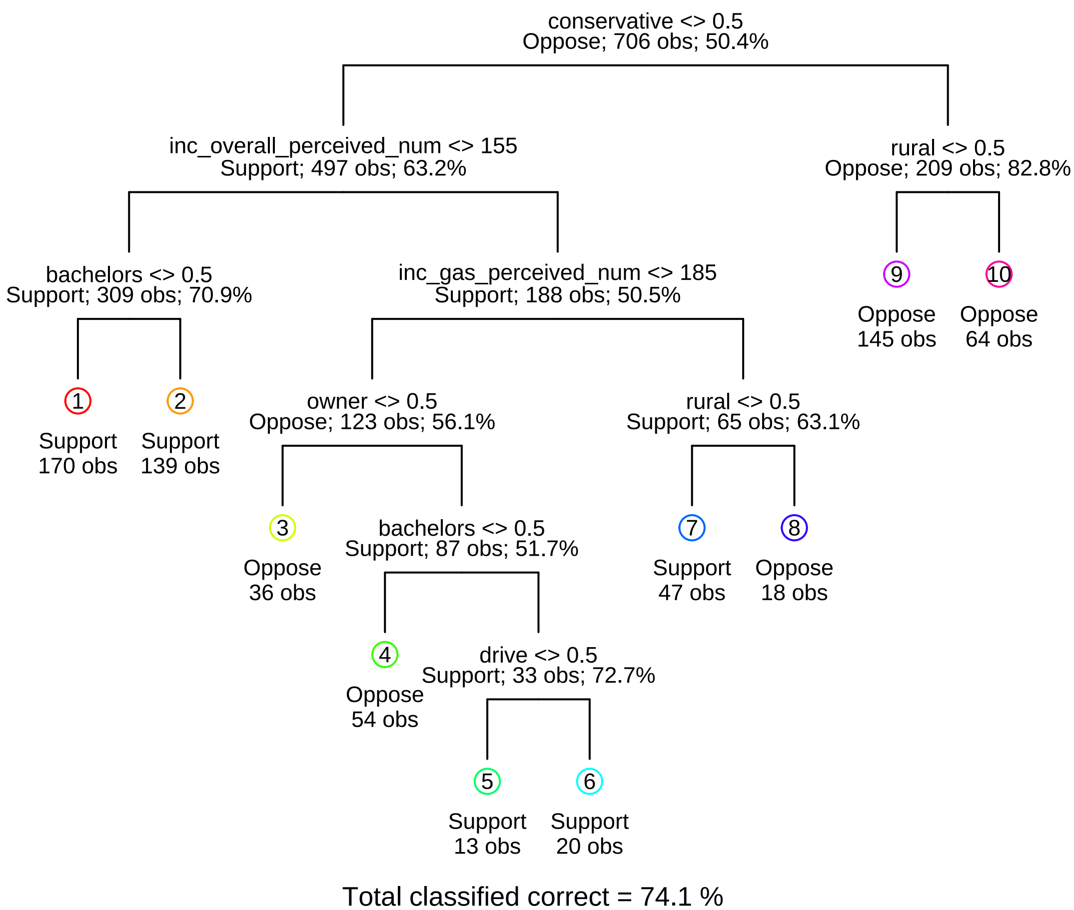

Figure 2: Decision tree with 10 leaves used to classify observations into those who oppose and those who support carbon taxes. The tree was grown using a "greedy" approach where a large tree was grown, and then pruned using cross-validation to return the tree of size 10 that minimizes the out-of-bag error rate.

Decision trees are algorithms that are low-bias but high-variance. Given that they are highly flexible models, they tend to accurately predict the outcome on the sample on which they are trained (low bias). The trade-off is that the predictive performance of decision trees on new (unseen) test data will tend to be worse. That is, a small change in the data sample might lead to large changes in the predicted outcome (high variance). To counter this problem, the random forest algorithm trains a large number of decision trees, randomly shuffling the predictors which are used to train the model, and returns the model (i.e., tree) that yields the best predictive performance (Breiman, 2001). However, Mullainathan and Spiess (2017) point out that the consistency of model parameters is often a problem with these techniques.

