TRANSPORTATION HABITS, MOTOR FUEL PRICES, AND PUBLIC SUPPORT FOR CARBON PRICING IN CANADA

by

Chloé Boutron

B.Sc. (Hons.), Royal Holloway, University of London, 2018

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in

THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES

(Political Science)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

October 2020

The following individuals certify that they have read, and recommend to the Faculty of Graduate and Postdoctoral Studies for acceptance, a thesis entitled:

Transportation habits, motor fuel prices, and public support for carbon pricing in Canada.

submitted by Chloé Boutron in partial fulfillment of the requirements for

the degree of Master of Arts

in Political Science

Examining Committee:

Kathryn Harrison, Professor, Department of Political Science, UBC
Supervisor

Fred Cutler, Associate Professor, Department of Political Science, UBC
Supervisory Committee Member

Abstract

This thesis explores the relationship between transportation habits, motor fuel prices, and public support for a carbon tax in Canada. It lies at the intersection of literatures on public opinion, environmental taxation, and climate politics. The thesis analyses an original panel survey conducted in five provinces around the implementation of the Canadian federal carbon tax in 2019. The thesis finds that driving as principal mode of transportation decreases support for a carbon tax by 11.3%, and an additional one cent increase in the price per litre of gasoline over the past month decreases support for a carbon tax by 0.3%. The thesis also finds that living in an urban center increases support for a carbon tax by 9.4% to 9.9% in Canada, as opposed to living outside of an urban center. This could be because more reliable transportation alternatives are available to urban dwellers. Partisanship is also found to have a strong effect on support for a carbon tax in Canada, in accordance with previous literature on the topic. The role of respondents' overestimations of the impact of a carbon tax on gasoline prices is explored but remains inconclusive. Several avenues for future research on the matter are presented in this thesis.

Lay Summary

A carbon tax is widely accepted among academics as the most cost-effective policy to mitigate climate change. Yet, it is very unpopular among the public. This thesis aims to understand the role of transportation habits and motor fuel prices in altering public support for a carbon tax. It finds that driving as principal mode of transportation decreases support by 11.3% and that an additional one cent increase in the price per litre of gasoline in the past month decreases support by 0.3%. It also finds that living in an urban setting increases support for a carbon tax by 9.4% to 9.9% in Canada, and that partisanship affects support. This thesis adds to a growing literature on public opinion and carbon taxes. It also provides insights for policymakers seeking to implement a carbon tax.

Preface

This thesis is the original, unpublished work of the author, Chloé Boutron. The survey data utilized in this thesis was kindly provided by my supervisor, Dr. Kathryn Harrison, and her co-authors, Dr. Erick Lachapelle, and Dr. Matto Mildenberger.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

CMA	Census Metropolitan Area
CO2	Carbon dioxide
GHGs	Greenhouse gases
NDP	New Democratic Party
SUV	Sport utility vehicle

Acknowledgements

I would like to express my gratitude to my supervisor, Kathryn Harrison, for giving me the opportunity to work on such an interesting project, and for her guidance and support. I would also like to thank her co-authors, Erick Lachapelle and Matto Mildenberger, for granting me access to their dataset. Thank you to my second reader, Fred Cutler, for his constructive questions and comments during the thesis defense. I would also like to show appreciation to the other faculty members who gave me advice on statistical methods and directed me towards relevant literatures.

Specials thanks are owed to my friends Hippolyte and Aidan for their support all along the preparation of this thesis. I am more than grateful for my family who has always encouraged me.

Chapter 1: Introduction

Climate change is the most threatening, enduring issue of the 21st century. Caused by the intensive release to the atmosphere of greenhouse gases (GHGs) generated by human activities, notably carbon dioxide (CO_2), climate change already has and will continue to have dramatic consequences.

A carbon tax, one of two forms of carbon pricing, is the most cost-effective option to reduce CO_2 emissions. Through making emitting CO_2 costly, a carbon tax incentivizes fuel-switching and behavioral changes. These changes may take the form of reduced industrial production, reduced use of motor vehicles, or the use of energy-efficient technologies (e.g., efficient home appliances, electric cars). Over 3500 U.S. economists and 1700 European economists, including Nobel price laureates and directors of financial institutions, have signed statements advocating the broad implementation of carbon taxes (Climate Leadership Council; EAERE).

A carbon tax remains a widely unpopular policy among the public, however. Carbon taxes have been rejected in referendums in the U.S. state of Washington (Anderson et al. 2019), vehemently opposed during the Yellow Vests protests in France, and repealed in Australia and Alberta. On average, only 49% of Canadians and 50% of Americans supported a (hypothetical) carbon tax in 2015/6 (Howe et al. 2015; Mildenberger et al. 2016), not enough to comfortably get such a policy passed by popular majority in either of the countries. Beyond reluctance to pay taxes, understanding why people oppose a carbon tax can help its implementation. Such understanding can inform the design of a carbon tax, accompanying mechanisms such as tax rebates, or information campaigns.

In their review of the literature on public opposition to carbon taxes, Carattini et al. (2018, 3-4) identify five, repeatedly-observed public concerns that drive opposition to a carbon tax: distrust in the government and its intended use of carbon tax revenues; concerns that a carbon tax policy could be regressive and unfair; doubts that a carbon tax can reduce CO_2 emissions and encourage less carbon-intensive behaviors; concerns that a carbon tax could negatively impact the economy and employment; and concerns that a carbon tax would excessively increase individual costs of living.

This thesis complements this literature by exploring how modes of transportation, gasoline prices, and the perceived impact of a carbon tax on transportation costs affect public support for a carbon tax. The rationale behind this exploration is that personal transportation often constitutes a sizable share of households' budgets. High motor fuel prices or recent market-driven price increases could therefore trigger opposition, or stronger opposition to a carbon tax. This effect was reported by Harrison (2013, 12) anecdotally in the case of the British Columbia carbon tax. Carattini et al. (2018, 3) and Rivers and Schaufele (2015, 33) also suggest that overestimations of the impact of a carbon tax on transportation costs could trigger opposition.

To uncover the nature of the relationships at stake, this thesis builds on political and economic behavioral literatures. It leverages the implementation, in 2019, of a federal carbon tax in five of ten Canadian provinces.

This thesis reports results from regressions carried out using the Canadian Climate Opinion Panel, a survey conducted around the implementation of the Canadian federal carbon tax by Kathryn Harrison, Erick Lachapelle, and Matto Mildenberger. The survey contains responses from two of the provinces where the federal carbon tax was implemented in 2019 (Ontario and Saskatchewan), two provinces which already had a carbon tax or cap-and-trade

system before 2019 (British Columbia and Québe), and one additional province (Alberta), which had its own carbon tax on households since 2017 but repealed it after a change of government in May 2019. Gasoline prices, collected from the Kent Group Ltd., were added to each wave of the panel for each respondent, based on the municipality nearest to their respective electoral riding.

The main findings of this thesis are that driving as principal mode of transportation decreases support for a carbon tax by 11.3%, and that an additional cent increase in the retail price per litre of gasoline over the past month decreases support by 0.3%. In the month before the implementation of the federal carbon tax in some Canadian provinces, the price per litre of gasoline increased by an average of 33 cents, of which an average of 28 cents were attributable to market conditions. This translates to an average 9.9% decrease in support for a carbon tax. Another key finding of this thesis is that living in an urban setting increases support for a carbon tax by 9.4% to 9.9% compared to living in a suburban, rural or remote area in Canada. This could be because transportation alternatives are readily available to urban dwellers. The thesis also finds that partisanship strongly affects support for a carbon tax in Canada: people intending to vote for the Conservative Party of Canada are 35% less supportive of a carbon tax than people intending to vote for the Liberal Party of Canada. This finding is consistent with existing literature on public support for environmental taxes (Davidovic et al. 2020; Thalmann 2004) and public support for carbon pricing in Canada (Mildenberger et al. 2020).

Chapter 2: Literature review: factors affecting support for a carbon tax

2.1 Transportation

In his study of a referendum in Switzerland, Thalmann (2004, 206) finds that vehicle ownership significantly reduces public support for environmental taxes that directly increase the price of motor fuels. Owning one additional motor vehicle, he finds, decreases support for such a tax by 21%. Hsu et al. (2008, 3617) explored how the ownership of different types of motor vehicles impacted public support for an increase in gasoline taxes in the metropolitan area of Vancouver, Canada. They find that SUV ownership does not particularly impact support for a gasoline tax increase, but the ownership of a van or minivan significantly reduces support. They propose that this could be due to van and minivan owners often having young children and, therefore, less disposable income. People with young children might also find alternative modes of transportation less convenient. Hsu et al. (2008, 3617) also find that people who commute by driving are much less likely to support a gasoline tax increase. They find, however, that the distance driven on daily commutes does not have a sizeable effect on support for a gasoline tax increase.

Peet and Harrison (2012) find that residents of rural and Northern British Columbia, Canada, were less likely to support the province's carbon tax. Rural residents argued that the tax was unfair because they perceive that they rely more heavily on driving, drive longer distances, and drive larger vehicles than their urban counterparts. Thalmann (2004) also finds that people living in urban centers are more supportive of an environmental tax than their rural counterparts.

This could be because more alternative modes of transportation are readily available to people living in urban settings.

People found to be more opposed to environmental taxes in relation to their transportation habits are similar to people found to have lower price elasticities of demand for gasoline.[1] Wadud et al. (2010) and Moshiri (2020) indeed find that those with children, driving commuters, and people living in rural areas have lower price elasticities of demand for gasoline.

Harrison (2013, 12) reports that a market-driven surge in gasoline prices in the months leading up to the implementation of the carbon tax in British Columbia in 2008 appeared to further public opposition to the tax. Gasoline prices also surged in France in 2018 in the months that preceded the Yellow Vests protests, which opposed a planned increase in the country's carbon tax (Bureau et al. 2015, 42). In this case, a link between gasoline price increases and opposition to the carbon tax increase has not been empirically established.

2.2 Demographics

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[2] for a carbon tax. Income thus should have a positive effect on support for a carbon tax. Nonetheless, 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.

[1] The price elasticity of demand is an economic measure of consumers' response to a one unit increase in the price of a good. It is inelastic when demand for a good does not vary when the price increases.
[2] The willingness to pay refers to the maximum price up to which individual consumers will choose to purchase a good.

Rotaris and Danielis (2019) find significant effects of gender on the willingness to pay for a carbon tax after controlling for factors such as environmental awareness. People who identify as male tend to be less willing to pay for a carbon tax than people identifying as female. Gidengil and Stolle (2010) find that Canadian women, on average, are more knowledgeable about practical aspects of the political life such as taxes or governmental services than men. As such, women may have a better understanding of a carbon tax and associated redistributive mechanisms. This could translate into additional support for a carbon tax.

Thalmann (2004, 206) finds that people aged 60 and over were more opposed to environmental tax propositions in Switzerland than people in younger age groups. The role of age in generating support or opposition is less clear for different segments of the population, between the age of 18 and 59. Age may also affect how people perceive fuel prices.

Kotchen et al. (2017) and Rotaris and Danielis (2019) find that education has a positive effect on willingness to pay for a carbon tax, and Thalmann (2004) finds that education increases support for environmental taxes. Hsu et al. (2008, 3617) also find positive effects of education on support for increases in gasoline taxes to limit pollution. Borrowing from previous literature, Hsu et al. propose that education increases support for such taxes because it increases people' awareness of environmental issues. Kotchen et al. (2017) and Rotaris and Danielis (2019) control for environmental awareness. Education might also improve people's understanding of tax mechanisms, or redistributive mechanisms.

Finally, Kotchen et al. (2017) and Rotaris and Danielis (2019) find significant effects of belief in climate change on the willingness to pay for a carbon tax. People who do not believe that climate change is happening are significantly less supportive of a carbon tax, by 25% (Kotchen et al. 2017, 3).

