How the Gasoline Market Responds to the Carney Administration's Carbon Tax Abolition*

An ARIMAX and Linear Regression-Based Evaluation Using Monthly Data from Canadian Provinces (Excluding Québec and Nunavut)

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This study examines the conditional responses of gasoline prices and fuel consumption to the abolition of the federal fuel carbon tax under the Carney Administration across Canadian provinces. Using monthly data from 2017 to 2025, we estimate a pooled time-series price model with autoregressive errors to characterize gasoline price dynamics conditional on crude oil prices, carbon tax levels, and province fixed effects. We then estimate a log-linear gasoline consumption model with province fixed effects to measure the short-run conditional price responsiveness of fuel demand. Counterfactual simulations suggest that, holding other factors constant, maintaining the carbon tax would have raised gasoline prices by less than one cent per litre in most provinces and would have generated only very small short-run changes in gasoline consumption, reflecting highly inelastic demand. Consequently, the implied short-run impact on transportation-related emissions is limited.From a policy perspective, these results support reinstating the fuel carbon tax primarily as a revenue-generating instrument to help alleviate the fiscal burden of financing Canada's green transition. At the same time, achieving meaningful emission reductions requires broader structural interventions, such as promoting fuel-efficient vehicles, electric vehicle adoption, and complementary transportation policies, rather than relying solely on short-run price-based measures.

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*Code and data are available at: https://github.com/Jie-jiao05/Carbon_Tax_Gasoline_Price/tree/main.

1 Introduction

Carbon pricing has long been regarded as a central component of Canada's climate policy framework and also a commitment from federal government's to environmental protection. Since 2019, under the Trudeau Administration, the federal government applied a fuel tax charge to provinces that did not develop their own compliant carbon pricing systems, and unified it nationally (Excluding Quebec). The objective of this measure was to encourage households and firms to reduce general consumption of fossil fuels, promote greener production. However, In early 2025, the Carney Administration announced the abolition of the federal carbon tax on gasoline and diesel. This policy was reveled as a significant shift in Canada's approach to climate governance. It also sparked nationwide debate concerning the affordability of carbon taxes, the extent of environmental responsibility, and the appropriate balance between climate policy and changes in gasoline prices.

The abolition of the fuel carbon tax directly affects retail gasoline prices, which are among the most visible and politically sensitive indicators of the cost of living in Canada. Canada is the fourth largest oil producer in the world, with a daily output of approximately 5.76 million barrels and about six percent of the global market share, ranking only behind Russia (U.S. Energy Information Administration 2024). Domestically, gasoline expenditures account for a substantial share of household budgets, especially in suburban and rural regions with limited public transit and in periods of extreme weather. Nationally, Fuel sales also represent an important source of government revenue. As a result, even small changes in gasoline prices can quickly alter consumption patterns and daily travel behaviour. Meanwhile, these behavioural adjustments might have direct consequences for greenhouse gas emissions for road transportation section, where the sector accounts for about 11.9 percent of global greenhouse gas emissions and nearly 74 percent of emissions from the transportation sector (U.S. Energy Information Administration 2024). Understanding how the removal of the carbon tax reshapes gasoline prices, and how these price movements influence gasoline consumption, and emissions, is therefore essential for assessing the broader economic and environmental implications of this policy change.

1.1 Research Questions

The purpose of this study is to evaluate how the Carney Administration's abolition of the federal fuel carbon tax influences gasoline prices and how these price changes impact Canada gasoline price and consumption adjustment. And how does the removal of Carbon tax causes transportation related emissions shift. To guide the empirical analysis, the following research questions are examined. And will be answered at Section 4.1.2.2 and Section 4.2.1.2

1. How did consumer-level gasoline prices respond to the abolition of the federal fuel carbon tax, conditional on crude oil prices and province-specific factors?
2. How do changes in gasoline prices relate to monthly fuel consumption across Canada, once local economic conditions and climate factors are taken into account?

These research paper aim to answer this question for a comprehensive assessment of the economic and environmental consequences of the carbon tax abolition and provide a structured basis for evaluating both observed and counter factual outcomes.

2 Data

2.1 Overview

This study uses monthly provincial data from 2017 to 2025. The main variables include the federal carbon tax (Canada Revenue Agency 2025), retail gasoline prices (Statistics Canada 2025a), provincial gasoline sales quantity (Statistics Canada 2025b), monthly temperature and precipitation (*Canadian Climate Normals Climate Environment and Climate Change Canada* 2025), crude oil price (Trading Economics 2025), and the number of registered vehicles (Statistics Canada 2025c). Together, they form a monthly province-level panel dataset, where the unit of observation is a province–month. This structure allows us to capture key economic, climate, and transportation factors across time and across provinces, which is necessary to evaluate how the removal of the federal carbon tax influences retail gasoline prices, consumption conditions, and consumer behavior.

