

Petroleum's Price Transmission and Imported Demand for Crude Oil in Thailand

Papusson Chaiwat

King Mongkut's University of Technology Thonburi,
Thailand. Email: papusson.cha@kmutt.ac.th

Nantarat Tangvitoontham

Srinakharinwirot University, Thailand.
Email: nantarat.tang@gmail.com

ABSTRACT: The study of the petroleum price structures in Thailand reveals that diesel is the important fuel because it influences inflation and productions' costs. Government wants to keep diesel's price stability; meanwhile, it is less control in gasohol and petrol prices. These prices are normally higher than diesel's price in order to support the renewable energy and reduce the consumption behaviors. Real price elasticity of imported crude oil in short run is insignificant but in long run is about 0.0660 statistically significant. While, real income elasticity is about 0.4841 in short run and increase to 0.9969 in long run. The price transmissions from crude oil to petroleum products demonstrate the inequality distribution with symmetry adjustments. Additionally, the adjustment to the long-run equilibrium of petrol price is slower than diesel price. Therefore, the efficiency energy policies should be in consideration to decrease the country's energy consumption in the future.

Keywords: price transmission; elasticity of crude oil demand

JEL Classifications: C32; Q41; Q48

1. Introduction

Last few years, crude oil prices have been dramatically unpredictability. The prices were upon from US\$58 a barrel in 2007 to over US\$130 a barrel in mid 2008. They became lower to US\$40 a barrel in beginning of 2009 and rose again to US\$80 a barrel in end of 2010. Furthermore, Thailand continuously increases importing crude oils due to insufficient domestic production. As a result, it reflects the trade deficits. Thai's government tried to use both direct and indirect policies to stable the price. Unfortunately, petroleum prices in the country were fluctuated. The government policies do not efficiently affect the better trade balance. The petroleum costs have been inevitability affected by the world crude oil price fluctuation. As a result, the inefficiency in private sector's management occurs. There are many evidences show that the economic prosperity has trickled down by these fluctuations. Consequently, the study on petroleum price structures and price transmissions are important.

Empirical energy studies on demand such as Ramanathan (1999), Nicol (2003), Cooper (2003), De Vita et al. (2006), Altinary (2007) are mostly laid on price and income elasticity. Therefore, these two factors should be the main variables to analyze the consumption behaviors. This paper estimates both short run and long run elasticities of demand for crude oil by using a multiple regression model. The model is derived from an adaptation of Nerlove's partial adjustment model, which confirms that the demand for crude oil is highly insensitive to changes in price. This study used co-integration and error-correcting model (ECM) to study the price transmission from crude oil to petrol.

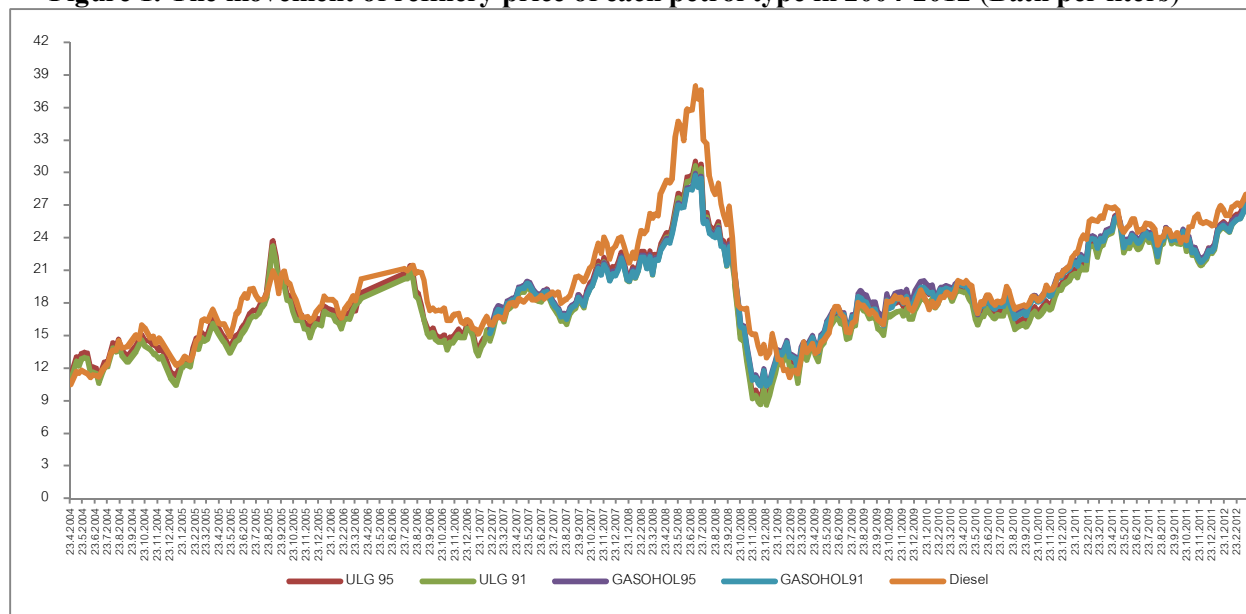
To define the behaviors, this study aims to analyze the petroleum price structure in order to classify the cost proportion. Then, the elasticity of imported crude oil to its price and incomes are defined. Finally, this paper will prove whether price asymmetric adjustment in both diesel and petrol exists by investigating the price transmission. The paper analysis bases on the crude oil import data from year 2002–2011. Moreover, the petrol price structures are investigated. The impacts of factors on oil price would also be considered.