2.3 Ideology and partisanship

In a comparative study of willingness to pay for environmental taxes, Davidovic et al. (2020, 686) find a significant role for political ideology. They find that identifying on the left of the ideological spectrum increases the willingness to pay for environmental taxes by 29%. Thalmann (2004, 196) finds that people affiliated with a left-to-center party, or an ecological party were more supportive of environmental tax propositions in Switzerland, between 35 and 45% more than people affiliated with center-to-right parties. Mildenberger, Lachapelle, and Harrison (2020) find that people supporting the Conservative Party of Canada were up to eight times more likely to oppose to the Canadian federal carbon tax than supporters of other parties. A plausible explanation to this phenomenon could be that people follow their party's stance on carbon pricing and a carbon tax. People may also be misinformed about carbon pricing and a carbon tax, depending on their party affiliation. They may receive biased information or self-select into biased news outlets. Parties opposed to carbon pricing or taxation have often exaggerated the costs and downplayed the benefits of such policies to their party followers.

When presented with new, accurate information about carbon pricing or a carbon tax, partisans may be reluctant to update their beliefs. People may also misreport their true preference for carbon pricing or a carbon tax in opinion polls, as means to support their party (Bullock et al. 2015). These phenomena are respectively known as motivated reasoning and the cheerleading effect.

2.4 Hypotheses

The previous section identified that the reliance on cars for transportation negatively impacts public support for environmental taxes or gasoline tax increases. To confirm the existence of a similar effect in Canada, I propose to test the following hypotheses related to life circumstances and lifestyle that could affect motor fuel consumption:

H1a: Relying on cars for transportation decreases support for a carbon tax.
H1b: Living in a rural setting decreases support for a carbon tax.
H1c: Having children decreases support for a carbon tax.

As has been done in previous literature, it will be useful to test different measures of transportation habits including principal mode of transportation, or vehicle ownership.

The similarity between groups who are more opposed to environmental taxes and groups who have a lower price elasticity of demand for gasoline as well as previous literature suggests that the price of motor fuels affects support for a carbon tax. I propose to test the following hypotheses:

H2a: High retail prices for motor fuels decrease support for a carbon tax.
H2b: Increases in retail prices for motor fuels decrease support for a carbon tax.

I also propose to test the relationship between perceptions of the personal costs ensuing from a carbon tax and public support for a carbon tax. First, I propose to check who is likely to hold such misperceptions.

H3a: Intending to vote for a right-wing party, and relying on cars for personal transportation generate overestimations of the share of fuel price increase that is attributable to a carbon tax.

I also propose to verify if demographic factors or attitudes towards politics or climate change affect perceptions of fuel prices.

Then, I propose to test the following hypothesis:

H3b: Overestimations of fuel prices, or overestimations of the share of fuel price increases that is attributable to a carbon tax decrease support for such a tax.

The literature reviewed in this section indicates several factors that could confound the relationships at stake. These are income, gender, age, education, accepting climate change science, and partisanship. Factors built into the first cluster of hypotheses such as having children and living setting could also confound the relationships described by the second and third clusters of hypotheses.

All the above hypotheses are likely to be impacted by provincial differences, notably due to policy variations across provinces. The next section details these differences, and discusses other variations pertaining to environmental attitudes, partisanship, and transportation.

Chapter 3: The Canadian Context

3.1 Carbon pricing in Canada

The province of British Columbia implemented the first broad-based carbon tax in North America in 2008 (Rivers and Schaufele 2015, 23). The tax covers roughly 70% of the province's GHGs emissions, including household emissions (home heating, transportation fuels). The price of a tonne of CO_2 was initially fixed at CAD$10, it rose to CAD$30 by 2012, and was then frozen until 2018. It reached the current CAD$40 in April 2019 (Murray and Rivers 2015, 676; British Columbia nd). This price corresponds to an addition of 8.89 cents on the price of a litre of regular gasoline.

Québec started operating a cap-and-trade system in 2013. It was joined by the U.S. state of California a year later, and briefly by the province of Ontario between January and July 2018 (Environment Québec nd). It first applied to business emitters that produce over 25000 tonnes of CO_2 per year and the electricity sector, but in 2015 was extended to transportation and other household emissions. The cap for yearly emissions is currently fixed at about 56.8Mt of CO_2 (ICAP 2019). This yields an average price of CAD$17.7 per tonne of CO_2, or approximatively 4.92 cents per liter of gasoline (ICAP 2020; NRCan 2020).

The New Democratic Party government of Alberta implemented a carbon tax on households in 2017 at CAD$20 per tonne of CO_2, which was increased to CAD$30 per tonne in 2018 (Alberta 2018). It was repealed on May 30th, 2019 by the newly elected United Conservative Party government, which had campaigned against the tax.

In 2018, the Canadian federal government set a minimum pricing requirement for CO_2 emissions in all Canadian provinces. It began implementing a carbon tax on provinces that did not have their own carbon pricing mechanism on April 1st, 2019. The tax was first implemented in Ontario, Saskatchewan, Manitoba, and New Brunswick. It was implemented in Yukon and Nunavut in July 2019 (Climate Change Canada 2019). Alberta, which had just repealed its provincial tax, was subjected to the federal carbon tax in January 2020. The federal government has separate carbon pricing schemes for industry and smaller emitters (households). My analysis focuses exclusively on the latter.

The federal carbon tax, which applies to households and small business, started at CAD$20 per tonne of CO_2 in 2019, and increases by CAD$10 each year. It added 4.4 cents to the price of a liter of gasoline in 2019, rising to 6.63 cents per liter in 2020.

The federal carbon tax features a dividend scheme for households, making it highly progressive. An estimated 90% of federal carbon pricing revenues is returned to households and the remainder is used to support particularly affected sectors such as small enterprises, municipalities, schools, and Indigenous communities (Ammar 2020). It is calculated based on the number of adults and children living in a household. A 10% supplement applies to households in small or rural communities (Climate Change Canada 2019). The dividend is returned to households in the form of a tax credit, delivered via annual tax returns. The dividend for one adult living in Ontario was CAD$154, and CAD$307 for a family of four in 2019. In more carbon-intensive Saskatchewan, where households are more impacted by the carbon tax, the dividend for one adult was CAD$305, and CAD$609 for a family of four (CRA 2019a; CRA 2019b). Dividends are set to increase as the price of a tonne of CO_2 emission increases.

Inhabitants of the provinces where the federal carbon tax was implemented received the rebate for the next 12 months shortly after the tax came into effect in April 2019.

3.2 Public support for carbon pricing

In 2016, only 50% of Canadians supported a hypothetical carbon tax. This estimate rose by 2018, when an estimated 58% of Canadians supported a cap-and-trade system, and 54% supported an increase in taxes on carbon-based fuels (Mildenberger et al. 2019). Support for either of these carbon pricing mechanisms varied by province. Only an estimated 46% of Albertans, and 45% of Saskatchewanians supported an increase in taxes on carbon-based fuels in 2018. Support was higher in Ontario and Manitoba – 54 and 52% respectively. In Québec and British Columbia, support was close to 60%. Interestingly, support for a cap-and-trade system was above 50% in all Canadian provinces in 2018.

3.2.1 Partisanship and carbon taxation

In early 2019, an estimated 36% of Canadians intended to vote for the Conservative Party of Canada (Leger Marketing 2019a). Around the time of implementation of the federal carbon tax in April, this estimate rose to 40%, before declining to 34.3% on the day of the federal election in October 2019 (Leger Marketing 2019a; 2019b). About 30% of Canadians intended to vote for the Liberal Party of Canada throughout the year. The party won the October 2019 federal elections with 33.1% of the vote, and a higher number of seats at the House of Commons.

In Alberta, intentions to vote Conservative were always above 50%, reaching 65% at times. Intentions to vote Conservative were also high in the rural provinces of Manitoba and Saskatchewan (Leger Marketing 2019a; 2019b; 2019c). Mildenberger et al. (2016) find that support for the Conservative party is higher in rural parts of provinces, regardless of the average support for the party across the province.

The Conservative Party of Canada opposes the federal carbon tax. At the provincial level, Doug Ford, Ontario's Conservative Premier led a campaign against the federal carbon tax, including mandating that gas pumps across the province display misleading stickers about the impact of a carbon tax on gas prices (Jones 2019). The Ford government is also challenging the constitutionality of the federal carbon tax, joined among other provinces by the Conservative government of Alberta, led by Jason Kenney, after its election.[3]

3.2.2 Public acceptance of climate change science

Table 1 summarizes the spatial distribution of acceptance of climate change science in Canada in 2018. It is derived from Mildenberger et al. (2019). Mildenberger et al. (2016, 7) also find that acceptance of climate change science is lower in rural parts of Canada.

	Climate change is happening	Climate change is caused by human activities
Canada	83%	60%
Alberta	70%	42%
Saskatchewan	71%	47%
Québec	89%	67%
Ontario	83%	60%
British Columbia	86%	61%

Table 1: Distribution of acceptance of climate change science in Canada in 2018 (Mildenberger et al. 2019).

[3] Decisions by three federal courts have been mixed; the case is scheduled to be heard by the Supreme Court of Canada in September 2020

Lachapelle et al. (2012, 341) find that the share of supporters of the Conservative Party of Canada that accepted climate change science was 64%, against 91% for supporters of the Liberal Party of Canada. 84% of supporters of the New Democratic Party accepted that climate change is happening.

3.3 Transportation habits

Most Canadians live in cities or urban centers, but they rely heavily on cars and light trucks for personal transportation. In 2016, 12.6 million Canadians relied on cars, SUVs or light trucks for their daily commutes, against 2 million relying on public transportation and a total population of about 35 million (Statistics Canada 2017). On average, in 2013, Canadian households owned 1.5 cars, SUVs or light trucks (Koehl 2014). The average fuel-efficiency of on-road motor vehicles in Canada is 8.9 liters of fuel per 100 kilometers (CER 2019). Only a small share of passenger vehicles are electric vehicles (EMC 2019; Statistics Canada 2020b).

Most of the personal road motor vehicle fleet in Canada runs on gasoline, particularly regular gasoline. Diesel only accounts for 7.3% of total retail sales, and higher octanes gasoline accounted for only 13.5% of total gasoline sales in 2015 (Kent Group Ltd. 2016; Gray 2019). The remainder of this thesis will therefore focus on regular gasoline only.[4]

[4] The prices for diesel and gasoline (regular, midgrade, premium) tend to vary together. In 2019, the price for diesel fluctuated with the price of gasoline until August. After that, the price of diesel increased slowly while the price of gasoline remained steady (Kent Group Ltd. 2020).

3.4 Gasoline prices in 2019

The retail price of gasoline is determined by the price of crude oil, refining and marketing margins, and governmental taxes. Appendix A provides more details about the components of gasoline retail prices and includes a schedule of taxes applicable on gasoline in different Canadian provinces for 2019.

Figure 1 reveals that the retail price of gasoline varied greatly in Canada in 2019. Starting at a low national average of CAD$1.05 per litre, it rose to CAD$1.38 per litre by late April 2019, before declining to around CAD$1.20 cents per litre for the rest of the year. Figure 2 reveals that gasoline prices in the provinces of Alberta and Saskatchewan were lower than elsewhere in the country, respectively averaging around CAD$1.00 and CAD$1.10 in 2019, but exhibited similar fluctuations over time.

Most of the rapid price increase in gasoline prices was driven by fluctuations in the market for crude oil. In late 2018 and early 2019, the price of crude oil significantly dropped. Shortly after, OPEC-led supply cuts and U.S. sanctions on Iran and Venezuela oil imports led to a rapid rise in the price of crude (Canadian Fuels Association 2020). This surge in the price of crude oil unfortunately coincided with the implementation of the Canadian federal carbon tax in some provinces on April 1st, 2019. Between January and April 2019, the retail price of gasoline increased by 33 cents on average, of which only 4.4 cents were attributable to the federal carbon tax only in Ontario, Saskatchewan, Manitoba and New Brunswick.[5]

[5] The British Columbia carbon tax also increased in April 2019, by approximatively 1.2 cent per litre. In May 2019, the auction for emission permits also cleared above the floor price, translating into an increase in prices at the pump.