2.2 Dependent Variables

2.2.1 Gasoline Price

Retail gasoline prices measure the monthly average sales price of gasoline in each Canadian province and territory, expressed in cents per litre. The data are obtained from Statistics Canada's Monthly Average Retail Prices for Gasoline and Fuel Oil (Statistics Canada 2025a)

The reported gasoline prices are recorded at the station level. To construct a representative provincial series, all available station-level observations within a province are averaged for each month. If only a single station observation is available for a province in a given month, that value is used directly. This procedure yields a consistent monthly provincial gasoline price series from January 2017 to September 2025. Figure 1 and Figure 2 respectively present the national and provincial gasoline price series used in the analysis.

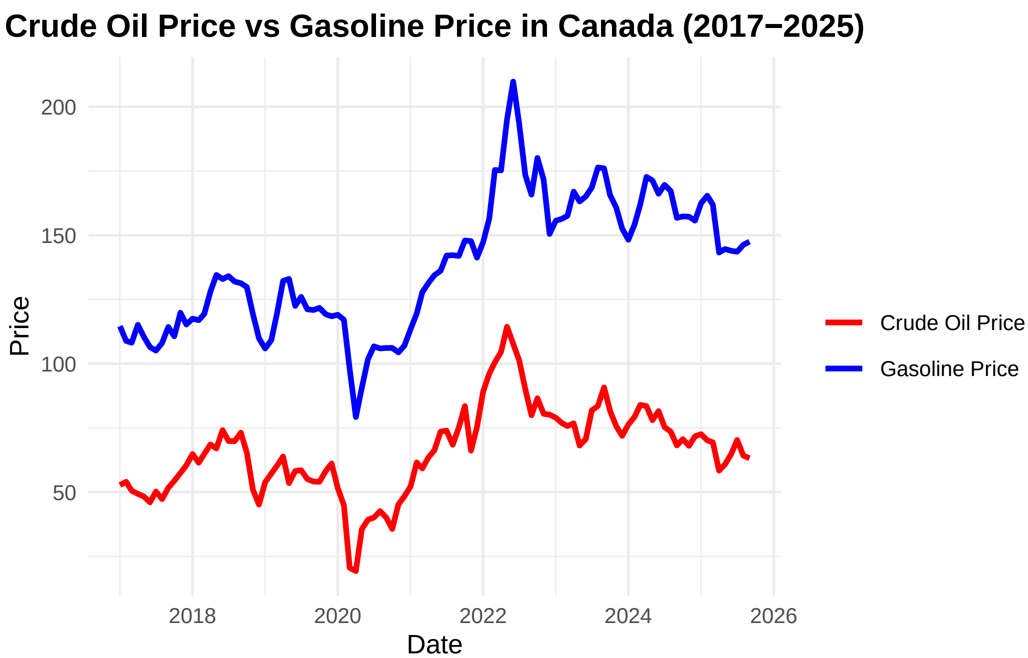

Figure 1: Gasoline Price in Canada (General Case)

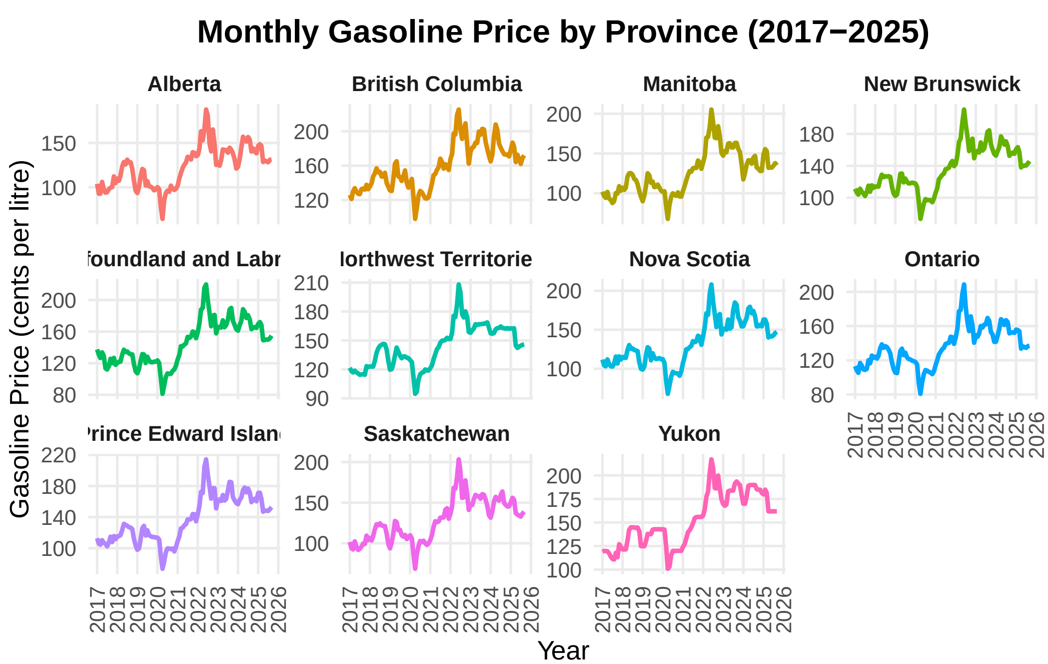

Figure 2: Gasoline Price in Canada by Province

2.2.2 Gasoline Sales Quantity

The gasoline sales quantity measures the total volume of fuel sold for road motor vehicles in each province, reported annually in units of one thousand litres. The data come from Statistics Canada's Sales of fuel used for road motor vehicles, annual (x 1,000) (Statistics Canada 2025b).

