ARE CRUDE OIL PRICE AND EXCHANGE RATE REALLY MAJOR CAUSES OF THE MOVEMENT IN THE THAI RETAIL GASOLINE PRICE?

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Abstract

This paper uses daily data to analyze the correlation between the Thai retail gasoline price to the change in crude oil price and exchange rate during the period of August 2006 to November 2014. The conclusions from the OLS estimation show that both crude oil price and exchange rate are, but not only, the causes of the movement in retail prices of ULG 95 RON in Bangkok. The seasonal factor might need to be considered for the unit change of gasoline price rather than the percentage change. Furthermore, some of the government charges are also major causes with almost 100% pass-through effect on the movement of the Thai retail gasoline price.

Keywords: Crude Oil Price, Exchange Rate, Retail Gasoline Price

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1. Introduction

This paper focuses on finding the correlation of the Thai retail gasoline price on crude oil price and exchange rate during the period of August 2006 to November 2014. We may recognize the fact that the price of crude oil has been fluctuating in past recent years reaching $100/barrel in February 2008 for the first time in the history, finally setting a record at $144/barrel in July 2008, and then plummeting down drastically below $34/barrel in December 2008. Thus, there is no surprise for us to also see the fluctuation in the retail gasoline prices around the world during the past decade. However, during the same period of time, the USD (which is used as a reference for crude oil pricing) has depreciated against most currencies in the world, including Thai Baht. This piece of information allows us to assert that the Thai retail gasoline price should take into account the appreciation of Thai Baht as it could play an important role in stabilizing country's retail gasoline price. We, therefore, continue to analyze the correlation between these motivating factors to verify whether the oil companies in Thailand are rational in setting their retail gasoline prices. Figure 1 shows the relationship between the retail gasoline price (RTP) in Bangkok, Thailand and the crude oil price (CRP) during August 2006 and November 2014.

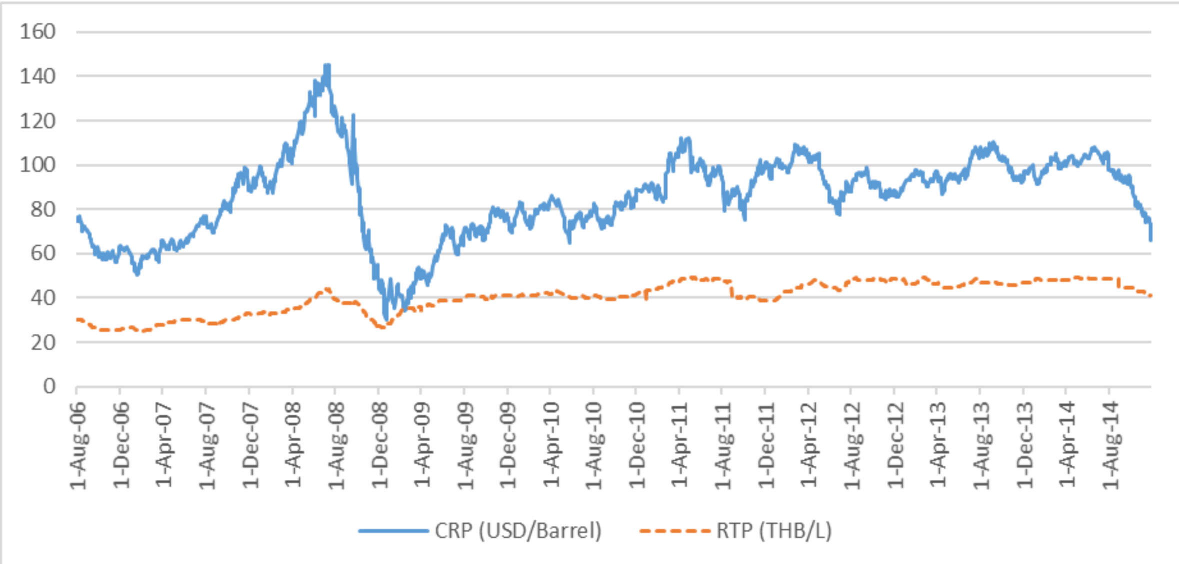

Figure 1 The movements of Thai retail gasoline and world crude oil prices from August 2006 to November 2014.