To further assess the robustness of the Conservative variable in predicting opposition to carbon pricing, we grow a random forest of 1,000 trees, and each time identify the variable that was used to make the first split. The top panel of figure 3 represents the variable importance plot for this random forest model. Remarkably, the candidate variable for the first split that led to the best predictions was Conservative political identity, followed by the subjective perceptions of the overall increase in energy costs due to carbon pricing policies, and then by the monthly expenditures on gasoline/diesel costs. Once again, the dummy variable for rurality appears as an important predictor of opposition to carbon taxes.

For comparison purposes, we also provide the variable importance plot for a random forest model predicting the support for carbon taxes in the bottom panel of figure 3. Even though the main argument of this paper focused on the determinants of opposition to carbon pricing, the key finding of this study that partisan identity is highly determinative of carbon pricing attitudes appears to hold for supportive views of carbon taxes too. As the results in figure 1 and table 1 suggested earlier, a dummy variable for Liberal identity is also a key determinant of public support for carbon pricing policies.

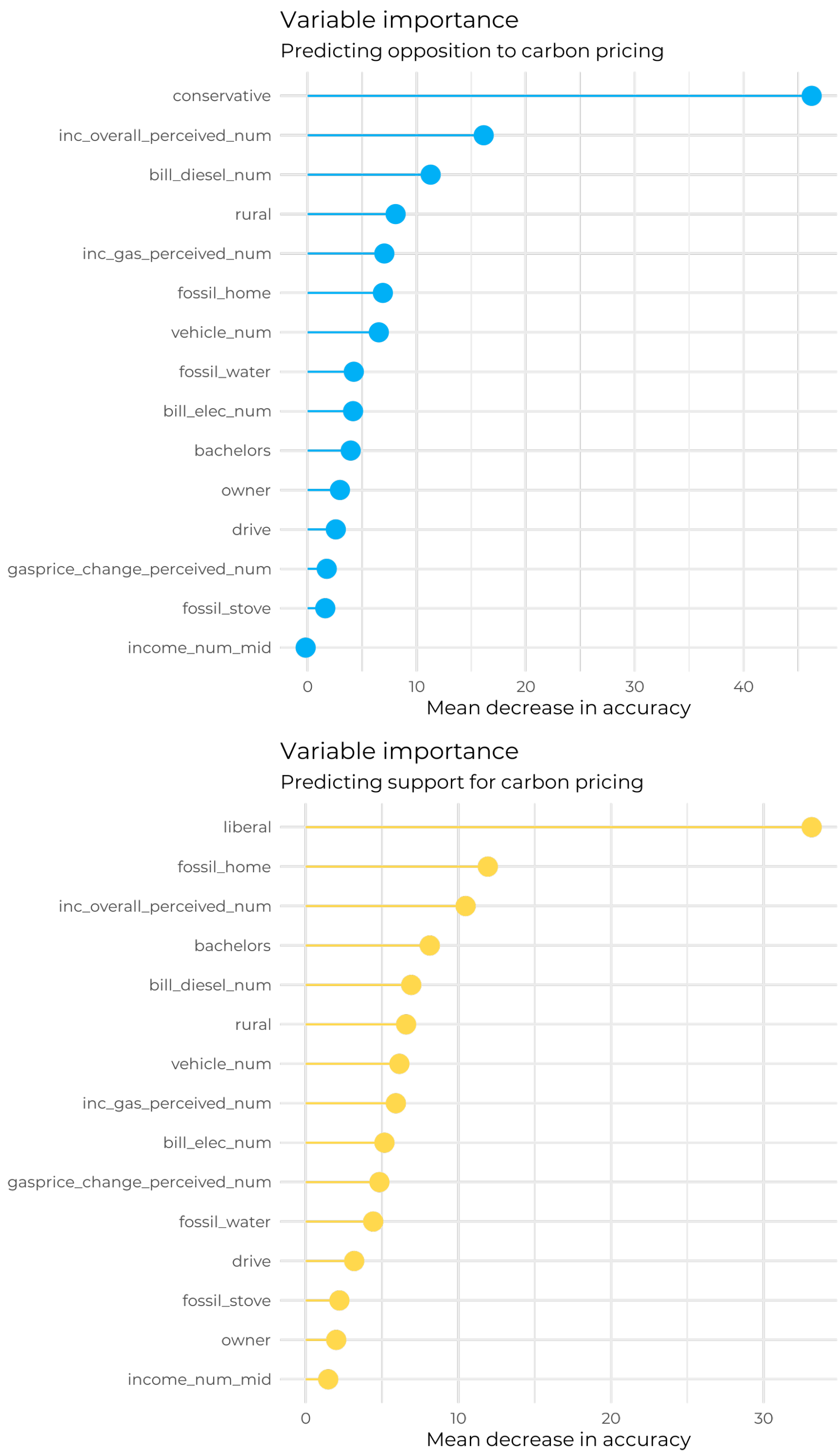

Figure 3: Variable importance plots for two random forest models that predict opposition (top panel) and support (bottom panel) for carbon pricing policies.