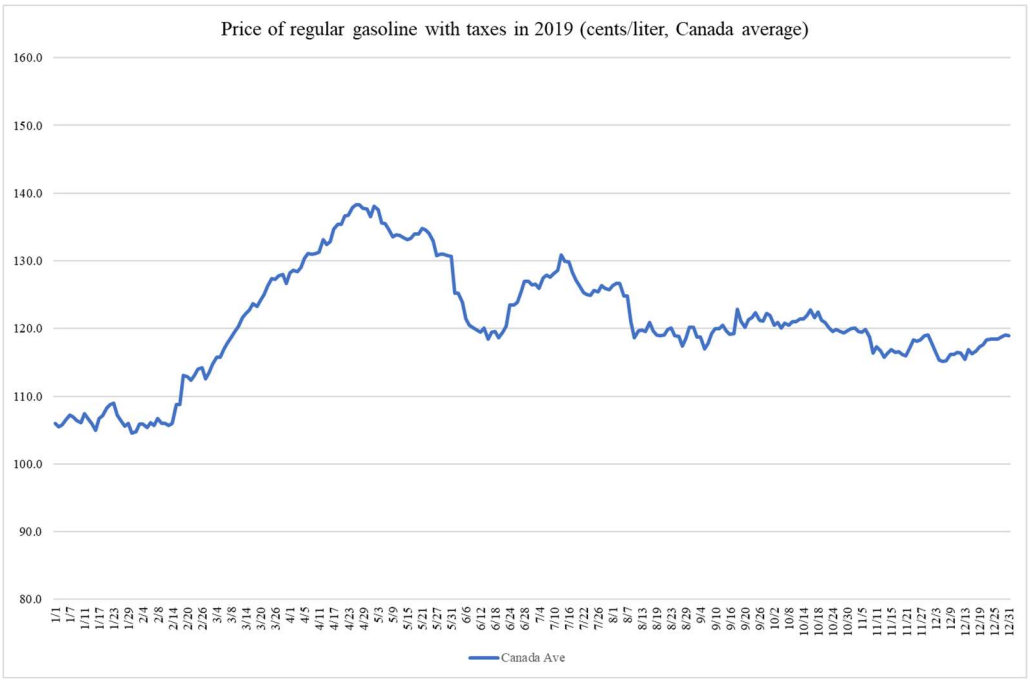

Figure 1: Daily average price of gasoline in Canada in 2019 (computed by the author, Kent Group Ltd. 2020).

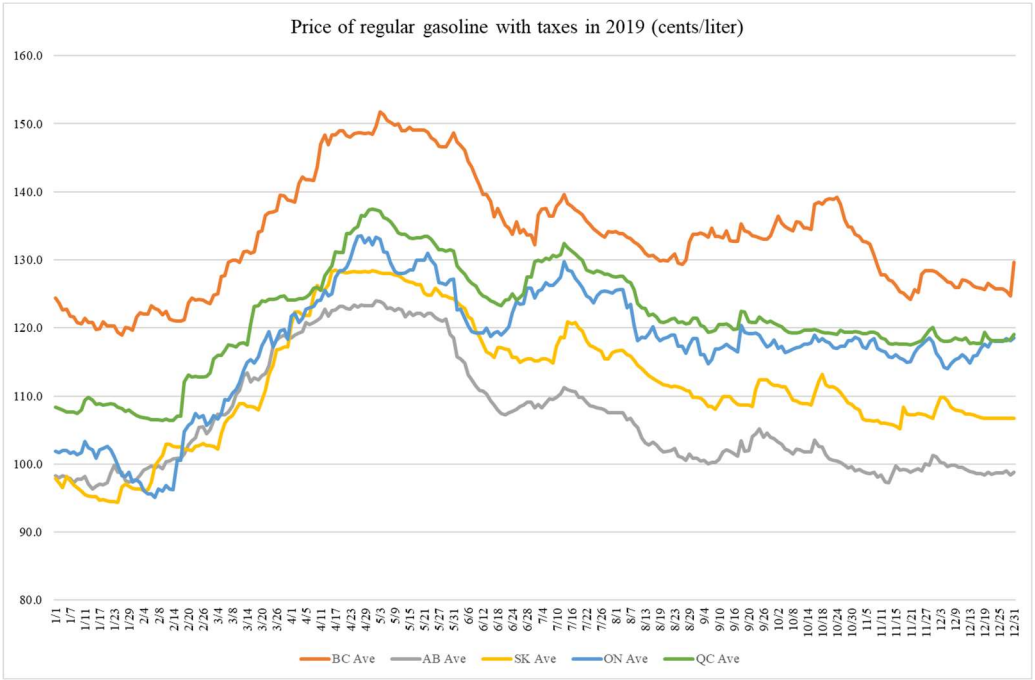

Figure 2: Daily average price of gasoline in selected Canadian provinces in 2019 (computed by the author, Kent Group Ltd. 2020).

3.5 Summary

This section has presented carbon pricing policies applicable in different provinces of Canada. It has also provided some background on the distribution of partisanship and public acceptance of climate change science in the country and has presented transportation habits and gasoline prices in Canada in 2019.

The context presented in this section reinforces the hypotheses presented in the second section of this thesis. Reliance on cars for personal transportation is expected to have a negative effect on support for a carbon tax in Canada. The large increase in gasoline prices shortly before the implementation of the federal carbon tax in April 2019 is expected to have decreased support for the tax or led to overestimations of the share of price increases attributable to a carbon tax. Partisanship and province of residence are also expected to have strong influences on support for a carbon tax in Canada.

Chapter 4: Data, methods of analysis, models

4.1 Data

The main dataset used for this thesis, the Canadian Climate Opinion Panel, is a four-wave panel survey collected by Kathryn Harrison, Erick Lachapelle, and Matto Mildenberger in 2019. It was administered online to a sample of respondents from the five most populous Canadian provinces: Ontario, Quebec, British Columbia, Alberta, and Saskatchewan.

The first survey wave was conducted between February 21st and March 3rd, before the implementation of the federal carbon tax in Ontario and Saskatchewan. The second wave took place between April 10th and April 28th, shortly after the implementation of the federal carbon tax. The third wave took place between June 27th and July 19th after respondents in federal-tax provinces would have received their income tax rebates, and the fourth wave took place between November 22nd and December 15th, following the October 2019 federal election.

The number of respondents who completed all four survey waves is 1190. 52 respondents did not provide information about their area of residence, bringing the number of respondents for whom we can estimate gasoline prices to n=1138. Appendix B describes variables of interests in the Canadian Climate Opinion Panel. Table 10 in Appendix B provides the roughly equal number of respondents living in each province across the four survey waves. The choice to study only 5 of 10 Canadian provinces based on policy variation introduced some unrepresentativeness with regards to partisanship relative to national averages. In particular, the share of respondents affiliated with the Conservative party is much higher than the Canadian national average. Table 10 also provides the average number of respondents who indicated support for each party.

Figures 3 and 4 depict the average support for a carbon tax over time in each province and for each partisanship, respectively.

Retail prices for gasoline were collected from the Kent Group Ltd. (2020). They were associated with each respondent for each survey wave based on the municipality in or nearest to the electoral riding in which they resided during the survey wave. Appendix C presents the method used to merge gasoline prices to electoral ridings.

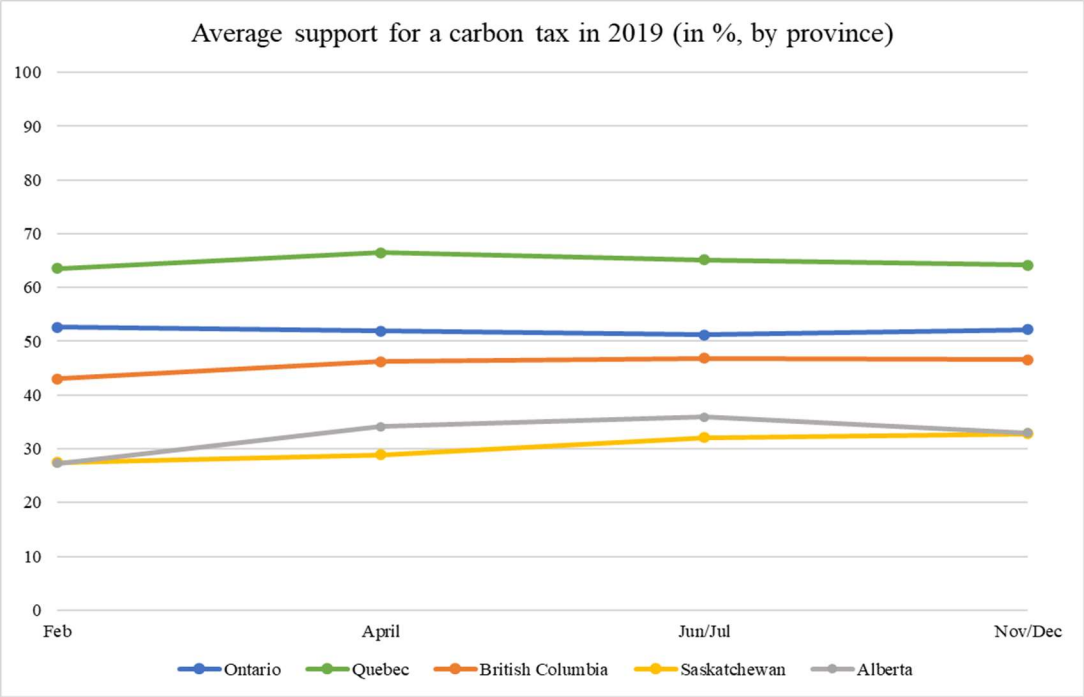

Figure 3: Average support for a carbon tax in Canada in 2019, by province.

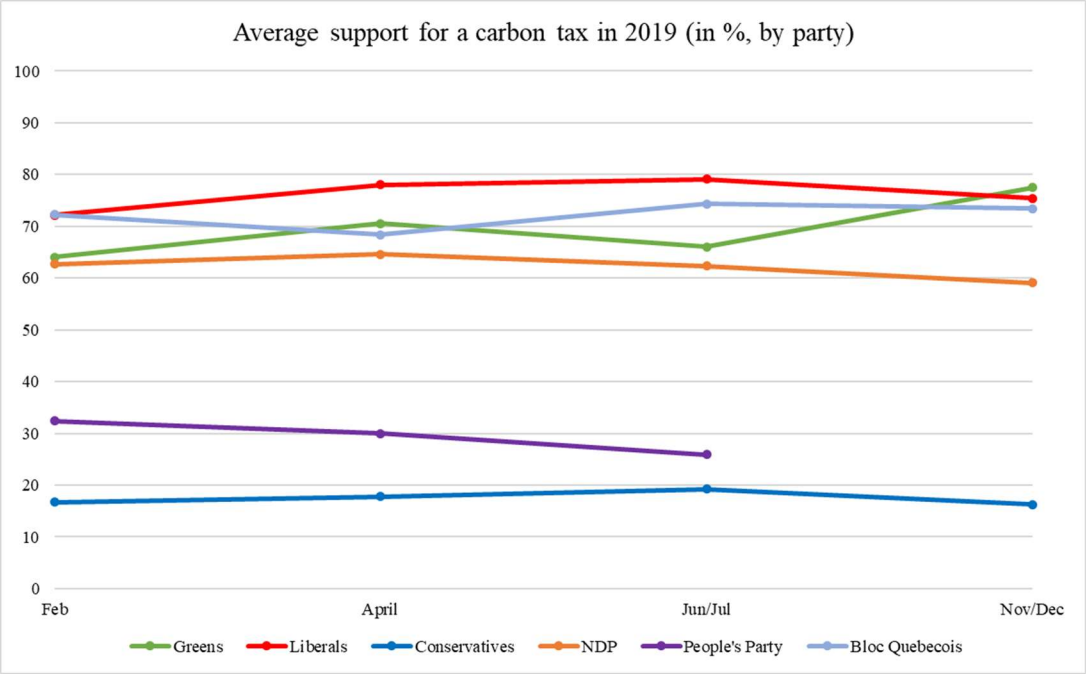

Figure 4: Average support for a carbon tax in Canada in 2019, by partisanship.

