

An Inquiry Into the Retail Petrol Market Study in Singapore

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AN INQUIRY INTO THE RETAIL PETROL MARKET IN SINGAPORE

Synopsis

This inquiry examines whether the retail petrol market in Singapore is competitive. In particular, it examines whether the petrol companies' retail petrol prices are the same and move in tandem ('price parallelism'), whether prices increase more or faster than they decrease ('rocket and feather' effect), and whether there is evidence of collusion between the players. Although the market structure and conditions of retail petrol in Singapore suggest a material risk of collusive or coordinated practices among the market players, based on current facts and data there is no evidence that the petrol players are engaged in anti-competitive collusive behaviour. The Competition Commission of Singapore (CCS) continues to monitor developments in the sector.

This article is contributed by staff members of CCS, and reflects their personal views. An abridged version was first published in the Ministry of Trade & Industry's 'Economic Survey of Singapore First Quarter 2011'.

Introduction

1. There is a common public perception that the retail petrol market in Singapore, being an oligopoly among a few large, international and vertically-integrated petroleum enterprises, is uncompetitive or even collusive. In particular, many consumers are under the impression that retail petrol prices are similar among competitors, move in tandem across companies (known as 'price parallelism'), and rise more/faster than they fall (known as the 'rocket-and-feather' phenomenon).
2. On the other hand, petrol market players have suggested that the shortage of land allocated for petrol stations is the main obstacle to making the retail petrol market more competitive in Singapore.
3. We have recently completed a market inquiry into the retail petrol market in Singapore to better understand the dynamics of this market. Using information obtained from market players¹, relevant government agencies and industry experts,

¹ CCS obtained commercially sensitive and confidential information from the petrol retailers, pursuant to section 61A of the Competition Act.

we performed an assessment of the petrol market to address the following questions:

- a. Is the current market structure conducive to competition?
- b. Does the available evidence suggest an uncompetitive market?
- c. Is there evidence of collusion between competitors in this market?
- d. Are there regulatory obstacles to competition in this market?

Industry Background

4. The petroleum industry is a supply chain of fossil fuel for various industrial and household consumption purposes. It consists of exploration and extraction of crude oil from the earth, refinery of crude oil into distillate products (such as petrol), as well as the logistics and retailing of the distillate products. The retail petrol market refers to the sale of petrol to motorists via fuel pumps at petrol stations². It is at the downstream end of the petroleum supply chain³.

5. There are four players in the petroleum industry in Singapore⁴. Each of them is vertically integrated, with a refinery plant⁵ and an islandwide network of petrol stations. Only about 20% of petrol produced by their refineries is sold domestically. The four players do not cross-sell each other's petrol. The remaining 80% of petrol is exported through open-market trading⁶.

6. There is no dedicated sectoral regulator for retail petrol in Singapore. Petrol station operators are nonetheless subject to urban planning by the Urban Redevelopment Authority (URA) and Singapore Land Authority (SLA), competitive bidding of petrol station sites conducted by Housing Development Board (HDB), safety rules by Singapore Civil Defence Force (SCDF), excise duty on petrol imposed by the Singapore Customs (Customs), and indirectly, differential road taxes

² Otherwise known as the 'pump' petrol market, so as to draw a distinction with bottled petrol, which is available for retail sales in many countries but prohibited in Singapore for safety reasons.

³ For the avoidance of doubt, the terms 'upstream' and 'downstream' markets in this paper refer to their antitrust meanings, based on the relative positions of two markets along a supply chain, as opposed to their meanings in the petroleum industry, based on the direction of oil flow. For instance, refinery is a 'downstream' business in the industry context, but it is an 'upstream' market to retail petrol in the antitrust context.

⁴ These are Chevron Corporation (Chevron), ExxonMobil Asia Pacific Pte Ltd. (ExxonMobil), Shell Eastern Petroleum Pte Ltd. (Shell), and Singapore Petroleum Company (SPC).

⁵ Chevron and SPC co-own Singapore Refinery Company (SRC), a joint-venture refinery plant.

⁶ Refined petrol is priced based on the Means of Platts Singapore (MOPS), which is an average daily transacted price in Singapore as per Platts, a leading global provider of commodity market information.

on petrol and diesel vehicles imposed by the Land Transport Authority (LTA)⁷. Lastly, business practices of the petrol players are subject to antitrust scrutiny by CCS.

The Retail Petrol Market in Singapore

7. We have observed the following features of the retail petrol market structure in Singapore:

Homogeneous product

8. Petrol is largely a homogenous commodity, which means that it is relatively easy for competitors to monitor each other's prices. Although petrol companies use additives to differentiate their products, the differences are not easily observable. In practice, consumers switch readily and quickly between competitors in response to price changes, suggesting high price elasticity of demand.

Lack of substitutes

9. There are different grades of petrol (e.g. RON 92, 95, 98 and Premium), as well as alternative vehicle fuels such as diesel. Due to vehicle engine specifications, petrol and diesel are generally not substitutable, and even the different grades of petrol may not be fully interchangeable⁸. These fuels are refined and sold by the same four players in Singapore. Of the different grades, RON 95 accounts for the largest portion of petrol sales at [50%-70%] of the market.

High market concentration

10. As of December 2010, there were 199 petrol stations in Singapore, with the breakdown outlined in [Exhibit 1](#):

Exhibit 1: No. of Petrol Stations per Company

Player	Number of Petrol Stations
ExxonMobil (Esso)	65
Shell	63
SPC	38
Chevron (Caltex)	33
Total	199

⁷ As diesel is not subject to excise duty in Singapore (for commercial purposes), a special lump-sum road tax is imposed on diesel private vehicles to neutralize any unintended fuel cost advantage.