2. Thailand's Price Structure for Gasoline

The crude oil can be transferred to many kinds of petrol. Normally, the refineries set the petrol prices equal to Singapore market price. Thus, diesel and other petrol's prices in Thailand do not directly depend on the world crude oil price. There are some factors that affect the prices. Most of factors are regulated by government policies which aim to stabilize the oil price when the crude oil price is fluctuating. Moreover, the policies will motivate consumers to change their behaviors to the proper way or to reduce the oil consumption. Figure 1 shows the trends of gasohol and diesel refinery prices. All refinery prices including Unleaded Gasoline 95 (ULG 95), Unleaded Gasoline 91 (ULG 91), Gasohol 95, Gasohol 91 and Diesel are moving in the same direction. However, diesel refinery price is the highest price at refineries. In period of crude oil crisis during February 1998 to May 1998, all petrol refinery prices reached the highest point. It reflects the impacts of the world petrol crisis to Thailand's economy.

Taxes are the government instrument that use to stabilize the petrol price and to support the renewable energy usage. Thai government uses both specific tax known as excise tax and municipality tax and ad valorem tax known as value added tax. These taxes will be mark up on the prices in multi stage of petrol structures. Both ULG 95 and ULG 91 have the highest tax rate (average 28% adding on its refinery prices) followed by Gasohol 95 and Gasohol 91 (average 26% mark up on its refinery prices). The least is Diesel (average 7% adding on its refinery price). These tools are used to support the diesel price due to reduce cost of production and transportation.

Figure 1. The movement of refinery price of each petrol type in 2004-2012 (Bath per liters)



Other instruments that used to control energy prices are a conservation fund and an oil fund. Although both funds use to stabilize the petrol prices, the inequality of charge rates, which imposes on petrol, will causes price perversion and distortion in consumption. Before August 2001, the data show that ULG 95 and ULG 91 were charged at the highest rate and be the main source of incomes for the funds. Nonetheless, the rates declined after that. However, there were still too high compared with other petrol types. Gasohol 95 and Gasohol 91 were imposed the low rate because government objects to motivate the usage of these petrol types. As mention above, diesel has more impacts on the costs of production and transportation, so the fund charge rate should be very low. Additionally, government sometimes pays a subsidy on it as shown as a negative value in figure 2.

Marketing margin is the different between the retail prices and the wholesale prices at the refineries. Also, it is the gas stations' revenues. The margin is controlled by main distributors and oil funds. Before year 2008, all petrol has a same rate of margin, but ULG 95 has the highest margin since October 2008 because consumers feel that ULG 95 has the highest quality. Therefore, distributors can mark up the higher margin. In contrast, the marketing margins of diesel are sometimes negative whenever world crude oil prices increase so fast since the distributors want to delay the higher prices

by reduced their margin in order to prevent the declining of oil consumption. The marketing margin rates are shown in figure 3.