From Figure 1, we can see that the movement of the Thai retail gasoline price is much smoother than the movement of the world crude oil price. The Pearson correlation between those two variables is 0.7328 which confirms the positive relationship. There are two possible reasons that may explain this phenomenon. First, this incidence is consistent with our assertion on exchange rate playing an important role of stabilizing the Thai retail gasoline price. We will confirm the significance of this finding when analyzing the data later in the paper. Second, it follows the finding by Asplund, Eriksson and Friberg (2000) who use daily data to examine price responses in the Swedish gasoline market to changes in the Rotterdam spot price, exchange rate and taxes. They find support for the hypothesis that the retail price is stickier downwards and upwards in response to the cost shocks. The phenomenon in which prices tend to adjust differently depending on their directions is known as *price asymmetry*. Moreover, prices respond more rapidly to exchange rate movements than to the spot market price movements. They explain the different response to exchange rates and spot prices by means of the volatility of both series. The spot price is proved to be more volatile than the exchange rate, creating more uncertainty for the firm. Therefore, firms may wait to see whether the spot price reverts, but reacts faster to the less volatile exchange rate, which is why we see that the movement of the retail gasoline price is much smoother than the crude oil price.

There are varies of papers discussed about the seasonal factor in gasoline price time-series models. The research of Gil-Alana and Gupta (2014) found that the cyclical movement of oil price data in Spain are around 74 month periodically which is supported by business cycle theory. One of the most popular in time-series model in gasoline price forecasting are including the autoregressive models, ARIMA model. The paper of Pindyck (1999) studied the long-run behavior of crude oil, coal and natural gas prices from 1887-1996 in the US. The state variables, namely marginal cost, were utilized and ultimately the results illuminates that the deterministic linear trend process yields the more powerful prediction. Additionally, Radchenko (2005) employed a shifting trend model with an autoregressive process in error terms. In our study we would employ the seasonal factor to be one of the independent variable to observe the retail gasoline price.

Bettendorf, Van der Geest and Varkevisser (2003) analyze the retail price adjustments in Dutch gasoline market. They estimate an asymmetric error correction model on weekly price changes for the years 1996 to 2001. They construct five datasets, one for each working day. The conclusions on asymmetric pricing are shown to differ over these datasets, suggesting that the choice of the day for which the prices are observed matters more than commonly believed. This finding is beyond the scope of this paper, however, providing a very interesting fact in attempting to explain the price setting behavior of Dutch integrated oil companies. We will focus merely on how well the changes in crude oil price, exchange rate, and some other proposing factors can explain the movement in the Thai retail gasoline price, and leave price asymmetry issue for future studies.

2. The Thai retail market for gasoline

2.1 Market description

The oil industry in Thailand has long been dominated by the Petroleum Authority of Thailand (PTT) which is considered as a national oil company (NOC). According to the oil marketing business with 1,335 retail stations and 38% of market share by volume of petroleum sold as of September, 2012 (Stock Exchange of Thailand, 2013). Thus, PTT is automatically a price leader of Thai gasoline market that it normally announces some changes to the suggested retail prices for all types of gasoline through evening daily news typically on television. The suggested retail prices will be effective on the next day at 5.00 a.m., and other major integrated oil companies (Shell, Exxon, BCP, and Chevron) will usually follow suit. This means that around 95% of service stations in Bangkok will sell each of their products at the same price, allowing for some independent oil retailers to sell their products at lower prices to attract more consumers, and the retail gasoline prices will naturally be slightly higher in rural areas due to transportation costs. However, this paper ignores these other areas and pays attention only to Bangkok area.