6 Discussion

This paper analyzes whether the basis for opposition to carbon pricing policies is rooted in material self-interest or in ideological positions. Carbon pricing policies are designed to abate GHG emissions by making the consumption of fossil fuels more expensive. Resistance to carbon taxes can then be seen as a rational response by taxpayers who seek to protect their own material self-interests. Yet, a persistent empirical puzzle in the political economy of climate change in industrialized countries is that mobilization against carbon taxes persists despite purportedly revenue-neutral carbon pricing instruments that are designed to rebate the carbon fee back to households.

We leverage a unique survey of Canadian respondents to empirically investigate the drivers of public attitudes towards carbon pricing as a function of partisan identities, subjective perceptions of the energy costs that result from carbon pricing policies, and material cost drivers such as monthly bills, transportation needs, and energy consumption requirements to maintain a home. First, we use Principal Components Analysis to discriminate between clusters corresponding to support or opposition to carbon pricing, and to identify the key axes of systematic variation in the data. Then, we estimate a series of linear probability models that estimate the impact of political ideologies, perceived costs, and actual costs of carbon pricing on opposition to carbon taxes. We find that a Conservative political identity is a substantively important determinant of opposition to carbon pricing, and remains robust to the inclusion of cost drivers to the regression model. Voting for Conservatives, compared to other parties, is associated with a 31-percentage point increase in the probability of opposing carbon pricing, holding income, education, geography, and carbon costs constant. Moreover, living in a rural area increases the likelihood of disapproving of carbon taxes, *ceteris paribus*. Our results also suggest that the number of vehicles owned by a household, in addition to whether the main source of energy for heating a home is derived from fossil fuels, are associated with increased opposition to carbon taxes.

A key result of our study is that it is the perceptions of the energy costs due to carbon taxes, rather than changes in the actual costs of energy, that explain opposition to carbon pricing. Moreover, partisan positions shape the ways in which respondents form their beliefs about the costs of carbon pricing policies. The paper then turns to analyzing the drivers of the subjective perceptions of carbon costs and asks whether these patterns differ for heating compared to gasoline costs. We find that perceptions of the additional heating costs as a result of carbon pricing policies are a function of more objective measures compared to beliefs about gasoline costs. In particular, we find that Conservatives overestimate the impact of carbon pricing on their monthly gasoline expenditures by $402, relative to voters from other parties. We use supervised machine learning techniques to validate the robustness of our interpretations, and demonstrate that Conservative party preferences and perceptions of energy costs are highly predictive of opposition to carbon taxes.

Our results suggest that variation in the general public's attitudes towards carbon pricing is mediated through their subjective understandings of their own political identities and economic circumstances. Variation in these cost perceptions is largely explained by changes in political positions, especially for gasoline costs, which suggests that mobilization against carbon pricing policies is often rooted in ideology, and that resistance to carbon taxes can manifest as ideologically-driven hostility to gas taxes. This paper therefore provides a suggestive explanation for why carbon-and-dividend schemes have continued to be the focus of intense political contestation, despite the promise that they hold of ameliorating the politics around the enactment of climate mitigation policies.

References

Algan, Y., Beasley, E., Cohen, D., Foucault, M., Péron, M., et al. (2019). Qui sont les gilets jaunes et leurs soutiens? *Observatoire du Bien-être du CEPREMAP et CEVIPOF*, *3*, 1–13.

Athey, S., & Imbens, G. (2016). Recursive partitioning for heterogeneous causal effects. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(27), 7353–7360. https://doi.org/10.1073/pnas.1510489113

Baker III, J. A., Feldstein, M., Halstead, T., Mankiw, N. G., Paulson Jr, H. M., Shultz, G. P., Stephenson, T., & Walton, R. (2017). The conservative case for carbon dividends. *Climate Leadership Council*, 1–2.

Baranzini, A., & Carattini, S. (2017). Effectiveness, earmarking and labeling: Testing the acceptability of carbon taxes with survey data. *Environmental Economics and Policy Studies*, *19*(1), 197–227.

