

Widening crack between crude oil price and retail price of gasoline

-an analysis of the Nova Scotia regular self serve gasoline market, 2001 to 2014

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Abstract

Despite a substantial fall in the crude oil price in recent months, the price of regular gasoline has not shown much decline. People feel that gasoline price rises at the speed of rocket and falls at the speed of a feather, thus asymmetry in the speed of price rise and the price fall. This asymmetry was felt in early in early 1990's and tested by several economists using US data relating to crude oil price, gasoline price and marketing margin. A paper by Borenstein et al. (1992) for National Bureau of Economic Research found that the gasoline price at the pump increases in four weeks after the crude price increase, while it takes 8 weeks for decrease in price after a fall in crude price. The Borenstein paper uses "asymmetric partial adjustment model". According to this paper the most significant asymmetry appears in the response of retail price to wholesale price changes. The paper also found that there was no asymmetry in response of wholesale gasoline price to crude price. In a paper presented at Canadian Economic Association conference in Ottawa (2011) Janelle Mann using "threshold autoregressive" (TAR) model found that the North American crude, and gasoline, wholesale and retail, prices are co-integrated and move to equilibrium once they have reached a threshold of marketing margins. Both these studies, and those in between them, reason that the asymmetry in response is caused by marketing margins. Michael J. Ervin (2011) of the Kent Group Limited (M.J. Ervin & Associates) points out that there has been widening gap (crack) between crude price of West Texas Intermediate (WTI) and the wholesale price of gasoline. This observation is different than all previous studies.

In Nova Scotia the gasoline price is regulated and the regulator decides on the transportation cost, maximum and minimum wholesale and retail margins. The regulated gasoline prices are prescribed using a fixed formula. Since the formula is fixed, the base wholesale price (rack price) and retail price are perfectly co-integrated. The current increase in crack between crude oil price and retail price may be explained by increasing gap between crude oil price and rack price. The present paper examines the relationship between WTI crude, Brent crude, rack (base wholesale) and retail prices by taking Nova Scotia data from 2001 to 2014. The period covers both the regulated and unregulated gasoline markets in Nova Scotia. The only refinery in Nova Scotia terminated its operations in 2013. Fuel terminals now provide the needed gasoline. However, this change has not affected the gasoline price calculation by the Regulator. The paper finds that the demand for crude oil has decreased and the supply of crude oil has increased lowering its price. On the other hand, the demand for gasoline is more stable while the

supply of gasoline has reduced for various reasons. As a result, the rack prices have stayed high and the refiner margins have increased causing widening of the crack between crude price and rack price of gasoline.

Introduction:

Many people feel concerned about increasing gap between crude oil price and the retail price of gasoline in recent months. The present paper examines this increasing gap, often called crack, in the context of Nova Scotia, where the price of gasoline is regulated.

Researchers have studied the relationship between crude price, wholesale price and retail price for several years. During 1990s, gulf war and after it, crude oil price fluctuated and so did gasoline price. When crude oil price rose, gasoline price also rose after a small time gap and when crude oil price fell, gasoline price also fell after a larger time gap. It was understood that as the cost of input (crude oil) rose, price of the manufactured product (gasoline) also rose. The adjustment takes a small time gap because of the menu cost and other factors. The rise in price in response to an increases in cost depends on the monopoly power of the wholesaler and the retailer. But when the crude price fell, the wholesalers and the retailers were slow to respond because of adjustment time involved in clearing already purchased inventories and level of competition in the retail market.

The market at the input production level during 1990s was dominated by OPEC and vertically integrated company like Exxon Mobil (Imperial Oil in Canada). The crude oil has to be refined. At the refining stage, there were a few more players. Gasoline once produced has to be marketed. At the marketing stage there are wholesalers and retailers who compete with each other depending on demand conditions in their local area of operation.

Given this market structure in the 1990s, economists were looking for reasons of response time of price of gasoline to change in crude prices in terms of marketing margins. Since gasoline prices responded asymmetrically to change in crude prices, taking asymmetric regression models was an obvious choice. Models used by economists in 1990s to 2011 were: Asymmetric Partial Adjustment model, Threshold Autoregressive (TAR) model, Momentum Threshold Autoregressive (M-TAR) model, Asymmetric Error correction (ECM) model, and Autoregressive Distributed Lag (ADL) model.