Figure 2. The income support to the fund from different types of petrol 2007–2012 (Bath per liters)

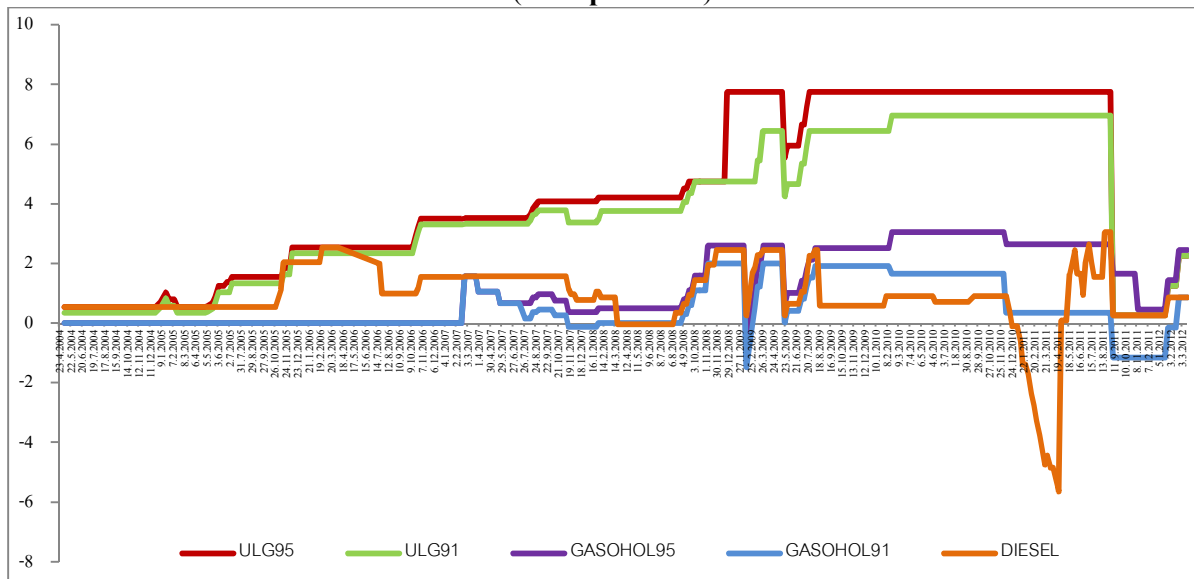
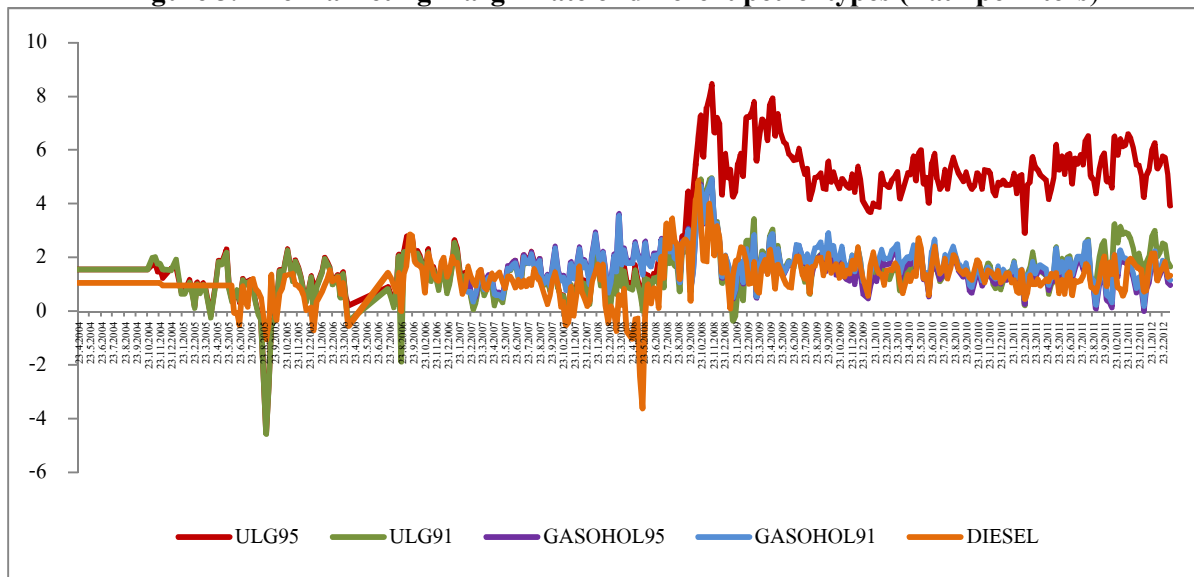


Figure 3. The marketing margin rate of different petrol types (Bath per liters)



Since the adjustment of the prices are not the same and have different lag time for adjusting, the price transmission would be analyzed in order to understand the impacts of crude oil price on different types of petrol.