Baranzini, A., Van den Bergh, J. C., Carattini, S., Howarth, R. B., Padilla, E., & Roca, J. (2017). Carbon pricing in climate policy: Seven reasons, complementary instruments, and political economy considerations. *Wiley Interdisciplinary Reviews: Climate Change*, *8*(4), e462.

Beiser-McGrath, L. F., & Bernauer, T. (2019). Could revenue recycling make effective carbon taxation politically feasible? *Science advances*, *5*(9), eaax3323.

Boyer, P. C., Delemotte, T., Gauthier, G., Rollet, V., & Schmutz, B. (2020). Les déterminants de la mobilisation des gilets jaunes. *Revue économique*, *71*(1), 109–138.

Brannlund, R., & Persson, L. (2012). To tax, or not to tax: Preferences for climate policy attributes. *Climate Policy*, *12*(6), 704–721.

Breiman, L. (2001). Statistical Modeling: The Two Cultures. *Statistical Science*, *16*(3), 199–215.

Carattini, S., Baranzini, A., Thalmann, P., Varone, F., & Vöhringer, F. (2017). Green taxes in a post-paris world: Are millions of nays inevitable? *Environmental and Resource Economics*, *68*(1), 97–128.

Carattini, S., Carvalho, M., & Fankhauser, S. (2018). Overcoming public resistance to carbon taxes. *Wiley Interdisciplinary Reviews: Climate Change*, *9*(5), e531.

Carattini, S., Kallbekken, S., & Orlov, A. (2019). How to win public support for a global carbon tax.

Depraz, S. (2019). La géographie est-elle une science engagée? fracture (s) territoriale (s) et gilets jaunes. *Historiens et géographes*, (446), 25–29.

Dolšak, N., Adolph, C., & Prakash, A. (2020). Policy design and public support for carbon tax: Evidence from a 2018 us national online survey experiment. *Public Administration*, *98*(4), 905–921.

Dresner, S., Dunne, L., Clinch, P., & Beuermann, C. (2006). Social and political responses to ecological tax reform in europe: An introduction to the special issue. *Energy policy*, *34*(8), 895–904.

Dresner, S., Jackson, T., & Gilbert, N. (2006). History and social responses to environmental tax reform in the united kingdom. *Energy policy*, *34*(8), 930–939.

Drews, S., & Van den Bergh, J. C. (2016). What explains public support for climate policies? a review of empirical and experimental studies. *Climate Policy*, *16*(7), 855–876.

Grimmer, J., Roberts, M. E., & Stewart, B. M. (2021). Machine Learning for Social Science: An Agnostic Approach. *Annual Review of Political Science*, *24*, 395–419.

Hammar, H., & Jagers, S. C. (2006). Can trust in politicians explain individuals' support for climate policy? the case of co2 tax. *Climate Policy*, *5*(6), 613–625.

Hansen, J. E. (2015). Environment and development challenges: The imperative of a carbon fee and dividend.

Harrison, K., & Peet, C. (2012). Historical legacies and policy reform: Diverse regional reactions to british columbia's carbon tax. *BC Studies: The British Columbian Quarterly*, (173), 97–122.

Hsu, S.-L., Walters, J., & Purgas, A. (2008). Pollution tax heuristics: An empirical study of willingness to pay higher gasoline taxes. *Energy Policy*, *36*(9), 3612–3619.

Jagers, S. C., Lachapelle, E., Martinsson, J., & Matti, S. (2021). Bridging the ideological gap? how fairness perceptions mediate the effect of revenue recycling on public support for carbon taxes in the united states, canada and germany. *Review of Policy Research*, *38*(5), 529–554.

Kallbekken, S., Garcia, J. H., & Korneliussen, K. (2013). Determinants of public support for transport taxes. *Transportation Research Part A: Policy and Practice*, *58*, 67–78.

Kallbekken, S., & Sælen, H. (2011). Public acceptance for environmental taxes: Self-interest, environmental and distributional concerns. *Energy Policy*, *39*(5), 2966–2973.

Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R., & Stern, N. (2018). Making carbon pricing work for citizens. *Nature Climate Change*, *8*(8), 669–677.

Lobby, C. C. (2018). Carbon fee and dividend policy.