⁸ Technically, motorists can switch to a higher grade of petrol than the engine specifies, but in practice, many motorists do not do so.

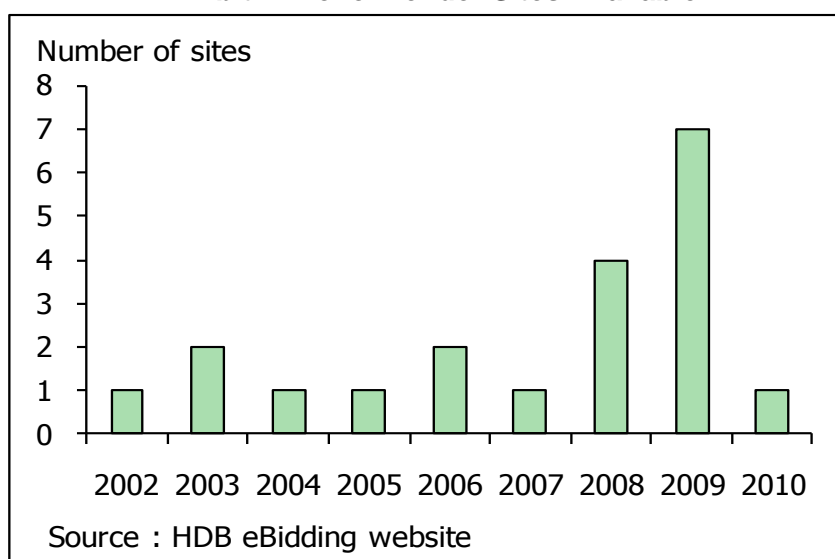
11. We have also studied the market shares of the four players by sales value⁹, and found that market concentration¹⁰ is high in Singapore. This is partly due to a lack of independent players which are not affiliated to the refineries.

High barriers to entry

12. Land premiums paid for retail petrol sites are generally high because of site scarcity. Depending on location and traffic volume, some sites can cost more than others¹¹. Players with better financial capabilities are more able to seek out premium sites with high car traffic.

13. The number of sites planned for petrol station use, and the location of these sites are set out in the national land use Master Plan, drawn up by URA. The planning considerations include ensuring that there are sufficient petrol station sites to meet the demand from motorists within the area, based on the number of residential units in the area. The sites are tendered out by HDB, in tandem with the development of the area. From 2001 to 2009, the number of new petrol station sites tendered averaged 2.4 per annum (Exhibit 2).

Exhibit 2: No. of Tender Sites Available



14. Given the mobility of vehicle traffic, a petrol retailer needs a critical number of petrol stations located throughout Singapore to be viable. If the history of SPC's acquisition of the sites of British Petroleum (BP)¹² is any indication, the minimum

⁹ Based on confidential information submitted by the petrol companies.

¹⁰ The Herfindhal-Hirshman Index (HHI) index value is 3,104 for the retail petrol market in Singapore, which the United States Department of Justice classifies as highly concentrated (Horizontal Merger Guideline: http://www.usdoj.gov/aatr/public/guidelines/horiz_book/15.html). HHI is calculated by summing the squared market shares of all individual players.

¹¹ Based on confidential information obtained from HDB.

¹² In 2004, BP decided to pull out of its operations in Singapore. Its 29 petrol stations were then sold to SPC, which had 10 stations prior to the acquisition.

efficient scale (MES) for a viable retail petrol operation in Singapore should be about 30 stations. As shown in Exhibit 1, all four incumbents have more than 30 sites. It would be difficult for new players to enter the market and achieve MES today, given the small number of new sites available each year, in planned locations only.

Vertically integrated players

15. All four players are vertically integrated with their refineries. This brings about efficiency benefits such as savings in transportation costs. At the global level, however, the prices at which they purchase crude oil are still subject to the bargaining power of oil exporting countries.

16. At the refinery level, every distillate product, including petrol, is a ‘by-product’ of a refinery operation. Depending on demand conditions of various distillate products from time to time, an individual refinery player may need to manage its inventory of petrol within a short period of time so as to avoid high storage costs due to high space rental costs in Singapore. In such circumstances, coordination of petrol prices or output levels may be difficult to sustain between the refinery players.

Weak buyer power

17. The petrol market is characterized by a large number of motorists purchasing small amounts of petrol each time. Individual buyers do not have the bargaining power to negotiate prices with the sellers.

Obscure effective prices

18. It is commonplace for the petrol market players to display their listed prices prominently at the entrance to their petrol stations. From time to time, they also announce impending changes to their listed prices through the public media. While this may appear to indicate good price transparency, in practice, all four players offer a wide variety of targeted promotion schemes such as loyalty rebates and credit card discounts. These promotions make it difficult for buyers to compare effective prices between competitors. Although some consumer self-help initiatives have emerged in recent years¹³, the information gap has not been fully bridged¹⁴.

19. In any case, pricing transparency can be a double-edged sword. Transparent prices may be used by competitors as a means of exchanging price information, and such price signals can make it easier for competitors to move into price coordination, which is anti-competitive. If a cartel exists in the market, it is easier for cartel members to monitor one another’s compliance, if prices are openly broadcasted.

¹³ For example, Petrolwatch (www.petrolwatch.com.sg) is a free service for motorists. It updates petrol prices promptly, sends SMS alerts to members on impending price changes, and attempts to monitor various discounts and promotion schemes. It has since become a popular website due to the fluctuations in petrol prices in recent years.

¹⁴ For example, Petrolwatch provides a “price board before and after house discounts”, which does not capture the full range of discounts and promotions.