2.2 Data description

There are currently seven types of gasoline being sold in Bangkok, Thailand that are ULG 95 RON (unleaded premium gasoline with research octane number = 95), Gasohol 95 E-10 (gasoline with ethanol 10% by volume), Gasohol 95 E-20 (gasoline with ethanol 20% by volume), Gasohol 95 E-85 (gasoline with ethanol 85% by volume), Gasohol 91 E-10 (gasoline with ethanol 10% by volume), High Speed Diesel (HSD), and Premium High Speed Diesel. According to the energy policy by the Ministry of Energy, each type of gasoline is subject to assorted government charges such as excise tax, municipal tax, value added tax, and oil fund charges. Nonetheless, during the surge in the world crude oil price, the government usually supports most of the gasoline products by imposing smaller oil fund charges on most types of gasoline, with an exception of only ULG 95 RON.

Thai oil fund was established in 1979 with the objective of stabilizing country's retail gasoline prices by charging distinctive fees from oil companies for every liter of gasoline they sell at the service stations which is considered by Energy Fund Administration Institute. Fees are differed among each type of gasoline product with ULG 95 RON being charged the highest amount at 9.65 THB/L as of November 28, 2014 which are determined by Energy Policy and Planning Office. The government then uses this oil fund to subsidize selected types of gasoline products to maintain country's economic condition when the price of crude oil increases continuously. Two of the subsidized products normally include, but not limited to, HSD which is one of the major costs of production for most industries in the economy, and Gasohol 95 E-85 which is the type of gasoline that the government encourages people to use because it contains 85% ethanol fuel and only 15% gasoline by volume. Consequently, the government subsidy makes the retail prices of some types of gasoline lower than what they should have been. In figure 2 shows that the percentage share of CHARGES (THB/L) in gas retail prices, ULG95 (THB/L), lie between 30 percent to 75 percent approximately. We found the drastically increasing in these values in August, 2008 due to the world economic crisis. However, these percentage share tended to increase from 2011 to 2014 by the reason of government policy to raise the oil fund.

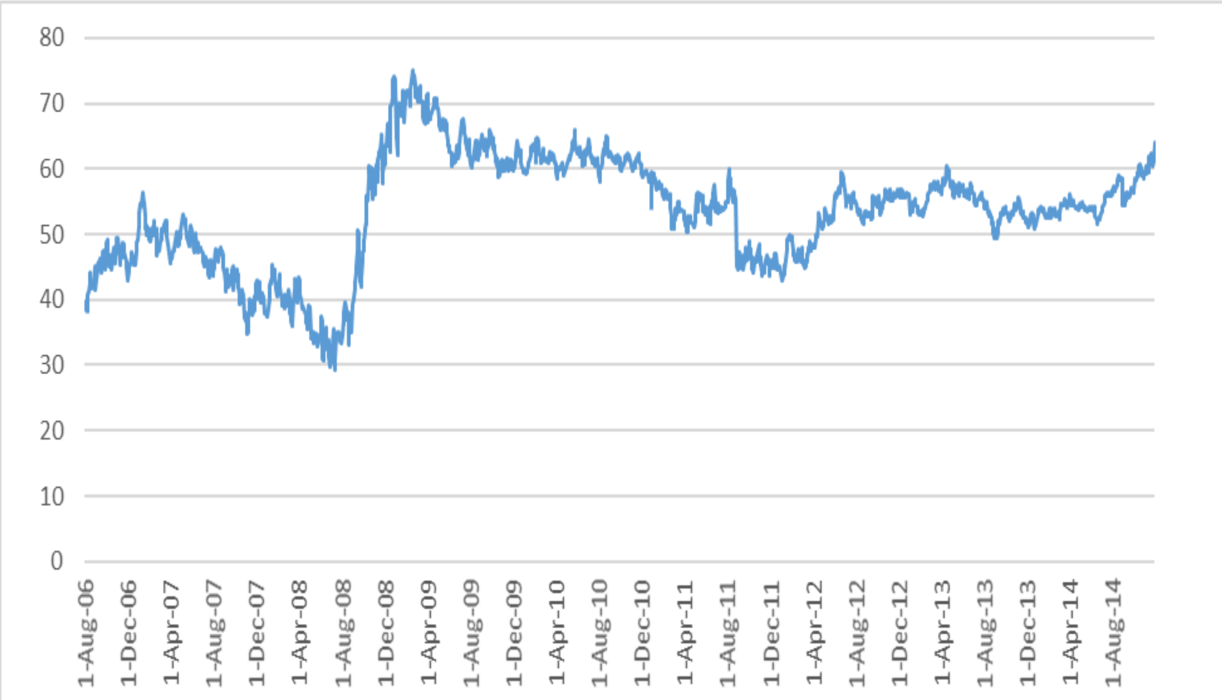

Figure 2 The percentage share of CHARGES (Baht/L) in daily retail gasoline price for ULG 95, RTP (Baht/L).
Source: Calculated by authors.