4.2 Statistical models

Appendix D contains the survey questions that were asked to create the variables included in the models detailed below. For all the following models, partisanship and province of residence are included as binary variables with Liberals and British Columbia as baselines (for both, support for a carbon tax was steady across waves). Some variables are only available for the first survey wave. As the data permits, I have run various models over the entire panel, the first survey wave only, or each wave separately. Clusters of hypotheses (hypotheses 1a, 1b, and 1c, and hypotheses 2a and 2b) are combined in a single model.

4.2.1 H1a, 1b, 1c: Reliance on cars, rural residence, and having children decrease support for a carbon tax.

Data about transportation habits is only available in the first survey wave. To capture the effect of transportation habits on public support for a carbon tax, I propose to run the following OLS model over the first survey wave:

$$S_i = \alpha + \beta_1 Transportation_i + \beta_2 CMA_i + \beta_3 Children_i + \beta_4 X_i + \varepsilon$$

$S_i =$ Dummy variable for individual support for a carbon tax with 1 equal to strongly or somewhat supports a carbon tax, and 0 equal to strongly or somewhat opposes a carbon tax.
$Transportation_i =$ Variable capturing respondents' reliance on cars for transportation (several specifications available, as discussed below).
$CMA_i =$ Dummy variable equal to one when the respondent lives in a Census Metropolitan Area.
$Children_i =$ Number of children under 18 years old living in the respondent's household.
$X_i =$ Confounding variables (income, gender, age, education, acceptance of climate change science, partisanship, province of residence).
$\varepsilon =$ Error term.

Three different variables were tested as measures of respondents' reliance on cars for transportation: a dummy variable equal to one if respondents' principal mode of transportation to work or school is driving, a variable that records the number of cars owned by respondents' households, and a categorical variable with the self-reported monthly gasoline expenditure of respondents' households. In subsequent models, only one of these variables is used as a measure of respondents' reliance on cars for transportation.

The variable CMA (Census Metropolitan Area) is used as a proxy for living in a large urban center or adjacent suburb. Respondents who do not live in a CMA may live in smaller, regional cities, or in rural or remote areas.

4.2.2 H2a, 2b: High retail prices for motor fuels or increases in retail prices for motor fuels decrease support for a carbon tax.

I propose to run the following OLS model over the entire panel, and over each survey wave:

$$S_i = \alpha + \beta_1 Price_i + \beta_2 \Delta Price_i + \beta_3 X_i + \varepsilon$$

$S_i =$ Dummy variable for individual support for a carbon tax.
$Price_i =$ Recent retail price (cents/L) of gasoline in the respondent's area of residence.
$\Delta Price_i =$ Recent changes in the retail price of gasoline (cents/L) in the respondent's area of residence.
$X_i =$ Confounding variables: transportation, children, acceptance of climate change science (only in the first wave), income, education (not available in the second wave), gender, age, living setting, partisanship, province of residence.
$\varepsilon =$ Error term.

To exploit the panel nature of the dataset, I also propose a fixed-effects model. It includes individual and province fixed effects to account for within-individual variation, and for carbon pricing policy differences across provinces. Several confounding variables are manually included in the model. This is to capture a possible effect of changes in the variables' values over time for individuals.

$$S_{it} = \alpha_i + p_i + \beta_1 Price_{it} + \beta_2 \Delta Price_{it} + \beta_3 X_{it} + \varepsilon$$

$S_{it} =$ Dummy variable for individual support for a carbon tax at time t.
$\alpha_i =$ Individual fixed effects.
$p_i =$ Province fixed effects.
$Price_i =$ Recent retail price of gasoline in the respondent's area of residence. In cents per liter.

$\Delta Price_i$ = Recent changes in the retail price of gasoline in the respondent's area of residence. In cents per liter.
X_i = Confounding variables (living setting, income, age, education, partisanship, province of residence).
ε = Error term.

Five specifications for retail gasoline prices and changes in retail gasoline prices were created to capture individuals' attentiveness to prices in time. They are:

1) The average retail price during the calendar month preceding the survey wave,
2) The average retail price during the week preceding the survey wave, and
3) The difference between the retail price on the day before the beginning of the survey wave and the retail price thirty days before the survey wave,
4) The difference between the retail price on the day before the beginning of the survey wave and the retail price seven days before the survey wave,
5) The difference between the retail price on the day before the beginning of the survey wave and the retail price sixty-one days before the survey wave.

4.2.3 H3a: Overestimations

I propose an OLS model to understand who, among respondents, tends to overestimate the share of recent gasoline price increases that is attributable to a carbon tax. I use the same OLS model to observe if demographics or other factors affect respondents' perception of gasoline prices.

The variable that captures overestimations of the share of recent gasoline price increases that is attributable to a carbon tax was created by comparing respondents' estimates (in percent) of this share with the actual share (in percent). The resulting variable is expressed in percent over

or under the actual percentage.[6] The variable that captures overestimations of gasoline prices was created by comparing respondents' recollections of gasoline prices in their local area during the week before the third wave, in July 2019, with actual prices. The two variables are available for the second and third waves of the panel survey. Therefore, I propose to run the following model on the second, and on the third wave.

$$O_i = \alpha + \beta_1 X_i + \varepsilon$$

$O_i =$ Overestimation of the share of price increases attributable to a carbon tax in percent (second wave), or overestimation of gasoline prices in cents per liter (third wave).
$X_i =$ Regressors: living setting, income, gender, age, education, partisanship, province of residence. Other likely confounding variables (children, acceptance of climate change science) are left out of this model because they are unavailable in the relevant survey waves.
$\varepsilon =$ Error term.

4.2.4 H3b: Overestimations of fuel prices, or overestimations of the share of fuel price increases that is attributable to a carbon tax decrease support.

I propose to run the following OLS model over the entire panel survey:

$$S_i = \alpha + \beta_1 O_i + \beta_2 X_i + \varepsilon$$

$S_i =$ Dummy variable for individual support for a carbon tax.
$O_i =$ Overestimation of gasoline prices in cents per liter or the share of price increases attributable to a carbon tax in percent.
$X_i =$ Confounding variables: income, education, gender, age, living setting, partisanship, province of residence. Other likely confounding variables (living setting, children, acceptance of

[6] If someone estimated that 50% of the recent gasoline price increase is attributable to a carbon tax, over the actual 13.33% that are attributable to the federal carbon tax, the variable records 50-13.33 = 36.7%.

climate change science) are left out of this model because they are unavailable in the relevant survey waves.
$\varepsilon =$ Error term.

To enable regressions with both types of overestimations in one model, overestimations variables which are available only once in the panel survey and in two different survey waves were extended. The value of overestimations of the share of price increases attributable to a carbon tax for each respondent in the second wave was attributed to the same respondent in the three other survey waves. The value of overestimations of gasoline prices for each respondent in the third survey wave was attributed to the same respondent in the three other survey waves.

I acknowledge that the above model presents a potential endogeneity problem, in that people could overestimate the impact of a carbon tax on gasoline prices or gasoline prices because they oppose a carbon tax, rather than oppose a carbon tax because they overestimate the tax's impact or prices.

Chapter 5: Results and discussion

5.1 Support for a carbon tax: transportation

Table 2 summarizes the results of three different specifications of the first model, ran over the first survey wave.

Specification (1) finds that driving as principal mode of transportation decreases support for a carbon tax by 11.3%, compared to other modes of transportation. This estimate is consistent with the findings of Hsu et al. (2008). Specification (3) finds that each $50 increase in monthly household spending on gasoline decreases support by 1.2%. The median monthly household gasoline spending in the Canadian Climate Opinion Panel was CAD$100 to CAD$149. This corresponds to a 4.8% decrease in support for a carbon tax. This estimate may be revised across time, as the price of a litre of gasoline varies. While Thalmann (2004) finds that car ownership significantly decreases support for environmental taxes, specification (2) does not find a significant effect for the number of cars owned by each respondent's household.

The smaller or insignificant effects of monthly gasoline expenditure and car ownership could be explained by the fact they do not capture respondents' individual reliance on cars for transportation. The survey asked respondents about their households' monthly gasoline spending and the number of cars owned by their households. Respondents may have a flawed recollection of their household's gasoline spending and may not fully seize how a carbon tax would affect the transportation habits of other members of the household. The findings could also reflect that respondents' own (perceived) dependence on cars is a more important factor than their costs

associated with car ownership in influencing support for a carbon tax. In subsequent models, the variable "Driver" is used to control for respondents' transportation habits.

All specifications find that living in a large urban center or a close suburb, in comparison to a smaller city or rural area, increases support for a carbon tax by 9.4% to 9.9%. These findings could be explained by the availability of reliable alternative modes of transportation in urban centers.

As opposed to a suggestion by Hsu et al. (2008), having children does not seem to affect support for a carbon tax. This could be because even if having children makes people more reluctant to pay taxes, or switch to alternative modes of transportation, it is likely to have them more worried about the future and climate change.

All specifications find that having a university degree increases support for a carbon tax by 7.2% to 8.2%, as opposed to not having a university degree. Other educational attainments were tested (e.g.: having a high school diploma) and seemed to affect support for a carbon tax, but in a less statistically significant manner. Acceptance of climate change science is controlled for in all the specifications, as discussed in the next paragraph. Therefore, a likely explanation to the effect of education on support for a carbon tax is that it increases people's understanding of how the tax or redistributive mechanisms work. Nonetheless, I find no evidence that education affects respondents' perception of the impact of a carbon tax on gasoline prices, as discussed in section 5.3.

All the specifications find that accepting that anthropogenic climate change is happening increases support for a carbon tax, by 29.7%. This is straightforward: climate deniers are unlikely to support a tax to combat an issue which they do not consider to be real.

Partisanship strongly affects support for a carbon tax: Conservatives are about 35% less supportive of a carbon tax than Liberals, and supporters of the People's party are about 20% less supportive of a carbon tax than Liberals. These findings are consistent with existing literature (Davidovic et al. 2020; Thalmann 2004; Mildenberger et al. 2020). There are several potential explanations. Both parties are right-wing parties and are traditionally relatively opposed to taxes. Both parties are also traditionally opposed to the federal Liberals, who are responsible for design and implementation of the Canadian federal carbon tax. The effect of partisanship on support for a carbon tax could also be caused by partisan bias. This explanation will be discussed further in section 5.3.

In practice, differences between Conservatives and Liberals are likely understated in these findings because factors such as living setting and acceptance of climate change science are controlled for. As discussed in the presentation of the Canadian context, people living in rural areas, climate change deniers, and those who deny that climate change is caused by human activities are more often affiliated with the Conservative party. Nonetheless, the sample overrepresents Conservatives; this could diminish the understatement.

Respondents' province of residence also affects support for a carbon tax. In the three specifications, Quebecers are more supportive of a carbon tax than British Columbians, by 8.4% to 8.8%. Potential explanations to this effect will be presented in the next sub-section.