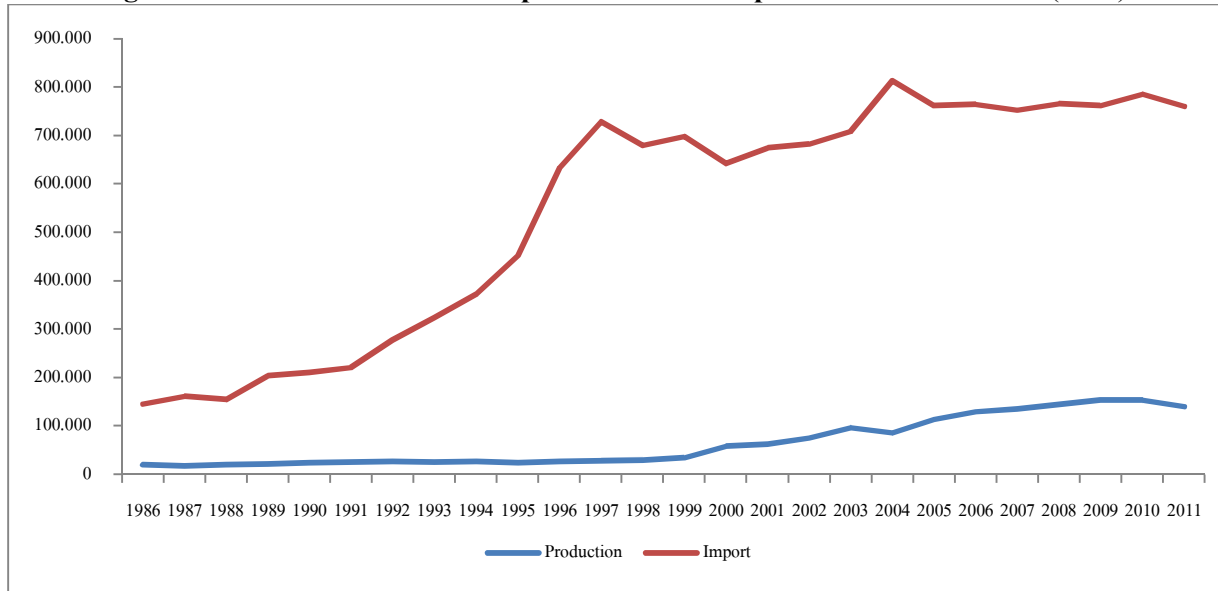
3. The Demand Elasticity for Imported Crude Oil

The imported crude oil is rapidly increasing especially in period 1995-1997. This high growth rate came from the economic expansion. According to the development of new technology, the new source of crude oil has been founded. However, the productions of crude oil are still too low compared to the rapidly growth of demand. Thus, the gap between them is incessantly high.

Middle East countries such as United Arab Emirates, Saudi Arabia and Oman are the main crude oil suppliers. In 1986-2010, the average proportion of imported crude oil from Middle East is about 70.47 percent followed by Far-east group (24.56 percent) and ASEAN (4.97 percent). However,