When a seller knows that its competitors are able to observe and respond quickly to any price reductions, the incentive to cut prices in the first instance is weakened, as the ability to gain market share through such a move is short-lived.

Conclusion

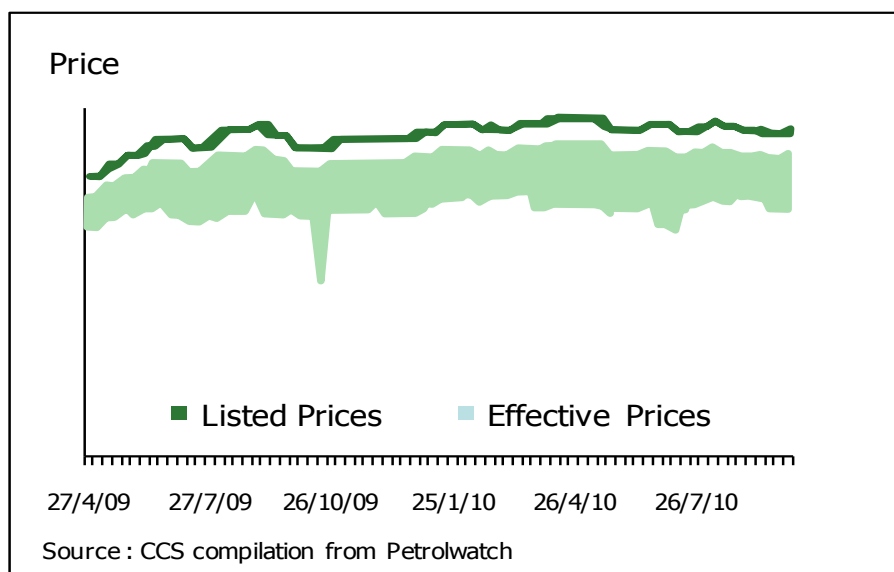
20. On balance, the market structure and conditions of retail petrol in Singapore suggest a material risk of collusive or coordinated practices between the market players. We next examine whether there is evidence that such anti-competitive behaviour is actually taking place, or is likely to be taking place.

Assessment of the Evidence

Listed prices are similar between competitors, but effective prices are not

21. We have adopted two different methodologies to compare the listed and effective prices of the petrol players¹⁵. Exhibits 3 & 4 compare the degree to which listed and effective petrol prices are similar between competitors. The dark green band depicts the range of listed prices between the four players across time¹⁶, while the light green band depicts the range of their effective prices¹⁷.

Exhibit 3: Listed Prices vs Effective Prices

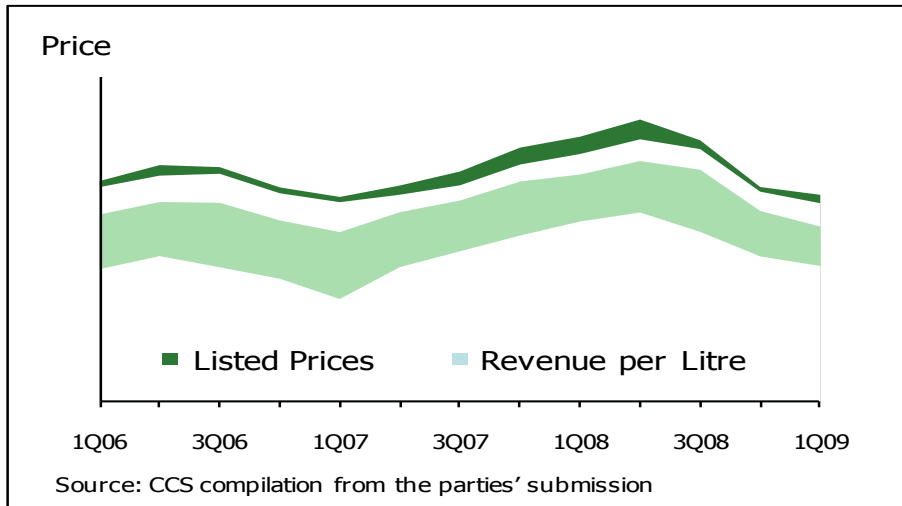


¹⁵ The first methodology compares the displayed prices of RON 95 petrol against the discounted prices after various promotions. For example, if a loyalty card holder receives a 5% discount on the spot, plus a further 3% in bonus points, then the effective price is 8% lower than the listed price. The second methodology compares the displayed prices of all grades of petrol against the actual revenue per litre of the petrol players. The first methodology is sensitive to the *eligibility* of individual consumers to various targeted discount schemes, while the second methodology is sensitive to the *product mix* of individual petrol players. However, the *consistency* of results between the two methodologies reinforces the conclusion.

¹⁶ The time periods covered under the two methodologies are different due to availability of data. See the respective charts for details.

¹⁷ The downward spike in discounted price around October 2009 was Shell's one-day promotion of \$1 per litre for the launch of its new petrol formula.