Table 2: Transportation habits and support for a carbon tax - first survey wave

	Dependent variable:		
	Support for a carbon tax		
	(1)	(2)	(3)
Driver	−0.113*** (0.033)		
Cars		−0.027 (0.018)	
Spending			−0.012* (0.007)
CMA	0.099** (0.048)	0.087* (0.048)	0.085* (0.048)
Children	0.005 (0.018)	0.007 (0.018)	0.009 (0.018)
Income	0.008 (0.008)	0.007 (0.008)	0.007 (0.008)
Female	0.033 (0.031)	0.043 (0.031)	0.045 (0.031)
Age	−0.002* (0.001)	−0.001 (0.001)	−0.001 (0.001)
University	0.077** (0.032)	0.072** (0.033)	0.082** (0.033)
Climate science	0.297*** (0.035)	0.297*** (0.035)	0.293*** (0.035)
Greens	−0.036 (0.063)	−0.034 (0.063)	−0.045 (0.064)
Conservatives	−0.352*** (0.040)	−0.354*** (0.041)	−0.352*** (0.041)
NDP	−0.009 (0.050)	−0.003 (0.050)	−0.015 (0.050)
Peoples	−0.201*** (0.077)	−0.217*** (0.078)	−0.191** (0.079)
BQ	−0.002 (0.080)	0.002 (0.080)	−0.003 (0.081)
Liberals			
ON	0.050 (0.047)	0.053 (0.047)	0.058 (0.048)
QC	0.088* (0.049)	0.078 (0.050)	0.084* (0.050)
SK	−0.078 (0.049)	−0.080 (0.050)	−0.081 (0.050)
AB	−0.025 (0.049)	−0.032 (0.049)	−0.036 (0.049)
BC			
Constant	0.406*** (0.099)	0.378*** (0.100)	0.395*** (0.103)
Observations	725	725	714
R^2	0.384	0.376	0.379
Adjusted R^2	0.369	0.361	0.364
Residual Std. Error	0.397 (df = 707)	0.399 (df = 707)	0.398 (df = 696)
F Statistic	25.934*** (df = 17; 707)	25.045*** (df = 17; 707)	24.987*** (df = 17; 696)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 3: Gasoline prices and support for a carbon tax - all survey waves

	Dependent variable:		
	Support for a carbon tax		
	(1)	(2)	(3)
Average price previous calendar month	−0.0004 (0.001)		
Price change over previous month	−0.003* (0.002)		
Average price previous week		0.001 (0.001)	
Price change previous week		−0.001 (0.002)	
Price change previous two months			−0.002* (0.001)
CMA	0.094*** (0.026)	0.094*** (0.026)	0.094*** (0.026)
Income	−0.001 (0.004)	−0.001 (0.004)	−0.001 (0.004)
Female	0.024 (0.017)	0.024 (0.017)	0.024 (0.017)
Age	−0.002*** (0.001)	−0.001*** (0.001)	−0.001*** (0.001)
University	0.112*** (0.018)	0.113*** (0.018)	0.113*** (0.018)
Greens	−0.058 (0.036)	−0.054 (0.036)	−0.057 (0.036)
Conservatives	−0.515*** (0.022)	−0.514*** (0.022)	−0.515*** (0.022)
NDP	−0.094*** (0.028)	−0.092*** (0.028)	−0.092*** (0.028)
Peoples	−0.410*** (0.056)	−0.417*** (0.056)	−0.415*** (0.056)
BQ	−0.066 (0.043)	−0.065 (0.043)	−0.064 (0.043)
Liberals			
ON	0.037 (0.034)	0.040 (0.035)	0.031 (0.028)
QC	0.114*** (0.032)	0.109*** (0.034)	0.105*** (0.030)
SK	−0.055 (0.038)	−0.046 (0.040)	−0.055* (0.029)
AB	−0.033 (0.042)	−0.011 (0.046)	−0.029 (0.028)
BC			
Constant	0.702*** (0.155)	0.545*** (0.166)	0.653*** (0.054)
Observations	2,420	2,420	2,420
R^2	0.313	0.311	0.312
Adjusted R^2	0.308	0.307	0.308
Residual Std. Error	0.415 (df = 2403)	0.416 (df = 2403)	0.415 (df = 2404)
F Statistic	68.343*** (df = 16; 2403)	67.854*** (df = 16; 2403)	72.650*** (df = 15; 2404)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4: Gasoline prices and support for a carbon tax - individual survey waves

	Dependent variable:			
	Support for a carbon tax			
	(1)	(2)	(3)	(4)
Average price previous calendar month	−0.002 (0.004)	0.004 (0.003)	−0.002 (0.003)	0.001 (0.003)
Price change over previous month	−0.010* (0.006)	−0.004 (0.005)	−0.004 (0.004)	−0.002 (0.005)
Driver	−0.112*** (0.033)			
CMA	0.118** (0.049)	0.103** (0.043)	0.035 (0.044)	0.136*** (0.046)
Children	0.006 (0.018)			
Income	0.008 (0.008)		−0.008 (0.007)	0.003 (0.008)
Female	0.035 (0.030)	−0.010 (0.027)	0.007 (0.030)	0.018 (0.031)
Age	−0.002 (0.001)	−0.002** (0.001)	−0.002* (0.001)	−0.001 (0.001)
University	0.077** (0.032)		0.112*** (0.031)	0.124*** (0.033)
Climate science	0.300*** (0.035)			
Greens	−0.036 (0.063)	−0.071 (0.055)	−0.121** (0.054)	0.044 (0.076)
Conservatives	−0.354*** (0.040)	−0.552*** (0.036)	−0.550*** (0.038)	−0.536*** (0.039)
NDP	−0.008 (0.049)	−0.115*** (0.044)	−0.108** (0.048)	−0.128*** (0.047)
Peoples	−0.189** (0.078)	−0.444*** (0.082)	−0.509*** (0.088)	
BQ	−0.001 (0.080)	−0.201** (0.078)	−0.083 (0.079)	−0.040 (0.070)
Liberals				
ON	−0.0001 (0.121)	0.106 (0.085)	−0.018 (0.091)	0.101 (0.085)
QC	0.068 (0.086)	0.198*** (0.069)	0.080 (0.078)	0.123 (0.090)
SK	−0.086 (0.125)	0.061 (0.101)	−0.089 (0.095)	0.031 (0.094)
AB	−0.046 (0.131)	0.058 (0.088)	−0.073 (0.113)	0.074 (0.114)
BC				
Constant	0.681 (0.570)	0.232 (0.395)	1.019** (0.424)	0.342 (0.422)
Observations	725	950	852	760
R^2	0.388	0.322	0.315	0.327
Adjusted R^2	0.371	0.312	0.302	0.314
Residual Std. Error	0.396 (df = 705)	0.414 (df = 935)	0.418 (df = 835)	0.414 (df = 744)
F Statistic	23.478*** (df = 19; 705)	31.688*** (df = 14; 935)	23.976*** (df = 16; 835)	24.149*** (df = 15; 744)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5: Gasoline prices and support for a carbon tax - fixed effect models

	Dependent variable:	
	Support for a carbon tax	
	(1)	(2)
Average price previous calendar month	−0.0005 (0.001)	
Price change over previous month	−0.003** (0.002)	
Average price previous week		0.001 (0.001)
Price change previous week		0.001 (0.002)
Age	0.008 (0.017)	0.032** (0.016)
Greens	0.040 (0.046)	0.042 (0.046)
Conservatives	0.022 (0.037)	0.020 (0.037)
NDP	0.052 (0.035)	0.051 (0.035)
Peoples	−0.012 (0.064)	−0.020 (0.064)
BQ	0.078 (0.060)	0.070 (0.060)
SK	−0.005 (0.420)	0.019 (0.421)
AB	−0.011 (0.242)	−0.010 (0.243)
Observations	2,420	2,420
R^2	0.011	0.006
Adjusted R^2	−0.615	−0.624
F Statistic (df = 10; 1481)	1.652*	0.891
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 6: Who overestimates fuel prices? The share of prices that is a carbon tax?

	Dependent variable:	
	Overestimation carbon tax	Overestimation gas prices
	(1)	(2)
CMA	−0.551 (2.527)	−1.562 (3.423)
Income		1.482*** (0.567)
Female	6.466*** (1.745)	1.954 (2.295)
Age	−0.078 (0.056)	−0.015 (0.072)
University		−4.264* (2.428)
Greens	−4.597 (3.479)	4.150 (4.174)
Conservatives	9.916*** (2.299)	1.009 (2.945)
NDP	−1.300 (2.802)	0.496 (3.656)
Peoples	3.345 (5.362)	11.519* (6.811)
BQ	−3.576 (4.798)	1.721 (6.097)
Liberals		
ON	−33.403*** (2.692)	−3.086 (3.524)
QC	−7.093** (2.909)	−1.543 (3.665)
SK	−34.189*** (2.713)	−5.734 (3.634)
AB	−4.690* (2.727)	−4.123 (3.574)
BC		
Constant	50.263*** (4.921)	−1.552 (6.850)
Observations	817	893
R^2	0.299	0.017
Adjusted R^2	0.289	0.001
Residual Std. Error	24.346 (df = 804)	32.939 (df = 878)
F Statistic	28.587*** (df = 12; 804)	1.078 (df = 14; 878)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 7: Overestimations and support for a carbon tax - all survey waves

	Dependent variable:		
	Support for a carbon tax		
	(1)	(2)	(3)
Overestimation gas prices	−0.001** (0.0003)		−0.001** (0.0003)
Overestimation carbon tax		−0.003*** (0.0004)	−0.003*** (0.0004)
CMA	0.093*** (0.026)	0.080*** (0.028)	0.079*** (0.028)
Income	−0.001 (0.004)	−0.002 (0.005)	−0.001 (0.005)
Female	0.025 (0.017)	0.072*** (0.020)	0.073*** (0.020)
Age	−0.001*** (0.001)	−0.001* (0.001)	−0.001* (0.001)
University	0.110*** (0.018)	0.127*** (0.020)	0.122*** (0.020)
Greens	−0.052 (0.036)	−0.064 (0.040)	−0.061 (0.040)
Conservatives	−0.514*** (0.022)	−0.473*** (0.025)	−0.473*** (0.025)
NDP	−0.091*** (0.028)	−0.134*** (0.031)	−0.134*** (0.031)
Peoples	−0.416*** (0.056)	−0.422*** (0.067)	−0.420*** (0.066)
BQ	−0.064 (0.043)	−0.099** (0.048)	−0.098** (0.048)
Liberals			
ON	0.016 (0.027)	−0.067** (0.032)	−0.066** (0.032)
QC	0.091*** (0.029)	0.092*** (0.032)	0.094*** (0.032)
SK	−0.072** (0.028)	−0.143*** (0.032)	−0.144*** (0.032)
AB	−0.043 (0.028)	−0.062** (0.031)	−0.061** (0.031)
BC			
Constant	0.671*** (0.053)	0.754*** (0.061)	0.754*** (0.061)
Observations	2,420	1,988	1,988
R^2	0.312	0.312	0.314
Adjusted R^2	0.308	0.307	0.309
Residual Std. Error	0.415 (df = 2404)	0.415 (df = 1972)	0.414 (df = 1971)
F Statistic	72.808*** (df = 15; 2404)	59.616*** (df = 15; 1972)	56.438*** (df = 16; 1971)
Note:			*p<0.1; **p<0.05; ***p<0.01

5.2 Support for a carbon tax: gasoline prices

Table 3 reports the result of different specifications of the second model, ran over the entire panel survey. These specifications include average gasoline prices and prices changes over the past month, the past week, and the past two months.

In all specifications, average prices at the pump do not significantly affect support for a carbon tax, but recent increases in the price of gasoline do. One additional cent increase in the price of gasoline per litre over the past month decreases support for a carbon tax by 0.3%, or 3% per 10 cents. One additional cent increase in the price of gasoline over the past two months decreases support by 0.2%. This is particularly significant in the context of the survey; gasoline prices increased by roughly $0.33 per litre in early 2019, most of that before implementation of the federal carbon tax. The discussion of the detailed analysis of support for a carbon over each survey wave sheds more light on the effect of recent changes in the price of gasoline.

Interestingly, more recent changes in the price of gasoline - over the past week - do not seem to affect support for a carbon tax, possibly because not all respondents' had refueled that week or because weekly fluctuations are common in any case. However, price changes over the past two months have a smaller impact on support than price changes over past month. This suggests that people are more attentive and responsive to relatively recent prices.

The effects of living in an urban center, having a university degree, and province of residence are like those discussed in the interpretation of Table 2 for all the specifications presented in Table 3. Age decreases support for a carbon tax by 0.2% per additional year. This finding echoes Thalmann's (2004) discussion of the role of age in support for environmental

taxes. As in Table 2, partisanship influences support for a carbon tax. An additional finding is that supporters of the NDP are less supportive of a carbon tax than Liberals, by 9.2% to 9.4%.

A sharp increase in gasoline prices at the beginning of 2019, before the second survey wave, prompted me to repeat the forgoing analysis for individual survey waves. Table 4 presents the result of the second model carried out over each survey wave with prices and price changes over the past month as main independent variables.