Therefore, ULG 95 RON is considered the most suitable type of gasoline to use in our study for two logical reasons. First, ULG 95 RON is the type of gasoline that the government has encouraged people to stop using it for a while due to country's large amount of import on high quality crude oil needed to produce ULG 95 RON. With this reason, the cost of the increase in the crude oil price will be passed through the retail price without any government subsidies resulting in a more accurate impact of the study. Second, ULG 95 RON contains very little to none of ethanol in its mixture so that any changes in the price of ethanol in either internationally or domestically will not affect the retail price of ULG 95 RON which again will benefit this study by controlling for an important external factor that cannot be done when using other types of gasoline.

We use daily data for the retail price of ULG 95 in Bangkok, reported by the Energy Policy and Planning Office (EPPO), Ministry of Energy, Thailand. For the inputs, we use daily data on Singapore spot crude oil prices reported by the U.S. Department of Energy (EIA), the exchange rate announced by the Bank of Thailand (BOT) for the period from 01 August, 2006 to 28 November 2014 except for weekends and holidays, and the three–season calendar reckoning reported by the Thai Meteorological Department (TMD). The retail price data include excise tax, municipal tax, value added tax (VAT), oil fund charges and marketing margin.

3. Empirical analysis

3.1 The model

We use the Ordinary least squares regression (OLS) to study the relationship between the retail price and independent variables:

$$RTP_t = \alpha + B_1 CRP_t + B_2 EXC_t + B_3 SEASON_t + B_4 CHARGES_t + E_t \quad (1)$$

where α is the constant term, RTP represents the retail price of ULG 95 (THB/L) including excise tax, municipal tax, value added tax, oil fund charges and marketing margin, CRP is the Singapore spot crude oil price ($U.S./barrel), EXC is the exchange rate (Baht/$U.S.), SEASON represents the seasonal variables to provide the seasonal fluctuation of Singapore spot crude oil price, and CHARGES denotes the summation of excise tax, municipal tax, value added tax, oil fund charges and marketing margin (THB/L). Notice the variable CHARGES which is the summation of all charges that occur to oil companies; it is very difficult to separate these charges into individual component. Moreover, it is not my interest to study the movement of all these charges individually since most of the charges are relatively constant during the study period. The only component that changes frequently is the marketing margin which is very difficult for consumers and government to observe. Therefore, we include CHARGES in the model because we find that it is crucial in increasing the fit of the model, and also generating the right signs for all other coefficients in the model.

3.2 The results

The OLS estimation results of Eq. (1) indicate the relationship between RTP and the independent variables as follow:

$$RTP_t = \underset{(0.2092)^{***}}{-18.7001} + \underset{(0.00038)^{***}}{0.209 CRP_t} + \underset{(0.0053)^{***}}{0.549 EXC_t} + \underset{(0.0072)^{***}}{0.045 SEASON} + \underset{(0.00107)^{***}}{1.0024 CHARGES_t} + e_t \quad (2)$$[4]

R-squared = 0.9990 *Durbin-Watson statistic = 0.067*

Johansen tests for cointegration: Trace Statistics 70.2694 at r = 0

[4] The Standard error of the coefficient shown in parentheses and the asterisk [***] : t-ratio significant at p < 1%.