Exhibit 4: Listed Prices vs Effective Prices

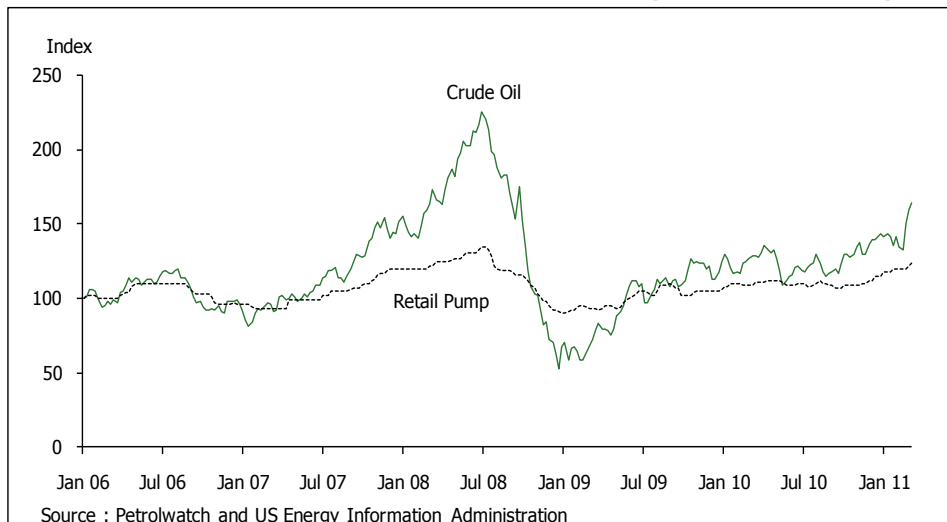


22. The fact that the light green band is much wider than the dark green band under both methodologies demonstrates that, while listed prices may be similar and move in tandem between the four players, the same is not true for effective prices. In other words, while listed petrol prices in Singapore are highly transparent and parallel, effective prices are quite varied between competitors. Price competition appears to take place at the effective price level, as buyers take advantage of the various promotion and loyalty schemes.

Pricing data does not exhibit a 'rocket-and-feather' pattern

23. Here, we examine the pricing data to see if the 'rocket-and-feather' phenomenon (i.e. petrol prices increase steeper than they decrease) exists. Exhibit 5 plots retail and crude oil prices in SGD terms from 2006 to 2011, indexed for ease of comparison. In general, crude prices were more volatile than pump prices, but over a full cycle (e.g. 2006-07, 2007-09), pump prices did not outpace crude prices, as would have been predicted by the 'rocket-and-feather' hypothesis.

Exhibit 5: Movements of Crude Oil and Retail Pump Prices in SGD (Indexed)



24. We have also reviewed the incidents of petrol price movements over the 12-month period from April 2010 to March 2011. As shown in Exhibit 6, there were 11 incidents of price increase (in red), 6 incidents of decrease (in green), and 4 incidents of full or partial reversal¹⁸ (in blue). During this period, crude oil price increased by 13.3% in SGD terms, while retail petrol prices increased by 12.7% on average.

Exhibit 6: Petrol Price Movements

Start date	No. of players involved	Direction	Magnitude	Time span
5 Apr 2010	4	Increase	2~3 cents	48 hours
17 May 2010	4	Decrease	-4~5 cents	2.5 hours
24 May 2010	4	Decrease	-2 cents	2.5 hours
17 Jun 2010	4	Increase	3 cents	26 hours
6 Jul 2010	4	Decrease	-3~4 cents	20.5 hours
26 Jul 2010	4	Increase	3 cents	24.5 hours
5 Aug 2010	4	Increase	2~3 cents	28 hours
13 Aug 2010	4	Decrease	-3 cents	3.5 hours
25 Aug 2010	4	Decrease	-2 cents	1 hour
8 Sep 2010	4	Decrease	-2 cents	1.5 hours
14 Sep 2010	2	Full reversal	3 cents	49 hours
1 Oct 2010	2	Full reversal	3 cents	99.5 hours
7 Oct 2010	4	Increase	3 cents	5 hours
10 Nov 2010	4	Increase	2 cents	17 hours
29 Nov 2010	4	Increase	3 cents	21 hours
7 Dec 2010	4	Increase	5 cents	8 hours
24 Dec 2010	4	Increase	3~4 cents	23 hours
18 Jan 2011	1	Increase	3~4 cents	22.5 hours
23 Feb 2011	4 (1 reversed)	Partial Reversal	3 cents	72 hours
3 Mar 2011	4	Increase	2~4 cents	21 hours
21 Mar 2011	4 (2 reversed)	Partial Reversal	-1~+2.3 cents	51 hours

Source: *Petrol Watch*

¹⁸ Full (or partial) reversal means that some players increased prices first, and subsequently reduced them back to the original level (or to somewhere still above the original level), because other players did not match (or did not increase prices by the same magnitude).

25. We observe that it took 5 to 48 hours to complete a round of price increase (i.e. between the first and last players to increase price), compared to 1 to 20.5 hours for price decrease, and 49 to 99.5 hours for price reversal. There is no clear evidence from these observations that petrol prices increased faster than they decreased.

26. Zooming into the price movements of a particular incident – during the 50 hours 45 minutes from 21 to 23 March 2011 – provides further insights into the market dynamics. As shown in Exhibit 7, one player increased its prices by 3 cents uniformly across all grades. The three other players reacted, but the magnitudes of their price increases were lower and regressive (i.e. less increase for higher grades). Later, the first two players who raised prices adjusted their prices downwards to match their competitors'. In the end, Grade 92 and 95 prices were increased by 2.3 and 1.3 cents respectively. For Grade 98 and Premium grade petrol, one player had reduced prices by 1 cent. These price movements did not appear to be highly coordinated among the players.