Lubell, M., Vedlitz, A., Zahran, S., & Alston, L. T. (2006). Collective action, environmental activism, and air quality policy. *Political Research Quarterly*, *59*(1), 149–160.

Mildenberger, M. (2020). *Carbon captured: How business and labor control climate politics*. MiT Press.

Mildenberger, M., Lachapelle, E., Harrison, K., & Stadelmann-Steffen, I. (2022). Limited impacts of carbon tax rebate programmes on public support for carbon pricing. *Nature climate change*, *12*(2), 141–147.

Mullainathan, S., & Spiess, J. (2017). Machine learning: An applied econometric approach. *Journal of Economic Perspectives*, *31*(2), 87–106. https://doi.org/10.1257/jep.31.2.87

Nowlin, M. C., Gupta, K., & Ripberger, J. T. (2020). Revenue use and public support for a carbon tax. *Environmental Research Letters*, *15*(8), 084032.

Rabe, B. G. (2018). *Can we price carbon?* MIT Press.

Sælen, H., & Kallbekken, S. (2011). A choice experiment on fuel taxation and earmarking in norway. *Ecological Economics*, *70*(11), 2181–2190.

Schuitema, G., Steg, L., & Forward, S. (2010). Explaining differences in acceptability before and acceptance after the implementation of a congestion charge in stockholm. *Transportation Research Part A: Policy and Practice*, *44*(2), 99–109.

Sénit, C.-A. (2012). The politics of carbon taxation in france: Preferences, institutions, and ideologies. *IDDRI SciencesPo, Paris*, *20*(10).

Thalmann, P. (2004). The public acceptance of green taxes: 2 million voters express their opinion. *Public Choice*, *119*(1), 179–217.

Appendices

A Codebook

variable	class	missing	factor_levels	group
bill_diesel_num	numeric	9969		bill.vars
bill_elec_num	numeric	10177		bill.vars
familiar_bills_3	categorical	10773	Not familiar, Somewhat familiar, Very familiar	bill.vars
bachelors	categorical	3088	0, 1	demographic.vars
edu_5	categorical	3088	College, Graduate or prof. degree, High school, Less than high school, Some college	demographic.vars
female	categorical	0	0, 1	demographic.vars
french	categorical	1008	0, 1	demographic.vars
fossil_home	categorical	0	0, 1	energy.vars
fossil_stove	categorical	0	0, 1	energy.vars
fossil_water	categorical	0	0, 1	energy.vars
home_size_num	numeric	11134		household.vars
homeowner_3	categorical	6540	Other, Own, Rent	household.vars
income_6	categorical	4107	$100,000 and over, $20,000-$40,000, $40,000-$60,000, $60,000-$80,000, $80,000-$100,000, Less than $20,000	household.vars
income_num_mid	numeric	4107		household.vars
owner	categorical	6540	0, 1	household.vars
rural	categorical	4124	0, 1	household.vars
rural_7	categorical	4099	In a remote area, In a rural area, In a small town, In a smaller, regional city, Not sure, Within a large city, Within a suburb, adjacent to a large city	household.vars
cp_oppose	categorical	0	0, 1	opinions.vars
cp_support	categorical	0	0, 1	opinions.vars
conservative	categorical	1105	0, 1	partisanship.vars
left_right_num	numeric	7770		partisanship.vars
liberal	categorical	1105	0, 1	partisanship.vars

party_9	categorical	1105	Bloc Québécois, Conservative Party, Don't know, Don't vote, Green Party, Liberal Party, NDP, Other party, People's Party	partisanship.vars
gasprice_change_perceived_num	numeric	0		perceptions.vars
inc_gas_perceived_4	categorical	6540	$0 per month, $1-$50 per month, $50-$99 per month, $100 or more per month	perceptions.vars
inc_gas_perceived_num	numeric	10181		perceptions.vars
inc_heat_perceived_4	categorical	5100	$0 per month, $1-$50 per month, $50-$99 per month, $100 or more per month	perceptions.vars
inc_heat_perceived_num	numeric	10454		perceptions.vars
inc_overall_perceived_num	numeric	10322		perceptions.vars
commute_7	categorical	6037	Cycle, Drive alone, Drive with others or carpool, This doesn't apply to me, Transit, Walk, Work/study at home	transport.vars
drive	categorical	6037	0, 1	transport.vars
km_driven_num	numeric	10525		transport.vars
vehicle_num	numeric	6288		transport.vars