

# Diesel Fuel Price Pass-through in Calgary

## Executive Summary

- ▶ This study is part of the ongoing research series by Corporate Economics which analyze the major indicators of Calgary's economy.
- ▶ This study has found that the relationships between crude oil prices and diesel fuel prices in Calgary are consistent and predictable, to the extent that the changes in crude oil prices can be used to forecast subsequent changes in retail prices of diesel fuel in Calgary for the next month.
- ▶ The City of Calgary operates a fleet of diesel buses and thus retail price for diesel fuel will affect the operating costs for public transit. This study should assist decision makers and the public to
  - (a) understand the statistical link between crude oil and diesel fuel price movements;
  - (b) develop a framework to forecast diesel fuel prices.

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## Briefing Note

### 1. Introduction

This study is part of the ongoing research series by Corporate Economics which analyze the major indicators of Calgary's economy. The City of Calgary operates a fleet of diesel buses and thus retail price for diesel fuel will affect the operating costs for public transit. This study should assist decision makers and the public to (a) understand the statistical link between crude oil and diesel fuel price movements; (b) develop a framework to forecast diesel fuel prices.

This study estimates the relationship between crude oil prices and diesel fuel prices and also the length of time it takes before a change in the price of crude oil is reflected in the retail price of diesel fuel in Calgary. The study uses monthly time series data from April 1986 to July 2010 to explore the above question.

The process of diesel production includes extraction, refinery, transportation, and final consumption<sup>1</sup>. Each stage in this supply/marketing chain incurs costs and the price increases with each sale.

Petroleum products are sold at any of the four stages of production and usually there is an average price for each level: spot market price, terminal price<sup>2</sup>, deal tankwagon (DTW) price<sup>3</sup>, and retail price. In this study, the prices reflecting intermediate costs were skipped and the focus was placed on the relationship between spot price and

retail price at the pumps; this captures the total pass-through effect and also the direct impact on consumers.

Spot market price refers to the price quoted for immediate spot settlement. It involves quantities in the thousands of barrels at a convenient transfer point. Spot prices for various petroleum products including diesel fuel are readily available for a number of large supply points, such as the Gulf Coast, New York Harbour, Los Angeles, and Cushing, Oklahoma. The WTI Cushing Crude Oil Spot Price is used a representative price in the report since it is a benchmark in oil pricing on the New York Mercantile Exchange for oil futures contracts<sup>4</sup>. The data on WTI Cushing is from the United States Energy Information Administration (EIA).

Retail price refers to the prices sold to the consumer, normally occurring at a service station, convenience store, or other retail outlet. The retail diesel fuel prices in Calgary are collected by Statistics Canada.

The analysis finds that 90 per cent of any spot price (West Texas Intermediate) change is reflected in the retail price for diesel fuel at the pump in Calgary one month after that change. Specifically, a 10 per cent change in crude oil price should cause the pump price for diesel fuel in Calgary to move in the same direction by 9 per cent after one month<sup>5</sup>. In Calgary, the fleet of buses is operated by diesel fuel. Thus the prices of retail diesel will affect the operating costs of public transit. This study is helpful for the policy makers and the public to understand market performance, forecast the movement of retail diesel fuel prices over the near term, assist the purchasing process, and optimize the budget planning.

1 Heating oil accounts for about 25% of the yield of a barrel of crude oil, which is the second largest "cut" after gasoline. Heating oil is burned in a furnace or boiler for the generation of heat or used in an engine for the generation of power. Diesel fuel in general is any fuel used in diesel engines. The most common is a specific fractional distillate of petroleum fuel oil, but alternatives that are not derived from petroleum, such as biodiesel, biomass to liquid (BTL) or gas to liquid (GTL) diesel, are increasingly being developed and adopted.

2 Terminal or rack price is the sale price for a truck load of fuel at the terminal.

3 Tankwagon refers to the price paid for a truck load or less of product delivered to a retail outlet.

4 WTI crude oil index is the most generally used benchmark in oil pricing and the underlying commodity of the New York Mercantile Exchange for oil futures contracts.

5 These results are in keeping with a previous analysis which found that, "With one percent increase in WTI, the price of heating oil will go up by 0.89 percent..." (Fan & Walters, 2009)

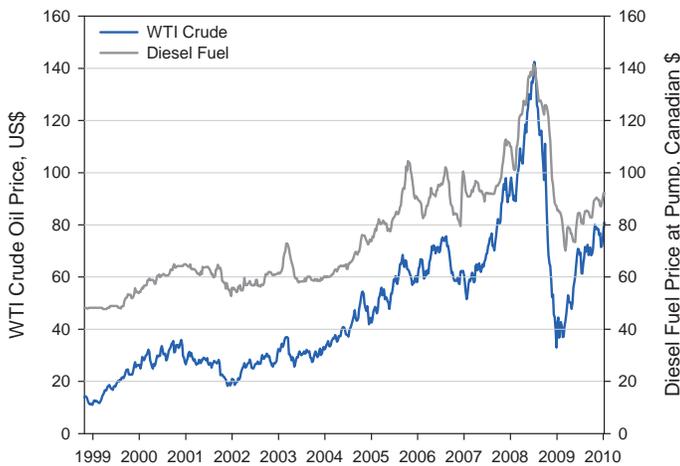
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## 2. Analytical Approach

Econometric analysis<sup>6</sup> shows the retail prices of diesel fuel as a function of lagged spot prices from previous months. Figure 1 shows the recognizable pattern of price pass-through from spot to retail price of diesel fuel in Calgary. Obviously the two curves are closely related and have similar shapes during both booms and busts. The hypothesis assumes that retail price for diesel fuel is positively correlated with the spot price for crude oil: a high crude oil price is associated with a high diesel fuel price and a low crude oil with a low diesel fuel price.