As in Table 3, prices at the pump remain insignificant, but price changes over the past month significantly decrease support only in the first survey wave. In this wave, an additional increase of one cent per litre of gasoline over the past month decreased support by 1%. This is interesting because prices one month before the first survey wave – in January 2019 - were relatively low and steady. They fluctuated by plus or minus 5 cents January 2019, compared to a more noticeable 15 cents increase one month before the second survey wave, in March 2019. The absence of significant estimates for price changes in the second and subsequent survey waves creates uncertainty around the above finding. One potential explanation is that data about respondents' transportation habits is available and included in the model only for the first survey wave. Increases in the price per litre of gasoline might only matter for respondents who rely on cars for personal transportation.

Living in an urban setting significantly increases support for a carbon tax across all the survey waves, as does having a university degree.[7] In the first survey wave, believing in climate

[7] Remember that data about respondents' educational attainment is unavailable in the second survey wave.

change still significantly increases support. In the second and third waves, age decreases support by 0.2% per additional year.

Partisanship significantly affected support for a carbon tax across all survey waves. Intention to vote for the Conservative party or the People's Party decreased support for a carbon tax by 35.5% and 19% respectively in the first survey wave, in comparison to intention to vote for the Liberal party. From the second wave onwards, intention to vote for the Conservative party and the People's Party decreased support by 51% and 41% respectively, and intention to vote for the NDP decreased support for a carbon tax by 10 to 12% compared to intending to vote for the Liberal party. In the second wave, being affiliated with the Bloc Quebecois decreased support for a carbon tax by 20%. In the third wave, being affiliated with the Green party decreased support by 12%. The change in the effect of intention to vote for the Conservative party or the People's Party from the first to the second, third and fourth waves might be attributable to omitted variable bias. Related factors such as acceptance of climate change science and transportation habits are only controlled for in the first survey wave because these variables are unavailable in other survey waves. Another explanation could be that respondents became more interested and animated about politics as the 2019 federal elections approached. Omitted variable bias and increased attention to politics might also explain the emergence of a partisan effect for the NDP, the Bloc Quebecois and the Green Party after the first survey wave.

Province of residence does not have a significant impact on support in Table 4. The only exception is that Quebecers were more supportive of carbon pricing than British Columbians in the second survey wave. This could be because they realized that they were not subjected to the federal carbon tax, nor any other carbon tax, because they are generally more concerned about

climate change than residents in other provinces, or because they value their province's cap-and-trade system.

Table 5 presents results from two specifications of the third model, a fixed effects model, run over the entire panel survey. The F-statistic is only significant for the specification that includes prices and price changes over the past month. For this specification, the sum of squared residual is very small, and the adjusted sum of squares is negative. Therefore, I report significant estimates from this model but cannot consider them as conclusive. As observed in Table 3, one additional cent increase in the price of gasoline over the past month appears to decrease support for a carbon tax by 0.3%.

The fact that the dependent variable of interest, support for a carbon tax, is a binary variable limits the probability of finding significant results. The likelihood that a binary variable varies greatly for one individual is limited, especially for a panel ran over one year. A longer survey with more a more granular measurement method for support for a carbon tax (e.g.: percent support for a carbon tax) could yield more conclusive results.

5.3 Overestimations: characteristics

Table 6 presents the results of two specifications of the fourth regression model. The first specification includes overestimations of the impact of a carbon tax on gasoline prices was carried out using data from the second survey wave. The second specification concerning overestimations of gasoline prices employs data from the third survey wave.

The mean overestimation of the share of recent gasoline price increases attributable to a carbon tax is 36.75% over the actual share (in percent) of recent gasoline price increases attributable to a carbon tax. This observation could directly result from the survey question design. Respondents were asked to report the share of recent gasoline price fluctuations that they believed was attributable to a carbon tax versus market fluctuations on a 0 to 100 sliding scale. Many respondents seem to have defaulted for the mid-point, 50%. Interestingly, the mean overestimation of recent gasoline prices in respondents' area of residence is quite small, 0.57 cents per liter, though with a standard deviation of 33 cents. Despite potential measurement issues, these observations suggest that people overestimate the impact of a carbon tax on gasoline prices but have a relatively accurate perception of these prices.

The F-statistic for the first specification is significant, but not for the second specification. The sum of squared residual is acceptable for the first specification. Therefore, I report significant results for the first specification only.

Respondents identifying as female overestimate the share of recent gasoline price increases attributable to a carbon tax 6.4% more than respondents identifying as male. This could be because more respondents identifying as female defaulted for the mid-point of the sliding scale. Respondents intending to vote for the Conservative party overestimate the share of recent price increases attributable to a carbon tax by 9.9% more than respondents affiliated with the Liberal party. This provides evidence of a partisan bias not only in support for a carbon tax, but in perceptions of the magnitude of the tax. The next sub-section discusses the effect of such bias on support for a carbon tax.

Respondents in Ontario and Saskatchewan, where the federal carbon tax was implemented, overestimate the share of recent gasoline price increases attributable to a carbon

tax about 34% less than respondents in British Columbia. This could be because they received more information about the impact of the federal carbon tax on gasoline prices. Respondents in Alberta and Quebec also overestimate the share of price increases attributable to a carbon tax less than British Columbians, by 4 to 7%. This could be because Alberta's carbon tax was a salient topic during the leadup to the election campaign soon after the second survey wave, and because Quebecers were aware that they were not subjected to a carbon tax. Quebecers might also not perceive the impact of the cap-and-trade system on gasoline prices. It has to be noted that the constant for overestimations of the share of recent price increases attributable to a carbon tax is 50.2%, or 36.9% above the actual share. It means that even if some respondents overestimate less than others, they still overestimate.

5.4 Support for a carbon tax: overestimations

Table 7 reports the result of different specifications of the fifth model run over the entire panel survey. One specification includes overestimations of gasoline prices, another includes overestimations of the share of recent gasoline price increases attributable to a carbon tax, and a final specification includes both types of overestimations. The rationale behind running these three specifications is that people are likely to perceive prices accurately, as suggested by the low mean overestimation of gasoline prices but may overestimate the impact of a carbon tax. They might also overestimate both, or just gasoline prices.

Significant coefficients include that overestimating gasoline prices by one additional cent decreases support for a carbon tax by 0.1%. Overestimating the share of recent gasoline price increases that is attributable to a carbon tax by one additional percent over the actual share

of prices attributable to a carbon tax decreases support by 0.3%. Together, overestimations decrease support by 0.4%.

Table 7 reports that when overestimations of the impact of a carbon tax are controlled for, Conservatives support a carbon tax less than Liberals by a somewhat smaller percentage than in other models (47% against 51%). Table 6 indicated that Conservatives are prone to overestimate the share of recent price increases attributable to a carbon tax. Together, these observations could suggest that overestimations of the impact of a carbon tax on gasoline prices decrease support.

Although suggestive, these findings must be viewed with caution given a potential issue of endogeneity mentioned previously. From the statistical models presented in this thesis, it is not possible to clearly distinguish whether respondents' support for a carbon tax decreases because they overestimate its impact on gasoline prices, or if they overestimate the carbon tax's impact on gasoline prices because they oppose the tax. Partisans, for example, may oppose a carbon tax in accordance with their party's stance. They could then receive or consume partisan information leading them to overestimate the impact of a carbon tax on gasoline prices. They could also overestimate the impact of the tax to align their political views on a carbon tax.

5.5 Summary of findings

Notable findings presented in this section are that individual reliance on cars decreases support for a carbon tax by 11.3%, and living in an urban center, where public transit provides more viable alternatives to individual vehicles, increases support for a carbon tax by 9.4% to 9.9%. These findings are consistent with existing literature. Another finding is that increases in the price of gasoline over the previous month decrease support for a carbon tax by 0.3% per

additional cent. Partisanship is also found to strongly affect support for a carbon tax in Canada. People intending to vote for the Conservative party of Canada were about 35% less supportive of a carbon tax than those intending to vote Liberal.

Overestimations of the impact of a carbon tax on gasoline prices appear to affect support for a carbon tax, as suggested by Carattini et al. (2018) and Rivers and Schaufele (2015). However, the statistical models used in this thesis do not allow me to resolve a potential endogeneity problem through which opposition to a carbon tax could generate overestimations of the impact of such a tax on gasoline prices.

Chapter 6: Conclusion

This thesis complements existing literature on public opposition to carbon taxes. It explores how modes of transportation and actual and perceived increases in personal transportation costs affect public support for a carbon tax in the context of Canada. The thesis leverages an original, four-wave panel survey collected in five Canadian provinces after the implementation of the federal carbon tax in some provinces in 2019. It proposes a series of statistical models, including a fixed-effects model.

The main findings are that driving as respondents' principal mode of transportation to work or school decreases support for a carbon tax by 11.3%, recent increases in the price of gasoline decrease support for a carbon tax by 0.3% per additional cent, and overestimations of the impact of a carbon tax on gasoline prices appear to decrease support for such tax. Another important finding is that living in an urban area, in the Canadian context, increases support for a carbon tax by 9.4% to 9.9% compared to living in a suburban, rural or remote area. Partisanship, particularly intention to vote for the Conservative Party of Canada, is also found to have a strong negative effect on support for a carbon tax.

A key implication of these findings is that policy makers could benefit from delaying the implementation of a carbon tax if they observed a surge in gasoline prices shortly before the implementation date. Another finding reported in this thesis points at the potential significance of information campaigns in mitigating overestimations of the impact of a carbon tax on gasoline prices in Canada. This, in turn, might increase public support, but would require more research.

Several missing survey variables and issues in statistical models indicate future research avenues to validate or supplement the above findings. Data about respondents' transportation

habits was only available in the first survey wave. Collecting data about transportation in a longer timeframe could generate refined estimates, including whether respondents changed their transportation habits in response to carbon pricing. A longer survey could help generate significant estimates for individual fixed-effects models. The sample studied in this thesis is not representative of the Canadian population with regards to partisanship. Including population weights in statistical models could help contribute to a better appreciation of the role of partisanship in support for a carbon tax, in relation to transportation habits and costs. In general, more research is needed to uncover how overestimations of the impact of a carbon tax on gasoline prices affect support for a carbon tax. An experimental setting could help circumvent the potential endogeneity issue discussed in this thesis.

References

Ammar, Nasreddine, and Parliamentary Budget Officer. 2020. "Reviewing the Fiscal and Distributional Analysis of the Federal Carbon Pricing System." *Office of the Parliamentary Budget Officer.* https://www.pbo-dpb.gc.ca/web/default/files/Documents/Reports/RP-1920-024-S/RP-1920-024-S_en.pdf

Alberta. 2018. "Climate Leadership Plan." *Government of Alberta.* https://open.alberta.ca/dataset/da6433da-69b7-4d15-9123-01f76004f574/resource/b42b1f43-7b9d-483d-aa2a-6f9b4290d81e/download/clp_implementation_plan-jun07.pdf

Anderson, Soren, Ioana Elena Marinescu, and Boris Shor. 2019. "Can Pigou at the Polls Stop US Melting the Poles?" *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3400772.

British Columbia. nd. "British Columbia's Carbon Tax" *Government of British Columbia.* https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax#:~:text=Learn%20more%20about%20the%20one,%2440%20per%20tCO2e.&text=To%20improve%20affordability%2C%20in%202019,as%20of%20July%201%2C%202019.

Bullock, John G., Alan S. Gerber, Seth J. Hill, and Gregory Huber. 2015. "Partisan Bias in Factual Beliefs about Politics." *Quarterly Journal of Political Science* 10 (4): 519–78. https://doi.org/10.1561/100.00014074.

Bureau, Dominique, Fanny Henriet, and Katheline Schubert. 2019. "Pour le climat : une taxe juste, pas juste une taxe." *Notes du conseil d'analyse économique* 50 (2): 1-12. https://doi:10.3917/ncae.050.0001.