Due to the original dataset provided was accounted in annual totals, to incorporate these data into a monthly time series model, each annual value was distributed across twelve months using a set of seasonally informed weights. For example, higher weights are assigned to months with traditionally higher gasoline consumption (Jun to Sept.). The resulting monthly series aligns with the frequency of other variables in the analysis. Figure 3 presents the resulting provincial gasoline sales series. Due to the substantially larger sales volume in Ontario, the vertical axis is displayed on a natural logarithmic scale to ensure comparability across provinces.

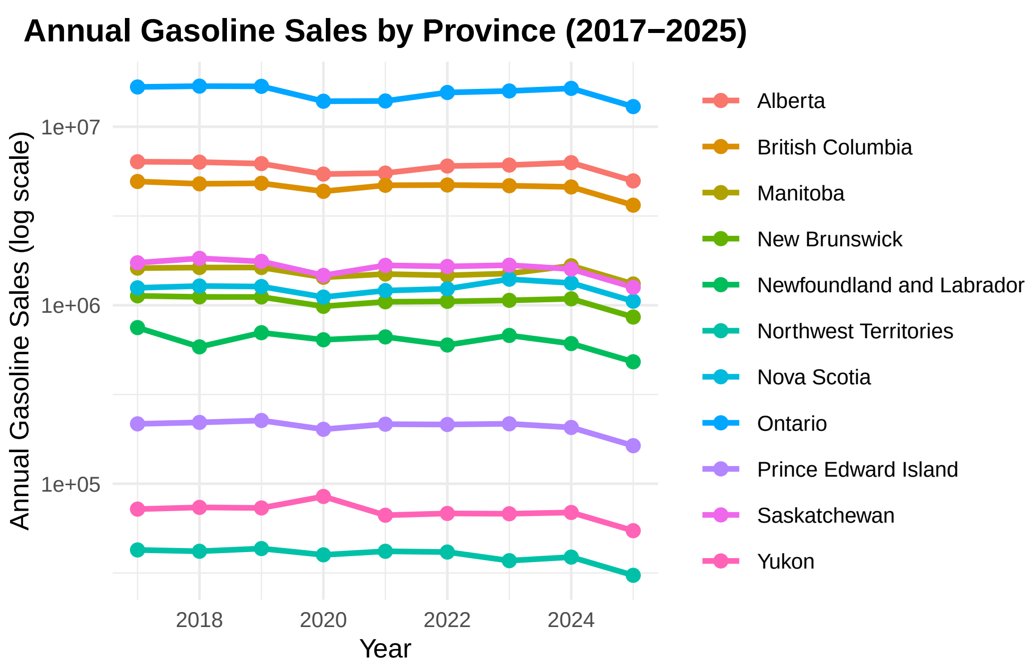

Figure 3: Gasoline Sales in Canada by Province

2.3 Explanatory Policy Variables

2.3.1 Carbon Tax

The carbon tax is included in the price model as an exogenous policy variable. It represents the per-litre fuel charge applied to gasoline under Canada's carbon pricing framework from 2019

Table 1: Fuel charge rates by Province (Unit $ per Litre)

Province	Fiscal Year					
	2019/04-2020/04	2020/4-2021/4	2021/4-2022/4	2022/4-2023/4	2023/4-2024/4	2024/4-2025/4
NL	4.42	6.63	8.84	11.05	14.31	17.61
P.E.I	4.42	6.63	8.84	11.05	14.31	17.61
NS	4.42	6.63	8.84	11.05	14.31	17.61
NB	4.42	6.63	8.84	11.05	14.31	17.61
ON	4.42	6.63	8.84	11.05	14.31	17.61
MB	4.42	6.63	8.84	11.05	14.31	17.61
SK	4.42	6.63	8.84	11.05	14.31	17.61
AB	4.42	6.63	8.84	11.05	14.31	17.61
BC	8.89	8.89	8.89	9.96	11.05	17.61
YT	4.42	6.63	8.84	11.05	14.31	17.61
NT	4.70	7.00	9.00	11.70	14.31	17.61

until its removal by the Carney Administration in early 2025. This tax schedule is determined by government legislation and follows a pre-announced path, making it independent of short-run gasoline price fluctuations.

For some certain provinces, such as British Columbi, do not follow the federal fuel charge, but operate their own provincial carbon-pricing systems. In these cases, provincial gasoline tax rates are converted into a comparable per-litre measure to ensure consistency across provinces. The values shown in Table 1 represent the applicable fuel charge rates for each province in every fiscal year.