### 2.1 Price Trends and Changes

**Figure 1:**  
Spot vs. Calgary Retail Diesel Fuel Prices

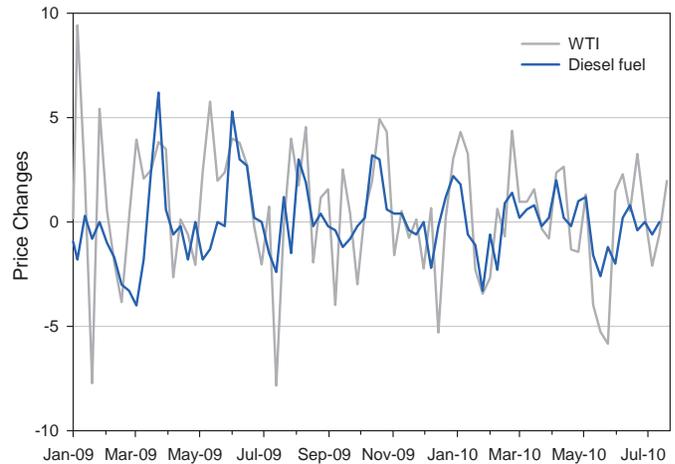


Sources: Statistics Canada; US Energy Information Administration; Corporate Economics.

<sup>6</sup> Energy Information Administration has theorized this phenomenon and tested by using US data: the impact of a spot price change can be seen to spread over several following weeks at the retail price.

**Figure 2:**

Monthly Spot and Calgary Retail Diesel Fuel Price Changes



Sources: Statistics Canada; US Energy Information Administration; Corporate Economics.

## 3. Empirical Results

This study was based on monthly data for the retail prices of diesel fuel in Calgary from April 1986 to July 2010 from the Statistics Canada, and the WTI crude oil spot price data from Energy Information Administration. The empirical estimations are recorded in Tables 1 and 2. The results show that about 90 per cent of the price pass-through from spot to retail markets is completed within one month, with some minor price fluctuations over the next several months.

When a one month lagged value of WTI crude spot price is used as the only explanatory variable, it is found that for a 10 per cent change in spot price, the diesel fuel price in Calgary will change in the same direction by 8.95 per cent after one month. More results to test the robustness can be found in Table 1. This pass-through

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effect was found to be robustly significant: the pass through effect varied slightly from 86.6 per cent to 92.6 per cent with different specification functions. For most of the specifications, the impacts from the spot price changes were found small and statistically insignificant after the first month.

A robustness check was performed by adjusting the diesel fuel prices in Calgary with monthly exchange rate (see table 2). The results showed no noticeable changes from those in Table 1. Again, most of the pass-through effect happens in the first month, varying from 85.8 per cent to 90.1 per cent.

### 4. Conclusions

Diesel fuel retail price in Calgary is closely related to the price of WTI crude oil spot price. The changes in spot price are passed on to the retail price at the pumps after one month. For a 10 per cent change in spot price, the price in Calgary's retail market will change by 9 per cent in the same direction after one month. The relationships between crude oil prices and diesel fuel prices in Calgary are consistent and predictable, to the extent that the changes in crude oil prices can be used to forecast subsequent changes in retail prices of diesel fuel in Calgary for the next month.

In Calgary, diesel fuel is used by most buses and large trucks. This study is helpful for the policy makers and the public to understand market performance, forecast the movement of retail diesel fuel prices over the near term, and optimize the budget planning.

## 5. Appendix

### 5.1 Specification Function for Regressions

We investigate the time series data of both spot price and diesel fuel retail price to check if they are stationary. The unit root test could not reject the hypothesis that the retail and spot prices have unit roots, and therefore both variables are non-stationary. Only stationary series can be estimated in level form. For series with unit roots first differences of all data are used for the regression analysis. The price response models are estimated in the function:

$$\Delta Retail_t = \alpha_0 + \sum_{i=1}^k \alpha_i \Delta Spot_i + \varepsilon_t$$

In the above function, we have

$\Delta$ : the month-to-month change

$Retail_t$ : the average monthly diesel fuel retail price at pumps in Calgary at month t

$Spot_i$ : the average monthly spot price for month t

$\varepsilon_t$ : the random error term at time t

Table 1 and 2 show the parameter estimates for the various regions using Ordinary Least Squares as the estimation method. The lag length is chosen by using the number of lags that minimizes the Akaike and Schwartz-Bayes information criterion values. This also provides parameter estimates that show little or no increase when an additional lag is added to the estimation.