Canada Energy Regulator (CER). 2019. "Market Snapshot: How does Canada rank in terms of vehicle fuel economy?" *Government of Canada.* https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/snpsht/2019/07-05hwdscndrnk-eng.html

Canada Revenue Agency (CRA). 2019. "5008-S14 Schedule 14, Climate Action Incentive (Ontario only)" *Government of Canada.* https://www.canada.ca/en/revenue-agency/services/forms-publications/tax-packages-years/archived-general-income-tax-benefit-package-2018/ontario/5006-s14.html

———. 2019. "5008-S14 Schedule 14, Climate Action Incentive (Saskatchewan only)" *Government of Canada.* https://www.canada.ca/en/revenue-agency/services/forms-publications/tax-packages-years/archived-general-income-tax-benefit-package-2018/saskatchewan/5008-s14.html

Canadian Fuels Association. 2020. "What's up with the price of gasoline?" Accessed August 15th, 2020. https://www.canadianfuels.ca/Fuels-and-Transportation/Whats-up-with-the-price-of-gasoline/

Carattini, Stefano, Maria Carvalho, and Sam Fankhauser. 2018. "Overcoming Public Resistance to Carbon Taxes." *Wiley Interdisciplinary Reviews: Climate Change* 9 (5): 1–26. https://doi.org/10.1002/wcc.531.

Climate Change Canada. "Pollution pricing." *Government of Canada*, July 11, 2019. https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work.html

Climate Leadership Council. Nd. "Economists' Statement on Carbon Dividends." Accessed August 15th, 2020. https://clcouncil.org/economists-statement/

Davidovic, Dragana, Niklas Harring, and Sverker C. Jagers. 2020. "The Contingent Effects of Environmental Concern and Ideology: Institutional Context and People's Willingness to Pay Environmental Taxes." *Environmental Politics* 29 (4): 674–96. https://doi.org/10.1080/09644016.2019.1606882.

European Association of Environmental and Resource Economists (EAERE). Nd. "Economists' Statement on Carbon Pricing." Accessed August 15th, 2020. http://www.eaere.org/statement/

Elections Canada. 2020. Coin des cartes. Accessed August 15th. Available from: https://www.elections.ca/content.aspx?section=res&dir=cir/maps2&document=index&lang=f

Environment Québec. nd. "A brief look at the Quebec cap-and-trade system for emission allowances." *Government of Quebec.* http://www.environnement.gouv.qc.ca/changements/carbone/documents-spede/in-brief.pdf

Gray, Kelly. 2019. "Forecourt Performance Report 2019." *CCentral*, http://ccentral.ca/forecourt-performance-report-2019/

Harrison, Kathryn. 2013. "The Political Economy of British Columbia's Carbon Tax." *OECD Environment Working Papers* (63): 3-22. http://dx.doi.org/10.1787/5k3z04gkkhkg-en

Howe, Peter, Matto Mildenberger, Jennifer Marlon, and Anthony Leiserowitz. 2015. "Geographic variation in opinions on climate change at state and local scales in the USA." *Nature Climate Change* (5): 596–603. https://doi.org/10.1038/nclimate2583

Hsu, Shi Ling, Joshua Walters, and Anthony Purgas. 2008. "Pollution Tax Heuristics: An Empirical Study of Willingness to Pay Higher Gasoline Taxes." *Energy Policy* 36 (9): 3612–19. https://doi.org/10.1016/j.enpol.2008.06.010.

International Carbon Action Partnership (ICAP). 2019. "Canada - Québec Cap-and-Trade System." https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems[]=73

———. 2020. "Allowance Price Explorer." https://icapcarbonaction.com/en/ets-prices

Jones, Allison. 2019. "Ford government argues carbon tax stickers on gas pumps help 'further' free expression." *CCTV News,* October 30. https://toronto.ctvnews.ca/ford-government-argues-carbon-tax-stickers-on-gas-pumps-help-further-free-expression-1.4662986

Kent Group Ltd. 2020. *Petroleum Price Data.* Accessed August 15th. Available from: https://charting.kentgroupltd.com/

———. 2016. "The Changing Role of Higher Octane Gasoline in the Canadian Retail Fuels Market." April 22. https://www.kentgroupltd.com/changing-role-higher-octane-gasoline-canadian-retail-fuels-market/

Koehl, Albert. 2014. "Let's talk about the car population problem." *The Star,* February 19. https://www.thestar.com/opinion/commentary/2014/02/19/lets_talk_about_the_car_population_problem.html#:~:text=The%20average%20Canadian%20household%20has,of%20joy%20from%20auto%20dealerships.

Kotchen, Matthew J., Zachary M. Turk, and Anthony A. Leiserowitz. 2017. "Public Willingness to Pay for a US Carbon Tax and Preferences for Spending the Revenue." *Environmental Research Letters* 12 (9). https://doi.org/10.1088/1748-9326/aa822a.

Lachapelle, Erick, Christopher P. Borick, and Barry Rabe. 2012. "Public Attitudes toward Climate Science and Climate Policy in Federal Systems: Canada and the United States Compared." *Review of Policy Research* 29 (3): 334–57. https://doi.org/10.1111/j.1541-1338.2012.00563.x.

Leger Marketing. 2019. *Report: Federal Politics.* February. https://leger360.com/surveys/federal-politics-february-21-2019/

———. 2019. *Report: Federal Politics.* April. https://leger360.com/surveys/federal-politics-april-28-2019/

Mildenberger, Matto, Erick Lachapelle, and Kathryn Harrison. 2020. "Climate rebates did not significantly increase Canadian support for carbon pricing." Working Paper.

Mildenberger, Matto, Peter Howe, Erick Lachapelle, Leah Stokes, Jennifer Marlon, and Timothy Gravelle. 2016. "The Distribution of Climate Change Public Opinion in Canada." *PLoS ONE* 11 (8). https://doi.org/10.1371/journal.pone.0159774.

Mildenberger, Matto, Peter Howe, Erick Lachapelle, Jennifer Marlon, Anthony Leiserowitz, Leah Stokes, and Xinran Wang. 2019. "Canadian Climate Opinion Map 2018." https://climatecommunication.yale.edu/visualizations-data/ccom/

Moshiri, Saeed. 2020. "Consumer Responses to Gasoline Price and Non-Price Policies." *Energy Policy* 137 (November 2019): 111078. https://doi.org/10.1016/j.enpol.2019.111078.

Murray, Brian, and Nicholas Rivers. 2015. "British Columbia's Revenue-Neutral Carbon Tax: A Review of the Latest 'Grand Experiment' in Environmental Policy." *Energy Policy* 86: 674–83. https://doi.org/10.1016/j.enpol.2015.08.011.

Natural Resources Canada (NRCan). 2020. "Fuel Consumption Levies in Canada." *Government of Canada.* https://www.nrcan.gc.ca/our-natural-resources/domestic-international-markets/transportation-fuel-prices/fuel-consumption-levies-canada/18885

Peet, Chelsea, and Kathryn Harrison. 2012. "Diverse Regional Reactions to British Columbia's Carbon Tax." *BC Studies* 173: 97–123.

Rivers, Nicholas, and Brandon Schaufele. 2015. "Salience of Carbon Taxes in the Gasoline Market." *Journal of Environmental Economics and Management* 74: 23–36. https://doi.org/10.1016/j.jeem.2015.07.002.

Rotaris, Lucia, and Romeo Danielis. 2019. "The Willingness to Pay for a Carbon Tax in Italy." *Transportation Research Part D: Transport and Environment* 67 (January): 659–73. https://doi.org/10.1016/j.trd.2019.01.001.

Statistics Canada. 2017. "Journey to work: Key results from the 2016 Census." *The Daily,* November 29. https://www150.statcan.gc.ca/n1/daily-quotidien/171129/dq171129c-eng.htm?indid=14433-4&indgeo=0

———. 2020. *Table 23-10-0067-01: Vehicle registrations, by type of vehicle.* Accessed August 15th. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2310006701

Stolle, Dietlind, and Elisabeth Gidengil. 2010. "What Do Women Really Know? A Gendered Analysis of Varieties of Political Knowledge." *Perspectives on Politics* 8 (1): 93–109. https://doi.org/10.1017/S1537592709992684.

Thalmann, Philippe. 2004. "The Public Acceptance of Green Taxes: 2 Million Voters Express Their Opinion." *Public Choice* 119 (1–2): 179–217. https://doi.org/10.1023/b:puch.0000024165.18082.db.

Wadud, Zia, Daniel J. Graham, and Robert B. Noland. 2016. "Gasoline Demand with Heterogeneity in Household Responses." *International Association for Energy Economics* 31 (1): 47–74.

Appendix A: Composition of the price of gasoline in Canada

The price of gasoline is set based on the price of crude oil, refining and marketing margins, and taxes. Fluctuations in the international market for crude have a direct impact on prices at the pump. Regional differences, and the presence or absence of a refinery nearby will impact the refining and marketing operating margins. This explains why gasoline, and generally motor fuels, are cheaper in the oil-producing provinces of Alberta and Saskatchewan compared to other provinces. Several taxes apply on gasoline in Canada; they are presented in Table 8. Taxes include the federal goods and services tax, provincial sales taxes, federal and provincial gasoline taxes, transit-taxes in several metropolitan areas (Montréal, Victoria, and Metro Vancouver), and a carbon tax or price.

The average price of one litre of gasoline in Toronto in 2019, CAD$1.17, can be broken down as follows: 45.5 cents were the costs of crude oil, 24.4 cents were the refining margin, 8 cents were the marketing operating margin, and 41.5 cents were taxes (Canadian Fuels Association 2020).

The price of gasoline varies between seasons, with higher prices in the summer. This phenomenon can be explained by a higher demand for gasoline in the summer, as people travel to their vacation destinations. It is also explained by regulations on gasoline evaporation; to comply with these regulations during warm summer days, anti-evaporation additives are added to gasoline. This increases the refining margin by several cents.

BRITISH COLUMBIA	Gasoline	Diesel
Provincial Tax	14.5	15.0
Carbon Tax	8.9	10.2
Federal Tax	10.0	4.0
GST/HST (%)	5%	5%
Provincial Tax-Vancouver	8.5	9.0
Transit Tax-Vancouver	18.5	18.5
Transit Tax-Victoria	5.5	5.5
ALBERTA	Gasoline	Diesel
Provincial Tax	13.0	13.0
Carbon Tax		
Federal Tax	10.0	4.0
GST/HST (%)	5%	5%
SASKATCHEWAN	Gasoline	Diesel
Provincial Tax	15.0	15.0
Carbon Tax	4.4	5.4
Federal Tax	10.0	4.0
GST/HST (%)	5%	5%
ONTARIO	Gasoline	Diesel
Provincial Tax	14.7	14.3
Carbon Tax	4.4	5.4
Federal Tax	10.0	4.0
GST/HST (%)	13%	13%
QUEBEC	Gasoline	Diesel
Provincial Tax	19.2	20.2
Federal Tax	10.0	4.0
GST/HST (%)	5%	5%
Transit Tax-Montreal	3.0	0.0
QST	9.975%	9.975%

Table 8: Schedule of taxes applicable on motor fuels in 2019 as of September 1st, 2019 for five provinces (cents/litre, unless indicated otherwise) (compiled by the Kent Group Ltd. 2020)

Appendix B: Descriptive statistics

Table 9: Summary statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Support	4,154	0.452	0.498	0.000	0.000	1.000	1.000
Driver	1,138	0.364	0.481	0.000	0.000	1.000	1.000
Cars	1,138	1.492	0.934	0.000	1.000	2.000	5.000
Monthly gas spending	1,096	4.915	2.604	1.000	3.000	6.000	12.000
CMA	4,552	0.874	0.332	0	1	1	1
Children	1,138	0.430	0.879	0.000	0.000	0.000	6.000
Income	3,024	4.187	2.069	1.000	3.000	6.000	9.000
Female	4,552	0.500	0.502	0	0	1	2
Age	4,552	51.846	15.933	18	39	64	90
University	3,414	0.348	0.476	0.000	0.000	1.000	1.000
Climate science	1,004	0.640	0.480	0.000	0.000	1.000	1.000
Overestimation gas prices	4,552	0.578	33.948	−200.767	−4.817	6.233	147.950
Overestimation carbon tax	3,700	36.758	29.121	−59.111	15.000	55.000	97.000

Table 9: Descriptive statistics of variables of interest

In Table 9, the variable "Support" corresponds to support for a carbon tax. It is a dummy variable with 1 equal to "somewhat supports" or "strongly supports", and 0 equal to "strongly opposes" or "somewhat opposes". Converted in percentage, the mean support for a carbon tax in all provinces, during the four survey waves was 45.2%.