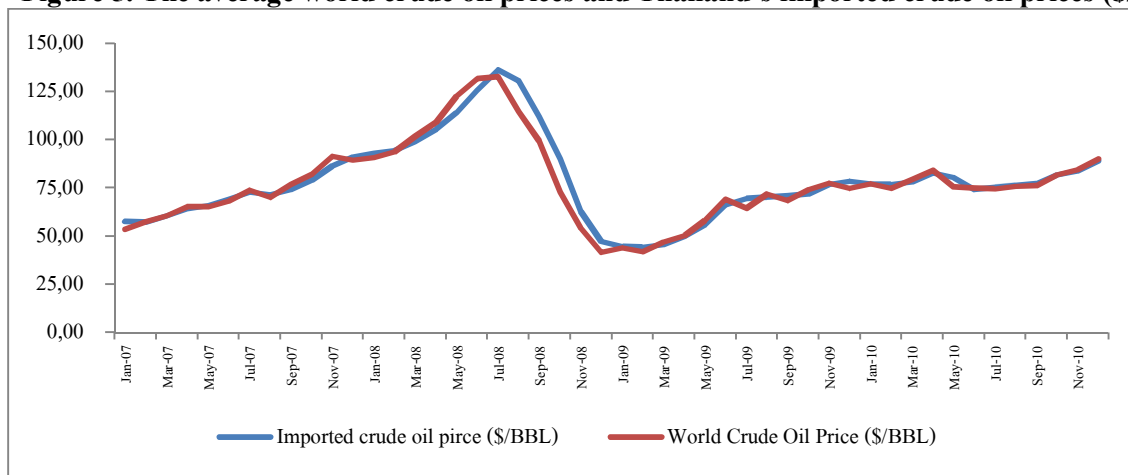
these proportions are change significantly in 2011 because of the high transportation costs and bilateral agreement. The imported crude oil from Middle-east increases to 77.57 percent of the total import. The imported oil from Far-east group decreases to 7.99 percent and the high growth rate of importing from ASEAN which increases to 14.43 percent; especially, from Malaysia and Indonesia.

Figure 4. The volume of crude oil production and imported from 1986-2011 (BBL)



The crude oil's price is fluctuated since unstable world economy, Middle East countries' policy and speculation demand. The unstable prices caused the high costs of imported crude oil and affected the petrol's price in Thailand. To solve the problem, the biggest Thai's refinery company, PTT, tries to make the forward contract that causes sometimes the prices would below the world market as shown in figure 5. The graph show that the imported price was close to the world price before September 1997 and went to the same direction. From September 1997 to November 1997, the cost of imported crude was lower than the world's price since PTT's forwarding price. After the highest world price in July 1998, both the imported prices and world prices constantly decreased. Noticeably, the imported prices are higher than the world prices in the down turn period. This reveals that Thailand has high costs of petrol and it is one of the reasons of trade deficit. The world's crude oil prices and the imported prices fluctuated and get close to each other again since June 2000.

Figure 5. The average world crude oil prices and Thailand's imported crude oil prices (\$/BBL)



Source: Energy Policy and Planning Office (EPPO), IMF

From the EPP0 and IMF data, the study derived the crude oil imported demand by used quantity imported crude oil (Q) as dependent variable. The demand function is presented as followed.

$$\text{Demand Function: } \ln Q = \beta_1 + \beta_2 \ln RP + \beta_3 \ln Y$$

Table 1. The short run demand of imported crude oil (Ordinary least square method)

Dependent Variable: ln (Q)					
	Constant	ln (Real price)	ln (Income)	AR(4)	MA(4)
Coefficient	6.4157	0.0416	0.4841	0.4406	-0.9900
Stdev.	2.8753	0.0483	0.2214	0.0714	0.0385
t statistic	2.2313**	0.8618	2.1866**	6.1667**	-25.7318**

* significant level at 0.10

**significant level at 0.05

R-squared = 0.2585

Adj. R-squared 0.2036

n=59 (after adjustments)

The results show that the real price elasticity of imported crude oil demand in short-run does not have statistically significance because the main refinery company trades the crude oil with forward rate (table 1). Thus, the real price in short run does not impact the quantity of imported crude oil. On contrast, the income elasticity for crude oil demanded is statistically significance with coefficient 0.4841. The elasticity is less than 1 which means the crude oil is the normal goods and necessary for consumers.

Table 2. The long run demand of imported crude oil (Co-integration Method)

Dependent Variable: ln (Q)		
	ln (Real price)	ln (Income)
Coefficient	-0.0660	0.9969
Stdev.	0.0563	0.0315
t statistic	-1.1723*	31.6476*

* significant level at 0.10

**significant level at 0.05

Log likelihood = 317.5761

n=59 (after adjustments)

Although the real price elasticity of imported crude oil in short run is insignificant, it is statistically significant in long run with coefficient 0.0660 (table 2). This inelasticity shows that imported crude oil is necessary to consumers. The real income elasticity of imported crude oil is increasing in long run. It is about 0.9969 and statistically significance. This reveals that consumers will use other energy sources such as natural gas instead due to the needs of impact reduction of the unstable crude oil price on theirs demanded in the long run.