2.4 Control Variables

2.4.1 Quantity of Vehicle Registered

The quantity of vehicle registered refers to the total road motor vehicles(include all weight range) officially registered in a province registration system within a given year and it is accumulative (Statistics Canada 2025c). This variable serves as a proxy for long-run transportation demand and vehicle stock.

2.4.2 Crude Oil Price

Our crude oil price are sourced from organization Trading Economic (Trading Economics 2025). As crude oil is the primary input in gasoline production, this variable captures short-run upstream cost pressures that affect retail gasoline prices uniformly across provinces. Figure 1 shows changes in crude oil and gasoline price under same time frame.

2.4.3 Climate and Precipitation

Climate variables are included to account for weather-related variation in driving behavior and fuel consumption. Average temperature and total precipitation data are obtained from Environment and Climate Change Canada (*Canadian Climate Normals Climate Environment and Climate Change Canada* 2025). But due to data availability constraints, each province's 2024 average temperature and total precipitation are used as fixed climate controls. Figure 4 summarizes cross-province differences in climate conditions.

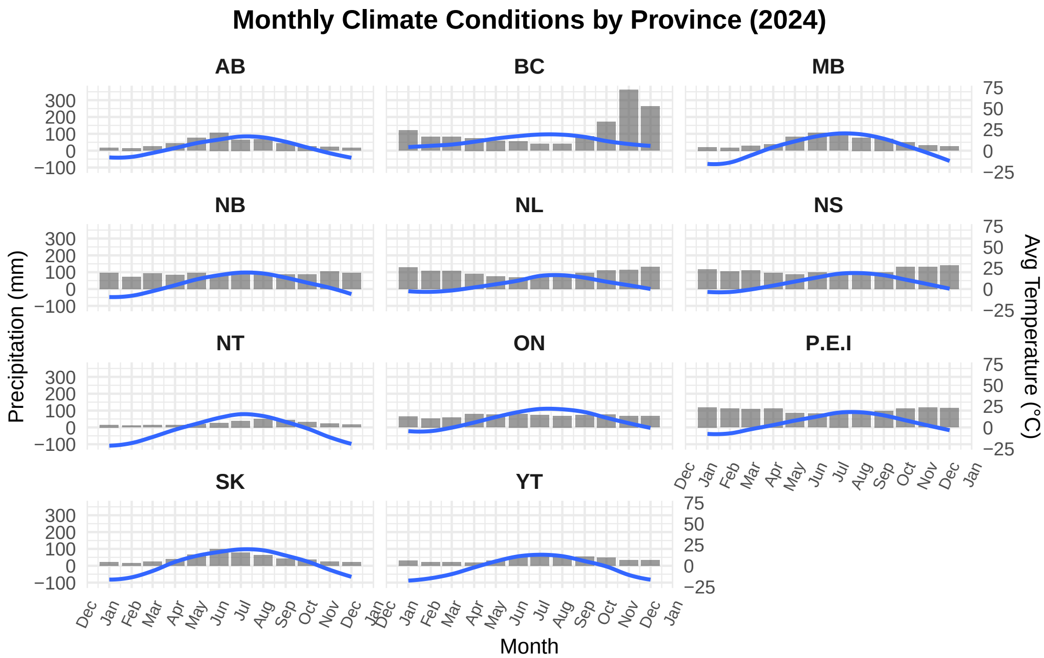

Figure 4: Temperacture and Precipitation Change by Provibce

3 Model

3.1 Supply-Side Price Model (ARIMAX)

Our retail gasoline price series is recorded at a monthly frequency and exhibit strong temporal dependence in Figure 1. In this case as it will violate the independence assumption required for general linear regression models. Estimating by using a simple regression without accounting for this time-series structure would therefore lead to inefficient estimates and potentially misleading statistical inference.

For this reason, the ARIMAX model is adopted to construct a reduced-form supply- side price model. The ARIMAX framework explicitly models autoregressive and moving average components in the error process, allowing past price movements to influence current prices while preserving a regression structure for observed explanatory variables. This makes the model well suited for capturing short-run gasoline price dynamics in the presence of persistent shocks. In addition, the ARIMAX model allows key market and policy variables as exogenous regressors. This enables the analysis to condition on observable cost and policy factors while separating their associations with gasoline prices from underlying time-series dynamics.

The objective of this model is not to establish a causal treatment effect of the carbon tax, but to examine how gasoline prices respond dynamically to tax removal and market changes and to construct counterfactual price paths under alternative tax scenarios.

3.1.1 Model Assumption

1. Time Depedence: Gasoline prices follow a time dependent structure where past price movements influence current prices.
2. Conditional exogeneity: Policy and market variables, including the carbon tax and crude oil prices, are treated as exogenous with respect to short-run gasoline price dynamics, allowing the model to estimate conditional price responses rather than causal effects.
3. Seasonality: Gasoline prices do not display strong deterministic seasonal patterns. Any remaining seasonal dependence is captured through the stochastic seasonal components of the ARIMA error process
4. Common Slopes: The relationship between gasoline prices and the included covariates is assumed to be common across provinces, while persistent differences in baseline price levels are captured by province fixed effects.
5. Error Structure: Error term is stationary and serially correlated only through the ARIMA component.