### 5.2 Regression Results

Bayes information criterion values. This also provides parameter estimates that show little or no increase when an additional lag is added to the estimation.



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Table 1: Pass-Through Effects from Spot to Retail Prices of Diesel Fuel in Calgary  
First Difference Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: Diesel Fuel Price at Pump in Calgary						
Spot price	0.8953347	0.700984	0.8660579	0.9259315	0.9127833	0.8815573
lag 1 month	(60.52)***	(7.65)***	(8.57)***	(9.28)***	(9.16)***	(8.82)***
Spot price		0.1978401	-0.322087	-0.229691	-0.176297	-0.152911
lag 2 months		(2.15)**	(-1.88)*	(-1.36)	(-1.03)	(-0.90)
Spot price			0.3634918	-0.178129	-0.136066	-0.078923
lag 3 months			(3.56)***	(-1.05)	(-0.80)	(-0.46)
Spot price				0.3988321	0.0994696	0.1369286
lag 4 months				(3.95)***	(0.58)	(0.80)
Spot price					0.2215016	-0.088116
lag 5 months					(2.19)**	(-0.51)
Spot price						0.2275131
lag 6 months						(2.22)**
Num. of obs.	290	290	290	290	288	287
R-squared	0.9271	0.9283	0.9313	0.9348	0.9359	0.9369
D.W. Statistics	1.95	2.20	2.33	1.99	2.66	2.41
F Statistics	3663.08	1856.86	1292.54	1018.14	823.72	693.01

Note: numbers in bracket are the t-values of the coefficients. \*, \*\*, and \*\*\* indicate statistical significance at 10%, 5%, and 1% level respectively.

Table 2: Pass-Through Effects from Spot to Adjusted Retail Prices of Diesel Fuel in Calgary  
First Difference Regression Results

Dependent Variable: Diesel Fuel Price at Pump in Calgary Adjusted by Exchange Rate	(1)	(2)	(3)	(4)	(5)	(6)
Adjusted spot price lag 1 month	0.8730147 (38.91)***	0.7530983 (8.45)***	0.8583723 (8.99)***	0.9011525 (9.44)***	0.8996102 (9.41)***	0.8883695 (9.27)***
Adjusted spot price lag 2 months		0.1228797 (1.38)	-0.225231 (-1.44)	-0.177708 (-1.14)	-0.155691 (-0.98)	-0.139074 (-0.88)
Adjusted spot price lag 3 months			0.2530587 (2.65)**	-0.083341 (-0.54)	-0.054288 (-0.34)	-0.047802 (-0.30)
Adjusted spot price lag 4 months				0.2605606 (2.76)***	0.0795605 (0.51)	0.1248038 (0.79)
Adjusted spot price lag 5 months					0.138473 (1.47)	-0.058818 (-0.38)
Adjusted spot price lag 6 months						0.1457992 (1.53)
Num. of obs.	124	123	122	121	120	119
R-squared	0.9254	0.9261	0.9300	0.9337	0.9344	0.9356
D.W. Statistics	2.17	1.77	1.79	2.01	1.98	2.03
F Statistics	1514.07	751.61	522.28	408.48	324.91	271.16

Note: numbers in bracket are the t-values of the coefficients. \*, \*\*, and \*\*\* indicate statistical significance at 10%, 5%, and 1% level respectively.

## Who We Are

Over the past ten years Corporate Economics has researched dozens of economic topics and developed reliable methods of forecasting and analysis. Monitoring economic trends allows us to develop unique insights on how external events are impacting the local economy and the Municipal Corporation. We provide services in four areas: forecasting, information provision, consulting and policy analysis.

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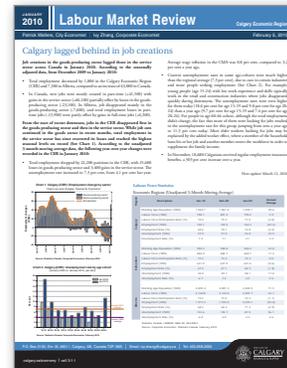
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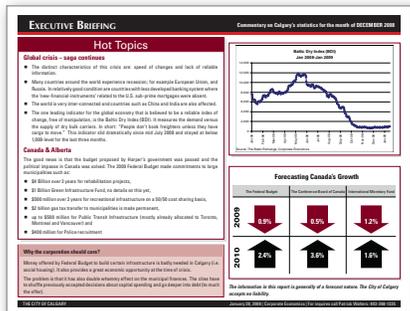
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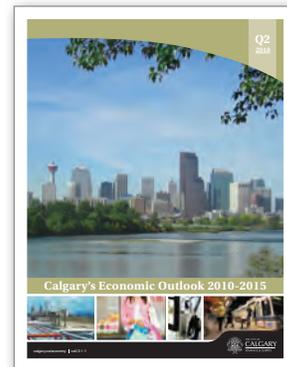
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