Exhibit 7: Price Movements of a Particular Incident

Date	Time	Player	Grade	Old Price	New Price	Change	Remarks	
21 Mar 2011	1500h	I	92	2.017	2.047	+0.030	Uniform price increase for all grades by one player	
			95	2.077	2.107	+0.030		
			Premium	2.215	2.245	+0.030		
	1800h	II	95	2.077	2.097	+0.020	Lower and regressive price increases across different grades by the three other players	
			98	2.150	2.160	+0.010		
			Premium	2.359	2.369	+0.010		
22 Mar 2011	1000h	III	92	2.017	2.040	+0.023		Lower and regressive price increases across different grades by the three other players
			95	2.077	2.090	+0.013		
			98	2.150	2.140	-0.010		
	1200h	IV	92	2.017	2.040	+0.023	Lower and regressive price increases across different grades by the three other players	
			95	2.077	2.090	+0.013		
			98	2.130	2.140	+0.010		
1300h	I	92	2.047	2.047	0.000	Partial reversal of price increases by two players		
		95	2.107	2.097	-0.010			
		Premium	2.245	2.225	-0.020			
23 Mar 2011	n.a.	I	92	2.047	2.040		-0.007	Partial reversal of price increases by two players
			95	2.097	2.090		-0.007	
			Premium	2.225	2.225		0.000	
	1745h	II	95	2.097	2.090	-0.007	Partial reversal of price increases by two players	
			98	2.160	2.140	-0.020		
			Premium	2.369	2.349	-0.020		

Source: Petrol Watch

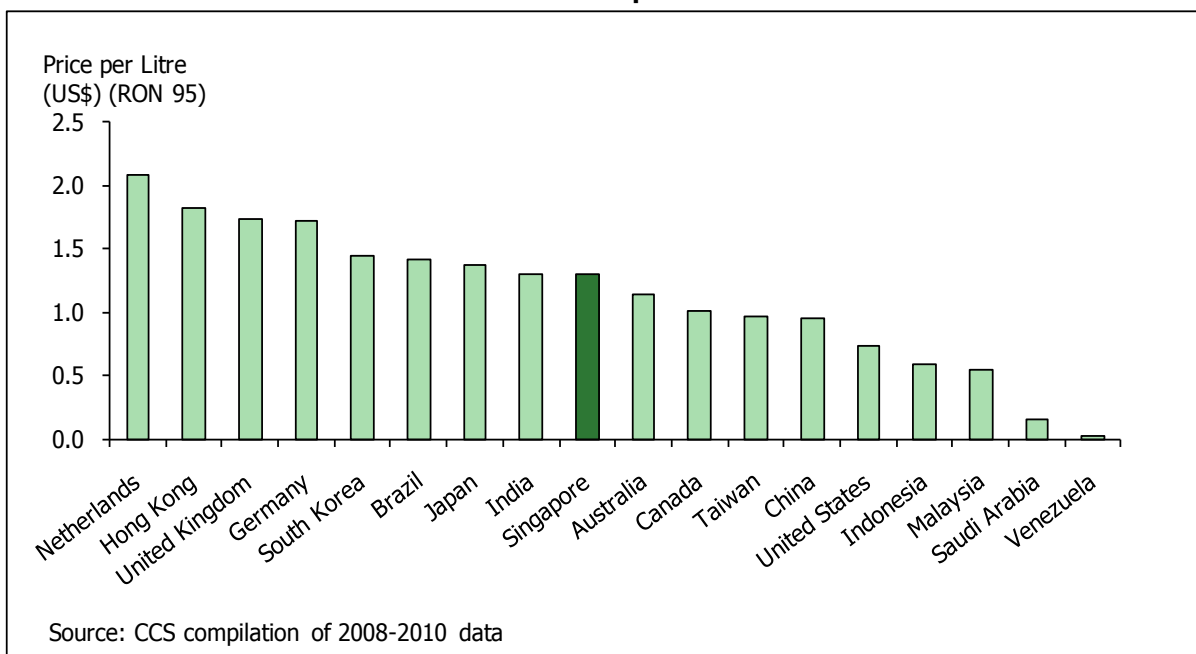
27. In addition, we have conducted an econometric analysis on the retail petrol prices to test if the ‘rocket-and-feather’ phenomenon exists (see Appendix 2). The results do not support the existence of such a phenomenon¹⁹:

- a. Overall, crude oil price movement was a good leading indicator of pump petrol price movement;
- b. The correlation between crude oil prices and petrol prices was not stronger when they rose than when they fell;
- c. Petrol prices did not rise more (in magnitude) in response to crude oil price increases than they fell in response to crude oil price decreases; and
- d. Petrol prices did not rise faster (i.e. shorter time lag) in response to crude oil price increases than they fell in response to crude oil price decreases.