Borenstein, et. al.(1992), in their study done for National Bureau of Economic Research used Asymmetric Partial Adjustment model by taking U.S. data. Their results confirmed that retail gasoline prices increase when crude oil prices go up and that increase takes about 4 weeks to happen. When crude oil prices fall, gasoline prices also fall but it takes 8 weeks for that to happen. This asymmetry in price increase and decrease may be due to exercise of market power or it may be due to inventory adjustment costs. They find that the most important asymmetry occurs in response of retail to wholesale price (which they took to be rack prices) changes and this may be due to short term market power of retailers. They did not find asymmetry in wholesale prices when crude oil prices change.

Taking data for 2008 to 2011 for a few Canadian and U.S. cities, Janelle Mann (2011) used a non-linear TAR co-integration model to study the relationship among the price of crude oil, rack (wholesale) and retail gasoline. Mann uses marketing margin threshold

(both upper and lower), which once reached drives margins back to equilibrium. In her words:

"The results using daily data between 2008 and 2011 suggest that upstream and downstream prices are co-integrated; however there is no adjustment back to the long-run equilibrium relationship until the deviation from the equilibrium margin exceeds a critical threshold. The results using weekly data between 2003 and 2011 suggest that upstream and downstream prices for cities whose retail, rack, and crude price are integrated of the same order are co-integrated and adjust back to the long-run equilibrium relationship no matter the size of the margin."

Both Borenstein and Mann relate asymmetry in gasoline price rise and fall to some kind of monopoly power exercised by the retailers in the market. Michael J. Ervin (2011) points out that in the oil industry wholesale price does not reflect the cost of gasoline. Despite the lower price of crude oil, the wholesale price of gasoline has not responded to the same extent, increasing the refining margins. Hence the main cause of the increasing crack is refining margins and to less extent the marketing margins.

Case of Halifax, Nova Scotia

It was first July 2006 that fuel price regulation was introduced in Nova Scotia. At that time the base wholesale price (rack price+ transportation cost+ wholesale margin + any forwarding averaging amount, which was zero for this time) was 69.9 cents per litre for regular gasoline. To this was added federal excise tax (10 cents) and provincial tax (15.5 cents) to get wholesale selling price of 95.4 cents per litre. For self service gasoline retail margin of 4 cents per litre was added before 14% HST was put to get 113.3 cents per litre selling price. The maximum retail margin was set at 5.5 cents per litre which was added to the wholesale selling price before HST 14% was added to get maximum price for self serve regular gasoline in Halifax. For full serve gasoline the minimum margin was 4

cents and the maximum margin was 7.5 cents per litre which gave retail minimum price 113.3 and maximum price maximum price 117.3 cents per litre.

Later on there were changes to the amounts. The ceiling on maximum full service price was removed, prices were set weekly instead of bi-weekly, HST fell to 13% before rising to 15%, transport margin increased, wholesale and retail margins increased.

The studies which used regression models to explain the relationship between crude oil price and retail price of gasoline delve on the marketing margins (wholesale + retail) when prices rise and prices fall. This analysis became irrelevant for Halifax (Nova Scotia) because the marketing margins were fixed by the regulator and did not change when prices varied.

However, the actual marketing margins were different than the regulated margins because of the nature of supplier-retailer relationship and also most of the retailers used opting out clause of the law. For instance a fully integrated retailer like Esso, the regulated margins did not mean any thing and hence opted out. Also, the Esso outlet leased out to businesses had their own contracts with Imperial Oil for supply of equipment and gasoline and thereby opted out of regulation. Only about 24% of the retailers fell in the regime of regulated margins.

The actual retail price of gasoline in Halifax varies between minimum and maximum prices set by the self serve gasoline. There is no ceiling price set by the regulator for full

serve gasoline. The actual marketing margin, therefore, differs from the regulated margins. Because of this difference between the actual and the regulated values, the actual values, given by the Kent marketing survey data are used in this paper. Regulator does not give data on crude oil and rack prices. These data together with retail price, wholesale price and marketing margin data are culled from the Kent marketing surveys for analysis in this paper.

The study covers both the free market years (2001 to June 2006) and regulated market years (July 2006 to 2014). Since the regulated margins were based on the pre-existing margins in the free market, there seems to be little difference in price setting in the regulated and unregulated markets. The regulated prices are slightly higher than the unregulated market because the expenses of carrying on regulation are built in the regulated prices.