3.1.2 Model Specification

The model takes the following form:

$$\log(\text{GasolinePrice}_{t,p}) = \alpha_p + \beta_1 \,\text{Tax}_{t,p} + \beta_2 \,\text{CrudeOilPrice}_t + \varepsilon_{t,p}, \tag{1}$$

$$\varepsilon_{t,p} \sim \text{ARIMA}(p,d,q) \times (P,D,Q)_{12}, \tag{2}$$

$$u_{t,p} \sim \text{Normal}(0,\sigma^2). \tag{3}$$

- p: province / territory index.

- t: monthly time index from January 2017 to September 2025.
- $\text{GasolinePrice}_{t,p}$: average retail gasoline price (cents per litre) in month t and province p; in the model we use its logarithm $\log(\text{GasolinePrice}_{t,p})$ to stabilise variance and interpret coefficients approximately as percentage changes.
- $\text{Tax}_{t,p}$: carbon fuel charge in cents per litre for month t and province p.
- CrudeOilPrice_t: benchmark crude oil price in month t, common across provinces.
- α_p: province fixed effect capturing time-invariant differences in baseline gasoline price levels across provinces.
- β_1, β_2: common regression coefficients measuring the average conditional response of log gasoline prices to the carbon tax and crude oil prices, respectively.
- $\varepsilon_{t,p}$: regression residual for province p after removing the effect of the covariates and province fixed effects; it follows a seasonal ARIMA process $\text{ARIMA}(p, d, q) \times (P, D, Q)_{12}$ capturing serial dependence in monthly gasoline prices.
- $u_{t,p}$: zero-mean Gaussian white-noise shocks driving the ARIMA error process, with variance σ^2.

3.2 Demand-Side Consumption Model (Linear Regression)

For Sales Quantity model we deploy a Linear regression model. The distribution of monthly sales appears approximately normal and shows limited seasonal variation in Figure 3 indicate that gasoline consumption does not exhibit strong cyclical patterns, which suggests that more complex time-series structures.

This model utilizes gasoline sales along with a series of key influencing factors, which include retail gasoline prices, average temperature, precipitation, and vehicle registration volume. These variables enter the specification in a stable and economically interpretable manner, consistent with standard demand theory. The estimated coefficients are interpreted as short-run demand responses, conditional on observed prices, weather conditions, vehicle stock, and province fixed effects. In particular, the price coefficient reflects how gasoline consumption varies with changes in retail prices under the assumption that prices are predetermined with respect to contemporaneous consumption decisions. And is for a more transparent and interpretable purpose of short-run gasoline demand behavior and price sensitivity.

3.2.1 Model Assumption

1. Linearity: The expected value of monthly gasoline sales is assumed to be a linear function of gasoline price, temperature, precipitation, and the number of registered vehicles.
2. Independence: Monthly observations are assumed to be independent after controlling for the included predictors.
3. Homoscedasticity: The variance of the regression residuals is assumed to remain constant across all levels of the predictors.
4. Normality of Residuals: The residuals from the regression model are assumed to follow an approximately normal distribution.
5. Retail gasoline prices are assumed to be predetermined at the monthly frequency with respect to contemporaneous gasoline consumption shocks. Conditional on observed prices, weather conditions, vehicle stock, and province fixed effects, unobserved demand shocks are assumed to affect prices over longer horizons.

3.2.2 Model Specification

$$\log(\text{Sales}_{t,p}) = \alpha_p + \beta_1 \log(\text{GasolinePrice}_{t,p}) + \beta_2 \,\text{AvgTemp}_{t,p} + \beta_3 \,\text{Precip}_{t,p} + \beta_4 \log(\text{VehiclesReg}_{t,p}) + u_{t,p}.$$

- $\text{Sales}_{t,p}$: monthly gasoline sales quantity in province p at time t; the model uses $\log(\text{Sales}_{t,p})$ as the dependent variable.
- $\text{GasolinePrice}_{t,p}$: monthly average retail gasoline price in province p at time t; the model uses $\log(\text{GasolinePrice}_{t,p})$.
- $\text{AvgTemp}_{t,p}$: average monthly temperature in province p at time t, capturing weather-related variation in driving activity.
- $\text{Precip}_{t,p}$: total monthly precipitation in province p at time t, capturing additional weather-related effects on gasoline consumption.
- VehiclesReg_{p}: total number of registered vehicles in province p, treated as a time-invariant indicator of underlying transportation demand.
- α_p: province fixed effect capturing persistent differences in baseline gasoline consumption across provinces.
- $u_{t,p}$: regression error term capturing unobserved short-run variation in gasoline consumption.
- **Reference group**: Alberta.