Petrol prices in Singapore are competitive by international comparison

28. Exhibit 8 compares Singapore’s petrol prices with a sample of countries around the world.

Exhibit 8: International Comparison of Petrol Prices

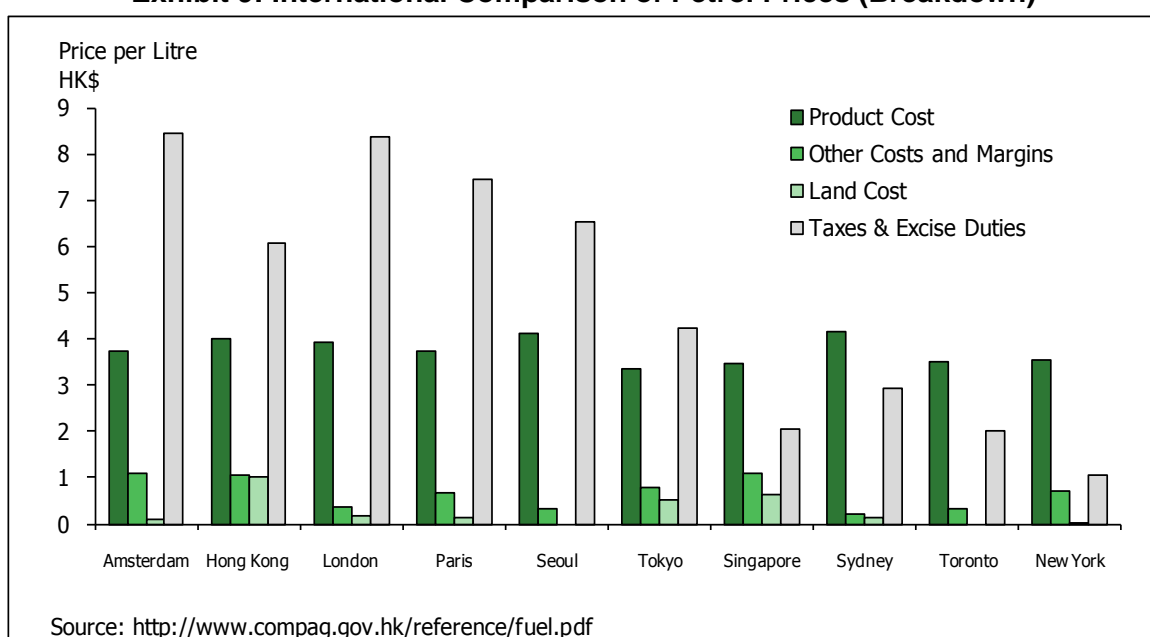


¹⁹ This finding is consistent with economic theory, which predicts that retail petrol prices track crude oil prices closely and symmetrically, in both competitive and cartelistic markets. The presence of ‘rocket-and-feather’ phenomenon would indicate that the cartelists, if any, were not maximizing their profits.

29. Singapore's petrol prices compare favourably with many developed economies such as UK, Germany, Japan and Korea; large developing economies such as India and Brazil; as well as similar sized economies such as Hong Kong. Places with cheaper petrol prices than Singapore are either oil exporting countries such as Saudi Arabia and Venezuela; those whose governments subsidizes petrol consumption such as Indonesia, Malaysia and Taiwan; those with low taxes such as the US; and those where input prices are regulated, such as China.

30. Exhibit 9 shows the breakdown of petrol prices in various countries into their cost components, namely product cost, land cost, duty and taxes, as well as other costs and margins.

Exhibit 9: International Comparison of Petrol Prices (Breakdown)



31. Amongst the 13 cities sampled, Singapore ranks 7th and 8th highest in terms of listed and effective petrol prices respectively. Its effective discount rate of 11.4% on listed petrol prices is the widest of all. The swing factor for petrol prices is taxation, which Singapore ranks the 8th highest. Product cost is the 2nd lowest, largely due to transport cost savings, as all the petrol companies have refineries located in Singapore. Land cost in Singapore ranks the 2nd highest, but land cost itself is not a significant component of total petrol cost.

Operating profit margins are in single-digits

32. Based on the financial information submitted by the petrol companies, the pre-tax operating profit margins²⁰ of their retail petrol businesses in Singapore ranged [0-10]% during the period from 2006 to 2009.

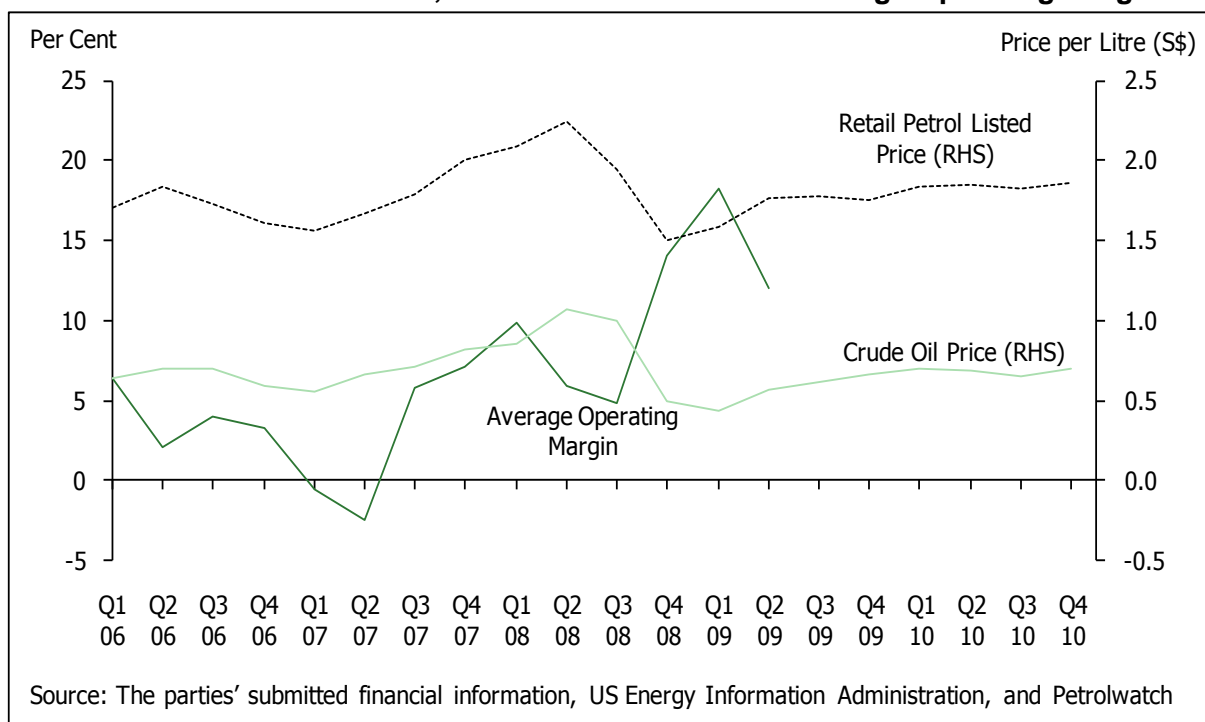
²⁰ Operating Margin is defined as total revenues less cost of goods sold, selling, general and administrative (SG&A) expenses as well as depreciation and amortization (i.e. both variable and fixed cost), divided by total revenues.