Results:

a) Relationship between crude and retail price of gasoline in Halifax:

Table 1 below gives crude oil and retail price of self serve gasoline in Halifax. One would not from the table that the absolute price difference between crude and retail price which is the total of refining margins, wholesale margin, retail margin, federal tax, provincial tax and HST, varied between 48.2 to 59.8 cents per litre. Since federal and provincial taxes are a constant value, the difference above reflects change in margins and HST.

The ratio of retail to crude prices varies from 296% to 181% showing that when the crude price is low, the ratio is high because of high ratio of fixed margins and fixed federal and provincial taxes, which are in cents per litre rather than percentages. Same way, when the crude price is high, the ratio is lower signifying lower ratio of fixed margins and taxes.

Table-1 (Cents per litre except ratio which is in percent)

Year	Crude price	Pump price	Absolute Difference	Retail/crude P ratio
2001	24.6	72.8	48.2	295.9
2002	25.2	73.4	48.2	291.3
2003	27.3	77.5	50.2	283.9
2004	33.2	87.3	54.1	263.0
2005	43.5	98.6	55.1	226.7
2006	46.0	103.9	57.9	225.9
2007	48.5	107.3	58.8	221.2
2008	64.5	117.8	53.3	182.6
2009	41.5	96.2	54.7	231.8
2010	48.7	105.8	57.1	217.3
2011	62.6	125.4	62.8	200.4
2012	71.8	131.4	59.6	183.0
2013	72.4	131.2	58.8	181.2
2014	71.4	131.1	59.7	183.6

One would note a big jump in crude price between 2010 and 2011. It was due to change in calculation used by refinery in Halifax. Instead of taking the price of West Texas Intermediate (WTI) crude, it used the price of Brent crude, which was higher. This shift in pricing formula reduced refining margins. The media took the cause of the company and supported the view of the management that it could not continue its operation with low operating refining margins. The Imperial Oil refinery in Dartmouth was decommissioned in 2013 making 200 oil workers unemployed. The shift in the pricing formula reduced good refining margin into low refining margin as is shown in table 2. Refining margin of about 20 cents became 5.4 cents per litre in October 2011 and 1.7

cents in November 2011. The cost of crude jumped from 57.6 in September to 72 cents per litre in October 2011. This all was caused by shift in the pricing formula.

Table-2: Crude price and refining margin, 2011.

(Cents per litre)

Month	Crude P	Refining Margin
August	55.8	21.7
September	57.6	19.7
October	72.0	5.4
November	73.0	1.7
December	71.2	2.9

The Imperial Oil refinery was commissioned in 1918 and has been using crude from North Sea (Brent crude), Saudi Arabia, southern American countries, etc. by ships. Its capacity was 89000 bbl/d (14,100m³/d). According to Michael J. Ervin (2011):

"The single most important reason is the difference between the price of West Texas Intermediate crude oil (WTI), and the price of Brent crude: the former originating in the Texas oil-patch, the latter originating in the North Sea. The two are of similar quality and, all other things being equal, should trade more or less at parity to each other. Historically that has been the case, but more recently, the price "spread" between the two has been significant."

Is it that Imperial oil refinery wanted to shut down operation in Dartmouth and convert it into oil terminals using refined products of Exxon Mobil, of which it was a part? The Irving Oil company in St John, NB has only 1/3 capacity of Imperial oil and cannot meet Atlantic Canada demand for gasoline. One often wonders why there was a shortage of gasoline in Nova Scotia in the first week of September 2015 till Nova Scotia regulator increased the price of gasoline by 6 cents per litre.

One may say that the Nova Scotia Utilities and Review Board uses a fixed formula and, therefore, is not susceptible to any outside pressures. We could be assured of this if the regulator gives a breakdown of its base wholesale (Benchmark) price. In the Order dated 3rd September it simply states:

"AND WHEREAS the Board revised the wholesale margin effective January 4, 2013, in its Decision, 2012 NSUARB 213, issued on December 12, 2012;

"AND WHEREAS the average of the average of the daily high and low reported product prices (in Canadian cents) for the week ended September 2, 2015 are:

*"Grade 1 Regular gasoline 53.8¢ per litre
Ultra-low sulfur diesel oil 54.6¢ per litre*