The results show that all the estimated coefficients on independent variables in Eq. (2) are significantly different from zero at the 1% significance level. However, the Dick-fuller test statistics indicate that we reject the null hypothesis that our model show follow a unit root process at 10% significance level as well as the Durbin-Watson statistic illustrates evidence of positive autocorrelation which indicates successive error terms are, on average, close in value to another. Because the trace statistic at r = 0 of 70.2694 exceeds its critical value of 68.52, we reject the null hypothesis that there is one or fewer cointegrating equation. When the regression of an integrated series on another unrelated integrated series produces t-ratios on the slope parameter which indicates a relationship much more often than they should at the nominal test level, the Spurious Regression Problem can appear. Therefore, we estimate Eq. (1) again by OLS and correcting the autocorrelation by using the AR(1) model. The estimated relationship is:

$$RTP_t = -19.323 + \underset{(0.264)^{***}}{0.207CRP_t} + \underset{(0.0049)^{***}}{0.583EXC_t} + \underset{(0.00642)^{***}}{0.0023SEASONS} + \underset{(0.00371)}{0.998CHARGES_t} + \underset{(0.00165)^{***}}{0.9951e_t} + u_t \quad (3)$$[5]

R-squared = 0.995 *Durbin-Watson statistic = 1.808*

After using the AR(1) model, the results remain that all the estimated coefficients on independent variables in Eq. (3) are significantly different from zero at the 1% significance level with exemption of SEASONS. This shows a rigorous outcome that the crude oil price and the exchange rate cause the movement including the coefficient on e_{t-1}, RHO (ρ). This shows a rigorous outcome that the crude oil price and the exchange rate cause the movement in the retail gasoline price. A one USD increase per barrel in the crude oil price results in a 0.207 THB/L increase in ULG 95, and as the exchange rate increases by one Baht per USD (depreciation in Baht) results in a 0.583 THB/L increase in ULG 95. This is a confirmation to my assertion earlier that the exchange rate plays an important role in stabilizing the retail gasoline price as shown in Figure 3 below:

[5] Ibid.

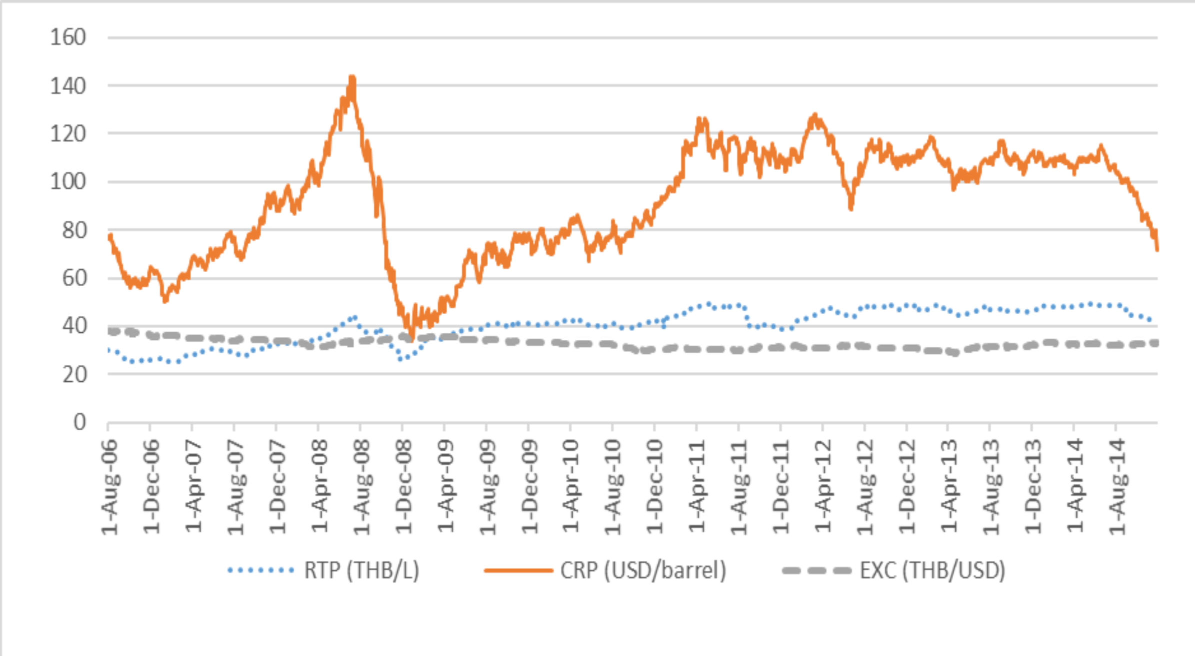

Figure 3 The changes in exchange rate plays an important role in stabilizing the retail gasoline price.