33. One potential gap is whether the vertically-integrated players have been channelling their profits upwards to the refinery level, so that the effects of collusive activities at the retail level cannot be detected. In this regard, we note that all four players use the MOPS price to account for their internal sales of petrol between their refinery and retail arms. Given that MOPS prices are based on open trading records, of which 80% are international transactions, there does not appear to be much room for manipulating profits between the refinery and retail levels.

Profit margins fluctuate counter-cyclically

34. Exhibit 10 plots the average operating profit margins of the petrol companies against crude oil prices across time. The profit margins exhibit a counter-cyclical pattern²¹, suggesting that the market players have not been able to take advantage of input cost fluctuations to increase their profits.

Exhibit 10: Crude Oil Prices, Listed Petrol Prices and Average Operating Margin



35. Counter-cyclicality alone is not sufficient to demonstrate that the market is competitive. However, the existence of a cartel would likely lead to the time trend of profit margins being maintained at relatively stable levels, rather than exhibiting the volatility as shown by data. This does not seem to suggest (successful) price coordination in the market.

²¹ A counter cyclical pattern in this context means that the profit margins of retail petrol companies increase when crude oil price falls, and vice versa.

Conclusion

36. Overall, the data does not indicate that the retail petrol market is uncompetitive, notwithstanding that the market structure suggests a material risk of anti-competitive practices. A conjecture that there has been collusion or coordination of prices among competitors is therefore not supported by available data.

Assessment of Regulatory Impact on Competition

37. This section explores whether the three main aspects of regulation on retail petrol operations in Singapore – namely urban planning, bidding process and tax structure – may amount to obstacles for the market becoming more competitive.

Urban planning is necessary

38. The problem of land scarcity is inherent to Singapore. Therefore, careful urban planning is necessary. As discussed above, only a few new petrol station sites are available every year, this makes it more difficult for new players to enter the market, with a critical scale of operations. However, it should be noted that land cost is not a significant cost driver, as it accounts for only [5-10]% of total petrol price.

The site allocation mechanism is competitive

39. HDB operates an eBidding mechanism for the allocation of petrol station sites. There is no pre-screening process to restrict the eligibility of bidders based on subjective criteria. The only substantial requirement is an upfront deposit²². The bidding process is an open, anonymous and ascending auction. Such a bidding process generally produces smaller increments between bids than, say, sealed-bid tenders²³. In particular, anonymity helps prevent bid-rigging between competitors. Sites are awarded to the highest bidder. HDB has informed us that the petrol companies do compete aggressively for new sites.

40. We considered whether the lease term of 30-years for new petrol station sites have contributed to the limited availability of new sites. However, we note that, in the context of land lease, 30 years is not long, compared to typical residential land leases of 99 to 999 years, and commercial ones of 99 years. In any case, the potential benefits of shorter lease terms are unclear, as each dollar invested would have to be amortized faster, leading to a tighter payback period which may affect investment incentives.

²² 10% of site valuation, fully refundable.

²³ In the Study of the Auto-Fuel Retail Market in 2005, the Economic Development and Labour Bureau of the Government of Hong Kong Special Administrative Region made a recommendation, for “Enhancing Competition”, by replacing a “single-shot sealed tender”, which “arguably can result in higher land premiums”, with an “open, multi-round ascending auction”.

Singapore's petrol tax structure is internationally competitive

41. As noted above, taxation is the swing factor for total petrol prices across different countries. Although petrol and diesel are subject to different tax treatments at the moment, a special tax on owners of diesel private vehicles (a lump sum tax) is designed to offset the excise duty on petrol sales (a variable tax). It is unclear if a revamp of diesel tax structure would necessarily subject petrol to more competitive constraint²⁴. After all, petrol and diesel are sold by the same four companies in Singapore, who would internalize their profits across different product lines.

Conclusion

42. It would appear that the overall regulation regime overseeing the retail petrol market in Singapore is generally pro-competitive. Land scarcity is a *natural* barrier to entry that cannot be overcome by regulation or deregulation. Our view is that regulation has not resulted in *incremental* impediment to competition.

Conclusion

43. Our analysis shows that the structure of the retail petrol market in Singapore contains a risk of collusive or coordinated practices between competitors. However, based on current facts and data, there is no evidence that the petrol players are engaged in anti-competitive collusive behaviour.

44. This study also finds that the regulatory regime is generally pro-competitive. The natural barrier of land scarcity cannot be overcome by regulation or deregulation. Over the period of the market inquiry, petrol prices in Singapore appear to be competitive by international comparison.

45. Based on current information, there does not appear to be a case for CCS to intervene. CCS continues to monitor developments in the sector. If there is material new information suggesting that petrol players have breached the Competition Act, CCS will initiate an investigation.

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COMPETITION COMMISSION OF SINGAPORE

²⁴ In theory, if petrol and diesel are subject to the same tax treatment, motorists can choose between buying a petrol or diesel private car in the first instance, taking into account the relative costs of pumping petrol and diesel.