4 Result

4.1 Model Estimation Result and Interpretation

4.1.1 Supply-Side Price Model (ARIMAX) Interpretation and Result

The ARIMAX price model is not intended to identify a causal effect of the carbon tax. Instead, it is used to capture the dynamic response of gasoline prices to policy and market variables while accounting for serial dependence and seasonality in prices.

Our ARIMAX is be determined as $\text{ARIMAX}(1,0,1)(0,0,1)_{12}$. The estimated AR(1) coefficient (0.5553) is strongly positive and highly significant, indicating that gasoline prices are highly persistent over time—current prices, and are strongly influenced by prices in the previous month, which is consistent with the retail fuel market gradual adjustment. For MA(1) term of 0.5103, it captures the immediate correction of unanticipated price shocks. The results show that unexpected fluctuations in gasoline prices are partially offset in the next period, rather than being completely absorbed in the current period. In addition, the seasonal MA(1)12 coefficient (-0.1803) reflects seasonal shock adjustment is at the annual frequency.

Table 2 reports estimates from the pooled price model, which relates log retail gasoline prices to the carbon tax, crude oil prices, and province fixed effects, with Alberta serving as the reference province. The coefficients describe conditional price responses rather than causal policy effects. The estimated coefficient on the carbon tax(0.091) represents a semi-elasticity, as gasoline prices enter the model in logarithms while the tax is measured in cents per litre. The estimate implies that a one-cent increase in the carbon tax is associated with an approximately 0.9 percent increase in retail gasoline prices, holding crude oil prices and province fixed effects constant.

While this does not imply an exact one-cent-for-one-cent increase in prices in levels, the magnitude indicates substantial short-run pass-through of the tax to consumer prices, suggesting that most of the tax burden is borne by consumers rather than absorbed by suppliers. In addition to tax effects, crude oil prices strongly influence gasoline prices, with a one-unit increase in crude oil prices associated with an approximately 0.85 percent rise in retail gasoline prices. At the same time, province fixed effects indicate persistent baseline differences relative to Alberta, with gasoline prices in Ontario averaging about 10 percent higher after controlling for taxes and oil prices.

4.1.2 Counterfactual Analysis

4.1.2.1 Set Up

We construct counterfactual gasoline price paths under an alternative carbon tax schedule following the 2025 policy change. The counterfactual is conditional: crude oil prices are held at their observed values, and only the tax path is altered. For each province, we use the fitted

Table 2: Pooled Price Model Coefficients (GLS)

Term	Estimate	Std. Error	t value	p value
(Intercept)	4.1657	0.0119	351.2842	0.0000
Tax_cents_per_litre	0.0091	0.0004	20.9726	0.0000
Crude_Oil_Price	0.0085	0.0002	55.0796	0.0000
ProvinceBritish Columbia	0.2585	0.0107	24.0876	0.0000
ProvinceManitoba	0.0202	0.0107	1.8816	0.0601
ProvinceNew Brunswick	0.0908	0.0107	8.4636	0.0000
ProvinceNewfoundland and Labrador	0.1660	0.0107	15.4679	0.0000
ProvinceNorthwest Territories	0.1587	0.0107	14.7926	0.0000
ProvinceNova Scotia	0.0769	0.0107	7.1656	0.0000
ProvinceOntario	0.1032	0.0107	9.6157	0.0000
ProvincePrince Edward Island	0.1005	0.0107	9.3679	0.0000
ProvinceSaskatchewan	0.0381	0.0107	3.5485	0.0004
ProvinceYukon	0.2155	0.0107	20.0815	0.0000

ARIMAX model to generate dynamic predictions over the post-policy period under (i) the observed tax schedule and (ii) a counterfactual schedule in which the carbon tax remains in place. The monthly counterfactual gap is computed as the difference between the counterfactual and observed predicted log prices, converted into percentage or cents-per-litre differences for interpretation.

The counterfactual analysis is conducted over the post-policy period April 2025 to September 2025. We set April 1, 2025 as the policy change date and define the pre-policy period as January 2017 to March 2025. The observed tax path $\text{Tax}_{t,p}^{\text{obs}}$ uses the realized fuel charge after April 2025, while the counterfactual path $\text{Tax}_{t,p}^{\text{cf}}$ holds the carbon tax fixed at each province's last observed pre-removal rate from March 2025 for all months from April 2025 onward.

$$
\begin{aligned}
\Delta_{t,p} &= \mathbb{E}\left[\log(P_{t,p}) \mid \text{Tax}_{t,p}^{\text{cf}}\right] - \mathbb{E}\left[\log(P_{t,p}) \mid \text{Tax}_{t,p}^{\text{obs}}\right], \\
\Delta_{t,p}^{\%} &= 100\left(\exp(\Delta_{t,p}) - 1\right)
\end{aligned}
$$

$\log(P_{t,p})$: log retail gasoline price in province p at month t, $\text{Tax}_{t,p}^{\text{obs}}$: observed carbon tax $\text{Tax}_{t,p}^{\text{cf}}$: counterfactual tax under the alternative policy scenario.