"Cars" corresponds to the number of cars each respondent's household owns. The variable "Spending" corresponds to the average monthly gasoline expenditure of each respondent's household. It is a categorical variable and the mean monthly expenditure is somewhere between CAD$100 and CAD$149, leaning towards CAD$149.

"CMA" is the short for Census Metropolitan Area, corresponding to the major urban centers in Canada. Respondents were assigned 1 when living in one of them, and 0 otherwise.

"Climate science" corresponds to acceptance of climate change science. 0 means that the respondent denies the existence of climate change or denies that it is caused by human activities. 1 means that they accept climate change science which proves that climate change is anthropogenic.

"University" captures respondents' educational attainment. It is a dummy variable equal to one if respondents are university graduates, 0 for all others.

"Overestimation gas prices" compares respondents' recollection of gasoline prices in their local areas during the week before the third survey wave to actual gasoline prices in the local areas during the week before the third survey wave. The variable captures difference with actual prices in cents per litre. On average, respondents overestimate the price of gasoline in their local area by only 0.58 cents per litre, but overestimations varied greatly as indicated by the standard deviation. It might reflect that some respondents drive seldom or never.

"Overestimation carbon tax" compares respondents' belief about the share of recent fluctuations in the price of gasoline that is attributable to a carbon tax to the actual share of recent fluctuations in the price of gasoline that is attributable to a carbon tax. For this variable, it was assumed that respondents in provinces other than Ontario and Saskatchewan were not facing a carbon tax or other carbon pricing schemes. Responses form respondents in Ontario and Saskatchewan were compared to the 4.4 cents that the federal carbon tax added to the price per litre of gasoline. The variable is expressed in percent over the actual percentage. On average, respondents overestimate the share of recent fluctuations in the price of gasoline that is attributable to a carbon tax by 36.75% over the actual share. It has to be noted that the question for this variable may have induced bias; a large number of respondents seem to have defaulted for the value "50%" when asked how much of recent gasoline price fluctuations were attributable to a carbon tax. This is obviously over the average 13.3% increase attributable to the federal carbon tax in Ontario and Saskatchewan. The exact wording and response collection method for this variable is presented in Appendix C.

Table 10: Average number of respondent for each province and each partisanship

ON	QC	BC	SK	AB	Greens	Liberals	Conservatives	NDP	Peoples	BQ
203.25	201.50	190.50	183.25	195.75	77.50	242.75	416.75	163.25	24.50	49.50

Table 10: Average number of respondents for each province or partisanship in a single survey wave

Table 10 present the average number of respondents living in each province and affiliated with each party across the four waves of the survey. Provinces are referred to by their two-letter province codes. “Peoples” corresponds to supporters of the People’s Party of Canada. “BQ” corresponds to the supporters of the Bloc Quebecois.

As noted in Chapter 4, section 4.1, the survey sample is not nationally representative with regards to partisanship. This is because a large share of Albertans and Saskatchewanians are Conservatives, and respondents from these provinces were overrepresented to hold the number of respondents from each province relatively equal.

Appendix C: Merging gasoline prices with the Canadian Climate Opinion Panel survey

Table 11 presents a list of the municipalities for which retail gasoline prices were available in the Kent Group Ltd. price dataset (Kent Group Ltd. 2020). Prices from these municipalities were associated to each respondent based on their electoral riding (derived from the postal code which they reported in the Canadian Climate Opinion Panel survey). For associations that required a geographical visualization of the electoral riding, I used the electoral riding maps provided by Elections Canada (Elections Canada 2020).

Cities	Province	Cities	Province
VANCOUVER	BC	PETERBOROUGH	ON
VICTORIA	BC	WINDSOR	ON
PRINCE GEORGE	BC	LONDON	ON
KAMLOOPS	BC	SUDBURY	ON
KELOWNA	BC	SAULT STE MARIE	ON
FORT ST. JOHN	BC	THUNDER BAY	ON
ABBOTSFORD	BC	NORTH BAY	ON
CALGARY	AB	TIMMINS	ON
RED DEER	AB	HAMILTON	ON
EDMONTON	AB	ST. CATHARINES	ON
LETHBRIDGE	AB	BARRIE	ON
LLOYDMINSTER	AB	BRANTFORD	ON
GRANDE PRAIRIE	AB	GUELPH	ON
REGINA	SK	KITCHENER	ON
SASKATOON	SK	OSHAWA	ON
PRINCE ALBERT	SK	SARNIA	ON
MOOSE JAW	SK	MONTRÉAL	QC
CITY OF TORONTO	ON	QUÉBEC	QC
BRAMPTON	ON	SHERBROOKE	QC
ETOBICOKE	ON	GASPÉ	QC
MISSISSAUGA	ON	CHICOUTIMI	QC
NORTH YORK	ON	RIMOUSKI	QC
SCARBOROUGH	ON	TROIS RIVIÈRES	QC
VAUGHAN/MARKHAM	ON	DRUMMONDVILLE	QC
OTTAWA	ON	VAL D'OR	QC
KINGSTON	ON	GATINEAU	QC

Table 11: Municipalities for which gasoline prices are available from the Kent Group Ltd. (2020)

The association between prices and respondents was straightforward when their electoral riding was withing one of the municipalities included in Table 11. For respondents in small (in squared km) ridings that span over two municipalities for which gasoline prices data was available, the cheapest price was associated to the respondent. This is especially relevant for ridings that span over two municipalities with one of the two applying a transit tax. The assumption behind this is that a rational consumer will purchase gasoline from the cheapest part of the riding when those are small.

Respondents living in a riding that includes a municipality, or a part of a municipality for which gasoline prices were available were assigned these prices.

Respondents living in a riding that is in the vicinity of a municipality for which gasoline prices were available were assigned those prices, minus the municipality's transit tax where applicable (Victoria, BC, Metro Vancouver, BC, Montréal, QC). Respondents in ridings belonging to the municipalities of Laval or Longueuil were assigned Montréal prices minus the transit tax. Respondents in small ridings (in squared km) bordering the municipality of Laval were also assigned Montréal prices minus the transit tax, as they live in direct suburbs (e.g.: Terrebonne).

Respondents living in a riding that borders a riding which includes a municipality for which prices were available were assigned those prices. For respondents living in ridings that are bordering several other ridings for which prices were available were assigned prices of the municipality that is closest to the largest part of the riding's borders (e.g.: Aloma and Timmins).

Respondents living in ridings for which none of the above rules applied were assigned the closest prices (distance in km), or were assigned prices as follows:

- Drummond, Saint Hyacinthe - Bagot, Shefford: these ridings are between ridings neighboring Montréal and ridings neighboring Sherbrooke. After observing current daily prices over several days, respondents living in these three ridings were assigned Sherbrooke prices as it appeared more consistent with the current distribution of fuel prices.
- Montcalm, Rivières du Nord: these ridings are between ridings neighboring Montréal and ridings neighboring Gatineau or Trois-Rivières. Here too, an observation of the current daily prices over several days helped assign Montréal prices minus tax to the respondents.
- Parry Sound - Muskoka: this riding did not have any direct borders with a municipality for which prices were available, or a riding that includes such a municipality. It could, by extension, have been assigned prices from Barrie, Peterborough, or Timmins. After looking at current daily prices over several days, respondents in this riding were assigned Timmins prices.
- Oxford: this riding could have been assigned London, Kitchener, or Brantford prices (direct vicinity with all three). After looking at current daily prices over several days, respondents in this riding were assigned Kitchener prices.
- Huron - Bruce: this riding could have been assigned London or Kitchener prices. After looking at current daily prices over several days, respondents in this riding were assigned London prices.

Appendix D: Survey questions employed

- Support: Based on what you know, how do you feel about putting a price or tax on fossil fuels like coal, oil and gas in order to reduce carbon emissions in Canada? This type of policy is often referred to as 'carbon pricing'.

❍ Strongly support (4)
❍ Somewhat support (3)
❍ Somewhat oppose (2)
❍ Strongly oppose (1)

- Principal mode of transportation: How do you get to work/school?

❍ Drive alone (1)
❍ Drive with others or carpool (2)
❍ Transit (3)
❍ Cycle (4)
❍ Walk (5)
❍ Work/study at home (6)

- Car ownership: How many vehicles, if any, does your household currently lease or own or?

❍ 0 (0)
❍ 1 (1)
❍ 2 (2)
❍ 3 (3)
❍ 4 (4)
❍ 5 or more (5)

- Monthly gasoline expenditure: On average, about how many dollars does your household (i.e. you and family members that you live with) spend on gasoline or diesel each month?

❍ $0 (1)
❍ $0-$49 (2)
❍ $50-$99 (3)
❍ $100-$149 (4)
❍ $150-$199 (5)
❍ $200-$249 (6)
❍ $250-$299 (7)
❍ $300-$349 (8)
❍ $350-$399 (9)
❍ $400-$449 (10)
❍ $450-$499 (11)
❍ $500 or more (12)

- CMA: Finally, what is the postal code of your current residence?

- Number of children in the household: How many children under 18 (live most of the time) in your household?

❍ 0 (0)
❍ 1 (1)
❍ 2 (2)
❍ 3 (3)
❍ 4 (4)
❍ 5 (5)
❍ 6 (6)
❍ 7 or more (7)

- Income: Which of the following best describes your gross family annual household income? Is it:

❍ Under $20,000 (1)
❍ $20,000-$39,999 (2)
❍ $40,000-$59,999 (3)
❍ $60,000-$79,999 (4)
❍ $80,000-$99,999 (5)
❍ $100,000-$119,999 (6)
❍ $120,000-$159, 999 (7)
❍ $160,000-$199,999 (8)
❍ $200,000 or more (9)

- Gender: Do you identify as:

❍ Male (1)
❍ Female (2)
❍ Other (3)

- Age: Please indicate your age in years.

- Education: What is the highest level of education you completed?

❍ Less than high school (1)
❍ High school graduate (2)
❍ Less than college/some CEGEP (3)
❍ College / CEGEP graduate (4)
❍ Apprenticeship (5)
❍ Some university (6)
❍ Undergraduate university degree (7)
❍ Post-graduate university degree (8)

- Acceptance of climate change science: From what you've read and heard, is there solid evidence that the average temperature on Earth has been getting warmer over the past four decades?

❍ Yes (1)
❍ No (2)

Is the Earth getting warmer mostly because of human activity such as burning fossil fuels, or mostly because of natural patterns in the Earth's environment?

❍ Mostly human activity (1)
❍ Mostly natural patterns (2)

- Partisanship: If the federal elections were held today, which party would you vote for?

❍ Green Party (1)
❍ Liberal Party (2)
❍ Conservative Party (3)
❍ NDP (4)
❍ People's Party (5)
❍ Bloc Québécois (6)

In wave four, the following question was asked: "Which party did you vote for?" Responses to this question were considered to be the natural pursuant of the initial question about partisanship, given that the Canadian federal elections took place just before the fourth wave.

- Province of residence: In which province or territory do you live?

- Perception of recent fuel prices: To the best of your knowledge, how much was the price of gasoline in your local area last week?

- Perception of the percentage share of recent price increases that is attributable to a carbon tax: Gasoline and diesel fuel prices fluctuate according to market conditions (e.g. supply and demand) but also because of government policies and taxes.

Using the sliding scale below please indicate how much of the increase in gasoline and diesel prices in your area is attributable to prevailing market conditions vs. government policies that price carbon?

0 – Completely by market forces
50 – Equally driven by market forces and government prices on carbon
100 – Completely driven by government prices on carbon