The coefficient on CHARGES, on the other hand, is very close to a unit which in fact has an insightful explanation that firms have no control over these charges since most of them are usually constant and announced by the government. Thus, one Baht changes in CHARGES results in a nearly 100% pass-through relationship with the retail price of ULG 95 as shown in Figure 3 below:

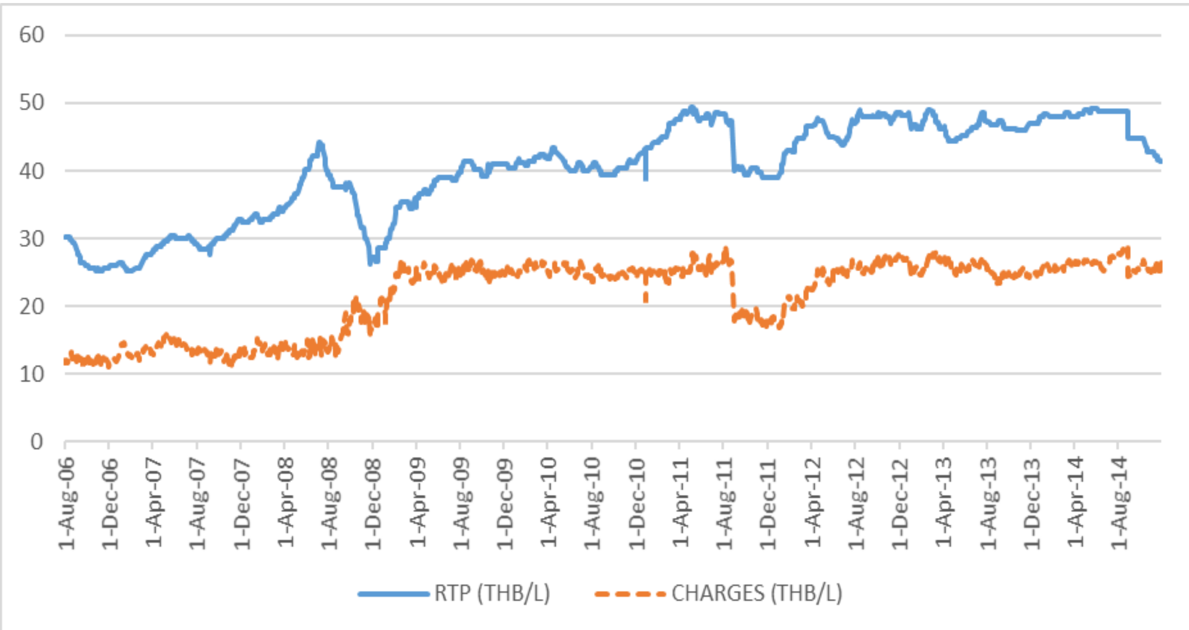

Figure 4 The change in CHARGES shows nearly a 100% pass-through effect on the movement in the retail price of ULG 95.

The only component in CHARGES that firms can control is their marketing margin which is why we see that the coefficient is not exactly a unit. The estimates allow us to explain firm's behavior in altering their marketing margins in order for them not to change their retail gasoline prices every single day. PTT is the price leader in the market and they will maintain their retail price as long as possible subject to their marketing margin. When their marketing margin is too low, we can expect them to announce in advance that they will increase the retail gasoline price tomorrow as I mentioned earlier in the paper. One major problem that occurs because of this pricing system is that most firms face lower marketing margins than PTT since PTT is the national oil company. As a result, those firms will increase their retail prices ahead of PTT and soon enough they will go out of the market because they cannot survive in this price competition market. BP was one of the largest oil companies who went out of the Thai oil market about a decade ago due to this price setting system.

There is no need to give an interpretation of the coefficient on e_{t-1}, RHO (ρ) since it is derived from AR (1) model to correct the autocorrelation in Eq. (2). The effect of AR (1) has already been reflected through the coefficients of all independent variables in Eq. (3) with no autocorrelation in u_t.