4.1.2.2 Result

$$
\begin{aligned}
\Delta_{t,p} &= \hat{\beta}_{\text{tax}}\left(\text{Tax}_{t,p}^{\text{cf}} - \text{Tax}_{t,p}^{\text{obs}}\right) = 0.0091 \times 17.61 = 0.1603, \\
\Delta_{t,p}^{\%} &= 100\left(\exp(0.1603) - 1\right) \approx 17.38\%
\end{aligned}
$$

The counterfactual analysis implies an average gasoline price difference of 17.38 percent in the post-policy period. This effect is identical across provinces because the pooled price model imposes a common tax pass-through coefficient, and the carbon tax removal represents a uniform policy shock of 17.61 cents per litre across all provinces at same time. Provincial fixed effects will affect baseline price levels but do not alter the magnitude of the tax-induced price change, resulting in the same counterfactual percentage difference for each province.

4.2 Sales Model Interpretation

```
Call:
lm(formula = ln_sales ~ ln_price + AvgTemp_C + Precip_mm + ln_veh_reg +
    factor(Province), data = demand_data)

Residuals:
     Min       1Q   Median       3Q      Max
-0.25238 -0.05019  0.00314  0.05083  0.25618

Coefficients:
                                            Estimate Std. Error t value
(Intercept)                                1.824e+01  1.646e+00  11.079
ln_price                                   2.798e-02  1.415e-02   1.977
AvgTemp_C                                  1.523e-02  2.353e-04  64.731
Precip_mm                                 -7.108e-04  7.052e-05 -10.080
ln_veh_reg                                -3.526e-01  1.124e-01  -3.135
factor(Province)British Columbia          -3.413e-01  1.324e-02 -25.788
factor(Province)Manitoba                  -1.817e+00  1.509e-01 -12.047
factor(Province)New Brunswick             -2.333e+00  1.939e-01 -12.034
factor(Province)Newfoundland and Labrador -2.987e+00  2.430e-01 -12.293
factor(Province)Northwest Territories     -6.634e+00  5.474e-01 -12.119
factor(Province)Nova Scotia               -2.145e+00  1.814e-01 -11.823
factor(Province)Ontario                    1.245e+00  1.105e-01  11.260
factor(Province)Prince Edward Island      -4.523e+00  3.823e-01 -11.832
factor(Province)Saskatchewan              -1.764e+00  1.549e-01 -11.385
factor(Province)Yukon                     -5.938e+00  5.048e-01 -11.763
                                          Pr(>|t|)
(Intercept)                                < 2e-16 ***
ln_price                                   0.04832 *
AvgTemp_C                                  < 2e-16 ***
Precip_mm                                  < 2e-16 ***
ln_veh_reg                                 0.00176 **
factor(Province)British Columbia           < 2e-16 ***
```