"NOW THEREFORE the Board prescribes the benchmark prices for petroleum products to be:

Gasoline:

Grade 1 53.8¢ per litre

Grade 2 56.8¢ per litre

Grade 3 59.8¢ per litre

Ultra-low sulfur diesel oil 54.6¢ per litre

"AND NOW THEREFORE the Board has determined, based on historical data regarding price changes and to achieve revenue neutrality, it is appropriate to apply, and the Board so orders, forward averaging corrections of:

Gasoline: minus 0.4¢ per litre

Ultra-low sulfur diesel oil: minus 0.4¢ per litre

"AND NOW THEREFORE the Board prescribes the prices for Petroleum Products as set forth in Schedule "A" effective on and after 12:01 A.M. September 4, 2015."

During the first week of September 2015, local media blamed regulation for shortage of gasoline rather than the absence of a refinery. Gasoline price is also regulated in New Brunswick and Newfoundland but there was no gasoline shortage because each of those

provinces has a refinery. In Nova Scotia decommissioning of refinery has led to such supply bottlenecks.

b) Relationship between WTI crude price and pump price in Halifax.

Let us consider a situation by taking WTI crude prices and pump prices in Halifax assuming that the crude oil price did not change to Brent in 2011. This situation is presented in Table-3.

Table-3 (Cents per litre except ratio which is in percentages)

Year	WTI Crude price	Pump price	Absolute P Difference	Retail/crude P ratio
2001	24.6	72.8	48.2	295.9
2002	25.2	73.4	48.2	291.3
2003	27.3	77.5	50.2	283.9
2004	33.2	87.3	54.1	263.0
2005	43.5	98.6	55.1	226.7
2006	46.0	103.9	57.9	225.9
2007	48.5	107.3	58.8	221.2
2008	64.5	117.8	53.3	182.6
2009	41.5	96.2	54.7	231.8
2010	48.7	105.8	57.1	217.3
2011	60.0	125.4	65.4	209.0
2012	54.2	131.4	77.2	242.4
2013	58.5	131.2	72.7	224.3
2014	51.3	131.1	79.8	255.6

In table 1, the absolute price difference was about 60 cents for years 2012-2014 but in table-2 it increased to above 70 cents reaching about 80 cents for the year 2014 because the year end saw a sharp decline in WTI prices. Similarly the ratio of retail price to crude (WTI) which fell below 200% in table 1, increased to about 255% in 2014.

Calculating prices and margins using WTI prices appears to be more appropriate than using Brent crude prices after the decommissioning of Imperial Oil refinery in Dartmouth. The gasoline is imported in ships and put in the oil terminals by Imperial Oil company and there is no reason why it should be using Brent crude now.

The media generally reports WTI price and the pump price leaving impression of widening gap between crude and the pump price and the general public feels frustrated in observing widening crack between pump price of gasoline and the WTI crude price.

c) Comparing margins with previous studies.

Table-4: Pump price, crude price, refining and marketing margins, Halifax, 2001-2014 (cents per litre)

Year	Pump P	Crude P	Refining	Marketing	Taxes	Fed. Tax	HST	Provincial
2001	72.8	24.6	8.2	7.0	33.0	10	9.5	13.5
2002	73.4	25.2	7.0	6.6	34.6	10	9.6	15
2003	77.5	27.3	8.5	6.2	35.6	10	10.1	15.5
2004	87.3	33.2	10.4	6.8	36.9	10	11.4	15.5
2005	98.6	43.5	9.2	7.6	38.4	10	12.9	15.5
2006	103.9	46.0	11.5	7.7	38.7	10	13.2	15.5
2007	107.3	48.5	12.8	7.5	38.7	10	13.2	15.5
2008	117.8	64.5	6.5	7.7	39.1	10	13.6	15.5
2009	96.2	41.5	11.2	7.0	36.6	10	11.1	15.5
2010	105.8	48.7	11.6	7.1	38.5	10	13.0	15.5
2011	125.4	62.6	13.5	7.4	41.9	10	16.4	15.5
2012	131.4	71.8	8.8	8.1	42.7	10	17.1	15.5
2013	131.2	72.4	8.4	8.1	42.6	10	17.1	15.5
2014	131.1	71.4	8.7	8.5	42.6	10	17.1	15.5

Studies done by Borenstein et. al. (1992) and Mann (2011) mentioned above take marketing margin as important factor in asymmetrical relationship between wholesale price (rack) and retail price of gasoline because according to these studies the crude oil

price and the wholesale (rack) price are co-integrated. The table-4 gives actual margins in Halifax from 2001 to 2014. After October 2011, refining margins are based on Brent crude oil price while prior to that they are based on Edmonton Par (WTI) price. Actually after the refinery closed in 2013, refining margins should have been based on Edmonton Par crude price.