Finally, let us take a look at the estimated coefficients in eq. (4), derived from performing natural log transformation to eq. (1). After estimating eq. (4) by OLS and correcting the autocorrelation by using the AR (1) model, the estimated relationship is:

$$\ln RTP_t = -0.392 + \underset{(0.00642)^{***}}{0.338} \ln CRP_t + \underset{(0.00642)^{***}}{0.364} \ln EXC_t + \underset{(0.0353)^{***}}{0.443} \ln CHARGES_t + \underset{(0.0052)^{***}}{0.9948} e_{t-1} + u_t \qquad (4)$$ [6]

R-squared = 0.8620 *Durbin-Watson statistic = 1.982*

Interestingly, the results are not consistent with the findings by Asplund (2000) when we interpret the estimated coefficients of eq. (4) as the price elasticity of each independent variable in the model. The results show that retail prices *do not* respond more rapidly to exchange rate movements than to the spot market price movements as seen from the smaller value of the elasticity. A 1% increase in the exchange rate results in only a 0.364% increase in the retail price whereas a 1% increase in the spot market price results in a 0.338% increase in the retail price. In this special case, firms react faster to the exchange rate than the crude oil price movements.

[6] Ibid.

4. Conclusion

This paper studies the relationship between the Thai retail gasoline price on the crude oil price and the exchange rate from August 2006 to November 2014. We employ daily data for the retail price of ULG 95 in Bangkok, the spot crude oil prices of Singapore market, and the exchange rate announced for the period from 1 August 2006 to 28 November 2014 except weekends and holidays. We include an additional variable CHARGES in the model because we find that it is crucial in increasing the fit of the model, and also generating the right signs for all other coefficients in the model.

The first OLS estimation results in Eq. (2) shows a rigorous outcome that the crude oil price and the exchange rate cause the movement in the retail gasoline price; however, the Durbin-Watson statistic illustrates evidence of positive autocorrelation. Additionally, the second OLS estimation is estimated with AR (1) model as shown in Eq. (3). The results remain significant at 1% level of confidence with slightly different in the size of the coefficients. Therefore, we conclude this study with two interesting findings. First, the estimation results suggest that the crude oil price and the exchange rate are, but not only, the causes of the movement in the retail price of ULG 95 in Bangkok. Second, we summarize that the summation of excise tax, municipal tax, value added tax, oil fund charges, and market margins, CHARGES, is also a major cause with almost 100% pass-through effect on the movement in the retail price of ULG 95. That is why we observe constant government charges on most components in CHARGES. The government knows that if it imposes higher rates on any of the components, firms will pass most of the costs through consumers by increasing the retail price as seen from the coefficient on CHARGES, 0.998. The final burden will fall directly to consumers and that is not what the government in most countries wants to see. The recommendation would be that the government might consider the gas tax rate as the optimal tax to ease the economic inefficiency. As we would like to see the sustainable economic growth in Thailand as well as the national comparative advantage in the world market, we would rather encourage the fuel price efficiency scheme to be truly effective.

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Appendix A: Variable Definitions and Data Sources

Variable	Definition and data source
RTP (THB/L)	The daily retail gasoline price for ULG 95 for one of the firms, Shell. RTP data includes excise tax, municipal tax, value added tax (VAT), oil fund charges and marketing margin. Source: The Energy Policy and Planning Office (EPPO), Ministry of Energy, Thailand.
CRP (USD/Barrel)	The daily spot crude oil prices of Singapore market. Source: Energy Information Administration (EIA).
EXC (THB/USD)	The daily exchange rate. Source: Bank of Thailand (BOT).
SEASON	The seasonal variables to provide the seasonal fluctuation of Singapore spot crude oil price. These take the values of 1, 2 and 3 respectively.
CHARGES (THB/L)	The summation of excise tax, municipal tax, value added tax, oil fund charges and marketing margin, using the formula: CHARGES = RTP - (CRP*EXC)/158.987, [1 Barrel = 158.987 Liter]