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factor(Province)Manitoba                     < 2e-16 ***
factor(Province)New Brunswick                < 2e-16 ***
factor(Province)Newfoundland and Labrador    < 2e-16 ***
factor(Province)Northwest Territories        < 2e-16 ***
factor(Province)Nova Scotia                  < 2e-16 ***
factor(Province)Ontario                      < 2e-16 ***
factor(Province)Prince Edward Island         < 2e-16 ***
factor(Province)Saskatchewan                 < 2e-16 ***
factor(Province)Yukon                        < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.07837 on 1140 degrees of freedom
Multiple R-squared:  0.998, Adjusted R-squared:  0.998
F-statistic: 4.123e+04 on 14 and 1140 DF,  p-value: < 2.2e-16
```

The estimated demand model relates monthly gasoline sales to prices, weather conditions, vehicle stock, and province fixed effects. Because both gasoline sales and prices enter in logarithms, the coefficient on price will be interpreted as a short-run price elasticity of demand, conditional on observed controls.

The model results show that gasoline price, temperature, and vehicle registrations are statistically significant predictors of gasoline sales. With an overall p-value of $p < 2.2 \times 10^{-16}$, we reject the null hypothesis that gasoline sales are unrelated to the included explanatory variables. The model also achieves an adjusted R^2 of 0.9978, indicating that approximately 99.78 of the variation in log gasoline sales is explained by the regression.

The coefficient on log gasoline price is 0.028 (p = 0.048), which is interpreted as a short-run price elasticity of gasoline demand conditional on observed controls. Specifically, a 1% increase in gasoline prices is associated with a 0.028% change in monthly gasoline consumption, holding temperature, precipitation, vehicle registrations, and province fixed effects constant. Noticeable, the magnitude is small, indicating that short-run gasoline demand is highly price inelastic. Besides, the result shows temperature change are changing people transpiration pattern, as warmer conditions generally encourage increased mobility and driving activity. The demand model shows that a one-degree Celsius increase in average monthly temperature raises gasoline consumption by approximately 1.5%. While higher precipitation will reduces fuel usage by discouraging outdoor activity and travel during adverse weather conditions. Each additional 1 mm of precipitation is associated with about a 0.071% decrease in monthly gasoline sales. The coefficient on log vehicle registrations (-0.353) is negative and statistically significant. Indicating that short-run changes in vehicle stock do not translate proportionally into higher gasoline consumption once persistent provincial differences were controlled.

4.2.1 Sales Model Counterfactual Analysis

4.2.1.1 Set Up

To assess the short-run consumption response to gasoline price changes, we conduct a conditional counterfactual simulation using the estimated demand regression. For each province p, we define a counterfactual price path in which retail gasoline prices are set to be 5 lower from $t \geq t_0$ onward, such that $\log P^{cf} t, p = \log Pt, p + \log(0.95)$, while temperature, precipitation, vehicle registrations, and province fixed effects are held at their observed values. We then generate predicted log sales under the observed and counterfactual price paths using the fitted model and compare the implied monthly sales levels (after exponentiating predictions) over the post-t_0 period. The resulting differences represent the short-run consumption response to a price decrease based on our model, conditional on observed controls, rather than a causal treatment effect.

$$\begin{aligned}
\Delta^D_{t,p} &= \mathbb{E}\left[\log\left(\text{Sales}_{t,p}\right) \,\middle|\, \log P^{cf}_{t,p}\right] - \mathbb{E}\left[\log\left(\text{Sales}_{t,p}\right) \,\middle|\, \log P_{t,p}\right], \\
\log P^{cf}_{t,p} &= \log P_{t,p} + \log(0.95), \\
\Delta^{D,\%}_{t,p} &= 100\left(\exp\left(\Delta^D_{t,p}\right) - 1\right).
\end{aligned}$$

$\log(\text{Sales}_{t,p})$: logarithm of monthly gasoline sales in province p at month t.

$\log P_{t,p}$: logarithm of the observed retail gasoline price in province p at month t.

$\log P^{\text{cf}}_{t,p}$: logarithm of the counterfactual gasoline price under a 5 price reduction scenario.

$\Delta^D_{t,p}$: short-run change in gasoline consumption implied by demand model, conditional on observed controls.

4.2.1.2 Result

$$\begin{aligned}
P^{cf}_{t,p} &= 0.95\, P_{t,p}, \\
\log P^{cf}_{t,p} - \log P_{t,p} &= \log\left(\frac{P^{cf}_{t,p}}{P_{t,p}}\right) = \log\left(\frac{0.95\, P_{t,p}}{P_{t,p}}\right) = \log(0.95), \\
\Delta^D_{t,p} &= \hat{\beta}_1\left(\log P^{cf}_{t,p} - \log P_{t,p}\right) = 0.028 \times \log(0.95) \approx -0.00144, \\
\Delta^{D,\%}_{t,p} &= 100\left(\exp(-0.00144) - 1\right) \approx -0.14\%.
\end{aligned}$$

The counterfactual effect is reported as a single value for all provinces for the same reason as elaborated in the supply-side analysis. The counterfactual simulation based on our model conditional association indicates that a 5% reduction in gasoline prices is associated with an approximately 0.14% decrease in monthly gasoline consumption in the short run. This mild response highlights the highly inelastic nature of gasoline demand over short horizons, reflecting very limited adjustment in driving behavior in the short term.

5 Conclusion and Policy Recommendation

From a policy perspective, the empirical results indicate that gasoline demand is highly inelastic in the short run. Specifically, the demand model shows that a 5% change in gasoline prices is associated with only a 0.14% change in monthly fuel consumption, once climate conditions, vehicle stock, and province fixed effects are held constant. This implies that increasing fuel prices alone is unlikely to generate substantial immediate reductions in individual gasoline use or driving-related emissions. And higher fuel prices primarily impose only modest short-run adjustment costs on consumers, with very limited immediate changes in transpiration behavior.

In this context, restoring the fuel carbon tax remains a relevant and practical policy choice for Federal Government of Canada. The primary role of the carbon tax should not be viewed as directly reducing gasoline consumption, but rather as a stable revenue instrument that supports sustainability and the green transition. Given Canada's ongoing fiscal pressures and rising expenditures related to climate transition and infrastructure development, reinstating the fuel carbon tax allows the federal government to expand its fiscal capacity.

The revenue generated from the carbon tax can then be redirected toward more effective and flexible emission-reduction oriented measures, such as expanding public transportation in major urban areas, subsidizing electric vehicle adoption, investing in charging infrastructure, and supporting clean transportation technologies. These structural policies will be beneficial in reducing gasoline dependence and improving vehicle fuel efficiency, leading to more substantial and durable reductions in road transportation emissions. Compared with simply raising fuel prices, this approach is more resilient and better aligned with Canada's long-term net-zero emissions target and sustainable economic development.

It is important to understand that the carbon tax is not only as a price signal, but also as a financing mechanism that helps alleviate the government's fiscal burden toward to the road of the green transition. Moreover, carbon tax rebates can partially offset the cost burden on households, ensuring that the overall impact on individual consumers remains limited while supporting Canada's broader climate and fiscal objectives.

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