Table-5: Refining margins in the first 6 months of 2015 (cents per litre)

2015 Month	Refiner Margin
Jan	7.8
Feb	8.2
Mar	11.4
Apr	11.1
May	12.7
Jun	18.5

The regulated margins were set in July 2006. One can observe that in the regulated margin period and the unregulated margin period there is no difference in the actual marketing margin. They varied between 6.2 and 7.7 cents per litre. Marketing margins increased after the Regulator increased the margins after 2012. The actual marketing margin does not cause asymmetry between wholesale price and the pump price in both the regulated and unregulated market periods.

The refining margins show erratic pattern, most of the time increasing whether the crude price is rising or falling except after 2012 to 2014 when Brent crude prices were used.

The refining margin depends on two factors: crude cost and rack price, the latter depends on demand for and supply of gasoline. In the first six months of 2015, the crude price fell

and the demand for gasoline was stable giving higher refining margins (table-5). The refining margin would be higher when we use Edmonton Par instead of Brent prices.

The difference between rack price and pump price contains variables and constants because of regulation. Constants are wholesale margin, transport cost, federal tax, provincial tax, maximum retail margin and minimum retail margin. There are only two variables the forward averaging amount and the HST amount. Forward averaging amount causes larger amount of fluctuations in pump price (than say, in New Brunswick, which does not use forward averaging in pricing formula) because amount is added when rack price is rising and subtracted when rack price is falling. Similarly HST amount rises when rack price is rising and falls when rack price is falling. Both these variables do not explain widening crack between pump price and crude cost. Increase in refining margin could possibly explain the increasing crack between the pump price and the crude cost.

Conclusion:

The crude price is determined by the world demand for and the supply of crude oil (input market) and the rack price of gasoline is determined by the demand for and the supply of gasoline (output market) in the local market. Prior to 2011, the conditions of demand and supply moved in similar manner in both markets giving impression that both markets are co-integrated. But recently, they have started moving separately. The demand for crude oil has fallen because the growth of the world economies have slowed, particularly China and India, on the one hand, and OPEC, under the leadership of Saudi Arabia, refused to reduce the supply of crude oil. The ISIS in Syria is also selling crude oil at whatever price

it can sell. Additionally, the embargo on Iran lifted. All these factors led to glut of crude oil in the market and fall in the price of crude oil.

The demand and supply of gasoline is determined by local conditions. The nearest gasoline market to Nova Scotia is New York Harbour. Gasoline price is determined by demand for and the supply of gasoline there. The North American refineries have anticipated reduction in future demand for gasoline because of the rise of alternative environment friendly fuels and hence cut down on gasoline production. Halifax refinery became the victim of such estimated future demand. Additional factors cause supply obstructions. In summer months, the forest fires may affect the delivery of gasoline by trucks, the four to six weeks closure of refineries for maintenance in Texas during summer months may further add to problems of supply and may cause pump price to go up. Similarly in winter, big snow storms may obstruct supply by trucks. The demand for gasoline has not fallen much resulting in stable higher prices. Thus on one hand, the price of crude has fallen and on the other hand the price of gasoline has not much fallen giving rise to increasing crack between the two prices.

References:

1. Severin Borenstein, A. Cohn Cameron and Richard Gilbert: "*Do Gasoline Prices Respond Asymmetrically to Crude Oil Price Changes?*", **National Bureau of Economic Research**, 1992. Working paper number 4138.
2. Janelle Mann: "*Do Wholesale and Retail Gasoline Prices Respond Asymmetrically to the Price Margin? - The North American Experience*". Ph.D. paper presented at 45th Annual conference of the **Canadian Economic Association**, June 2011.
3. Michael J. Ervin: "*Crude, Cushing and Crack Spreads: How to make Sense of it all?*" 2011. Available from **Kent Marketing Survey Website**.