**APPENDIX 1:
Summary of Arguments**

Perceptions	Assessment
<p>Petrol prices are the same between the companies, and they move in tandem</p>	<ul style="list-style-type: none"> ▪ After accounting for various discounts and promotions, petrol prices (effective prices) are not the same or moving in tandem (paragraph 21)
<p>Petrol prices exhibit “rocket and feather”:</p> <ul style="list-style-type: none"> ▪ They increase by a larger magnitude than they decrease ▪ They increase faster than they decrease 	<ul style="list-style-type: none"> ▪ Petrol prices are subject to fluctuations in crude oil price ▪ Data analysis concludes that petrol prices did not increase by a larger magnitude or faster than they decrease, relative to crude oil price movements (paragraph 27)
<p>Petrol is expensive in Singapore</p>	<ul style="list-style-type: none"> ▪ Petrol prices in Singapore are competitive internationally, discounting those countries which export crude oil or subsidise petrol (paragraph 29)
<p>Land cost is an entry barrier for petrol stations in Singapore</p>	<ul style="list-style-type: none"> ▪ Land scarcity is inherent to Singapore ▪ However, land cost is not a significant component of total petrol cost (paragraph 31)
<p>Petrol companies are profitable</p>	<ul style="list-style-type: none"> ▪ Operating profit margins of the petrol companies are in single-digits (paragraph 32) ▪ Profit margins of the petrol companies have fluctuated significantly over time (paragraph 35)
<p>Petrol companies are colluding</p>	<ul style="list-style-type: none"> ▪ Current evidence does not demonstrate collusion between the petrol companies (paragraph 43) ▪ CCS will continue to monitor and will take action if there is evidence of anti-competitive conduct (paragraph 45)

APPENDIX 2: Econometric Analysis on the ‘Rocket-and-Feather’ Hypothesis

We have performed an econometric analysis to test whether the ‘rocket-and-feather’ phenomenon exists, i.e. whether retail petrol prices in Singapore increase faster and larger in magnitude than they decrease, relative to fluctuations in crude oil prices.

In the analysis, we used a panel of data comprising 9 time series of retail petrol prices in Singapore, weekly between January 2006 and June 2009. The 9 series are based on the respective RON 92, 95 and 98 prices of three petrol companies. Crude oil prices were based on WTI spot prices, adjusted for SGD:USD exchange rates obtained from US Federal Reserve.

Using the panel data above, we performed a pooled regression, based on a fixed effects model as follows:

$$\Delta R_{it} = \alpha + \alpha_a D_a + \alpha_b D_b + \alpha_c D_c + \gamma TIME_t + \sum_{i=0}^4 \beta_i^+ \Delta C_{t-1}^+ + \sum_{i=0}^4 \beta_i^- \Delta C_{t-1}^- + u_{it}$$

Where:

ΔR_{it}	= changes in retail oil prices, where i denotes the different companies
D	= dummies for each petrol company denoted as a, b and c
ΔC_{t-1}^-	= decrease in crude price, zero if increase
ΔC_{t-1}^+	= increase in crude price, zero if decrease
$TIME_t$	= time trend to adjust for nominal price changes
α	= constant
u_{it}	= error term

The regression results are displayed at [Table 1](#). The overall equation is F -significant at a 1% confidence level. When crude oil prices increase, a two-week lag (the variable DCrude_up2) yielded the highest t -significance in explaining pump price movements. When crude oil prices decrease, a one-week lag (DCrude_dn1) yielded the highest t -significance.

Table 1: Econometric Analysis

Results of Models ron98 95 and 92 using 4 lags			
	Ron98	Ron95	Ron92
Dcrude_up	0.022 (0.165)	0.04 (0.303)	0.031 (0.228)
Dcrude_up1	0.045 (0.411)	0.039 (0.355)	0.05 (0.455)
Dcrude_up2	0.649*** (4.458)	0.632*** (4.310)	0.633*** (4.279)
Dcrude_up3	0.259 (1.968)	0.247 (1.868)	0.257 (1.914)
Dcrude_up4	0.028 (0.235)	0.012 (0.096)	0.005 (0.044)
Dcrude_dn	0.195* (2.017)	0.186 (1.903)	0.191 (1.936)
Dcrude_dn1	0.454***	0.454***	0.441***

Results of Models ron98 95 and 92 using 4 lags			
	Ron98	Ron95	Ron92
	(5.848)	(5.807)	(5.601)
Dcrude_dn2	-0.089 (-0.894)	-0.085 (-0.845)	-0.109 (-1.069)
Dcrude_dn3	-0.031 (-0.388)	-0.025 (-0.312)	-0.022 (-0.276)
Dcrude_dn4	0.018 (0.189)	0.030 (0.301)	0.019 (0.195)
time	0.000 (0.820)	0.000 (0.928)	0.000 (0.894)
_cons	-0.004 (-1.068)	-0.004 (-0.987)	-0.004 (-1.087)
N	243	243	241
R-sq	0.302	0.294	0.285
adj. R-sq	0.262	0.254	0.244
F	8.996	8.682	8.220
T statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001			

Based on the above results, we tested the rocket-and-feather hypothesis, based on a null hypothesis that the sum of exponentially discounted coefficients of lagged increases in crude oil prices is equal to that of decreases, i.e.:

$$H_0: \sum_{i=0}^4 \left(\frac{1}{e^{i\rho}}\right) \beta_i^+ = \sum_{i=0}^4 \left(\frac{1}{e^{i\rho}}\right) \beta_i^-$$

The results – F-values with a sensitivity analysis of various discount factors – are at [Table 2](#). Given the low F-values, the null hypothesis cannot be rejected at a 10% confidence level.

Table 2: F-Value

F-value	$e^{-\rho} = 1.00$	$e^{-\rho} = 0.99$	$e^{-\rho} = 0.95$	$e^{-\rho} = 0.90$
RON 98	0.17	0.18	0.22	0.31
RON 95	0.22	0.23	0.27	0.36
RON 92	0.17	0.18	0.22	0.30

As such, we conclude that, based on an econometric analysis on crude oil and retail petrol prices, the ‘rocket-and-feather’ phenomenon did not exist at a statistically significant level.