4. Price Transmission

This study expands the analysis on the price transmission in order to reflect the unbalanced price transfer in different levels of consumption. This study examines the transmission from crude oil import prices to the prices at the refinery. The ordinary least square is method to define the short run equilibrium and co-integration is method to define the long run equilibrium. The results show that when crude oil price changes, the diesel price would be closely changed in the same direction than other petrol in both short run and long run followed by ULG 91, Gasohol 91, Gasohol 95 and ULG 95 (Table 3). However, the coefficients of price transmission of all petrol in long run are less than in short run. It means that refinery prices are more inequality transfer from crude oil in long run.

Table 3. The petroleum price transmission

Dependent variables	ln (Diesel)		ln (ULG 95)		ln (ULG 91)	
	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run
Constant	0.6348 (0.0333)**	- -	0.7449 (0.0343)**	- -	0.6499 (0.0353)**	- -
ln (Crude)	0.8557 (0.0122)**	0.8348 (0.0585)**	0.7945 (0.0126)**	0.7731 (0.0379)**	0.8194 (0.0130)**	0.7971 (0.0371)**
Log likelihood	484.0538	1486.642	473.8667	1407.982	463.0824	1401.186
N	376	376	376	376	376	376
Dependent variables	ln (Gasohol 95)		ln (Gasohol 91)			
	Short-run	Long-run	Short-run	Long-run		
Constant	0.7808 (0.0324)**	- -	0.7366 (0.0331)**	- -		
ln (Crude)	0.7850 (0.0115)**	0.7749 (0.0334)**	0.7962 (0.0117)**	0.7857 (0.0353)**		
Log likelihood	426.4806	1026.35	421.4770	1024.9510		
N	261	261	261	261		

**significant level at 0.05

Standard deviations are in the parentheses

The error correcting model (ECM) is used to find the adjustment from short run equilibrium to the long run equilibrium. The model can determine the asymmetric between adjustment period of price increases and decreases denoted by λ . If λ equals to 1, the asymmetry adjustment occurs when price is increasing. If λ equals to 0, the asymmetry adjustment occurs when price is decreasing. This study also uses Wald test to test these asymmetry adjustment. The ECM models is shown as follow:

$$\begin{aligned}
 \Delta \ln Diesel_t &= a_3 \Delta \ln Crude_t + a_5 \lambda ECM_D + a_6 (1 - \lambda) ECM_D + \varepsilon_t \\
 \Delta \ln ULG95_t &= b_3 \Delta \ln Crude_t + b_5 \lambda ECM_{U95} + b_6 (1 - \lambda) ECM_{U95} + e_t \\
 \Delta \ln ULG91_t &= c_3 \Delta \ln Crude_t + c_5 \lambda ECM_{U91} + c_6 (1 - \lambda) ECM_{U91} + m_t \\
 \Delta \ln Gasohol 95_t &= d_3 \Delta \ln Crude_t + d_5 \lambda ECM_{G95} + d_6 (1 - \lambda) ECM_{G95} + n_t \\
 \Delta \ln Gasohol 91_t &= g_3 \Delta \ln Crude_t + g_5 \lambda ECM_{G91} + g_6 (1 - \lambda) ECM_{G91} + s_t \\
 \therefore ECM_D &= \ln Diesel_{t-1} - a_0 - a_1 \ln Crude_{t-1} = \hat{\varepsilon}_{t-1} \\
 ECM_{P95} &= \ln ULG95_{t-1} - b_0 - b_1 \ln Crude_{t-1} = \hat{e}_{t-1} \\
 ECM_{P91} &= \ln ULG91_{t-1} - c_0 - c_1 \ln Crude_{t-1} = \hat{m}_{t-1} \\
 ECM_{G95} &= \ln Gasohol 95_{t-1} - d_0 - d_1 \ln Crude_{t-1} = \hat{n}_{t-1} \\
 ECM_{G91} &= \ln Gasohol 91_{t-1} - g_0 - g_1 \ln Crude_{t-1} = \hat{s}_{t-1}
 \end{aligned} \tag{1}$$

Where

- $\varepsilon_t, e_t, m_t, n_t$ and s_t = stochastic error term
- a_3, b_3, c_3, d_3 and g_3 = the rate of price transmission from short run equilibrium to long run equilibrium when price is symmetry adjustment
- a_5, b_5, c_5, d_5 and g_5 = the speed of adjustment rate of Error-correcting model when price is above the long run equilibrium
- a_6, b_6, c_6, d_6 and g_6 = the speed of adjustment rate of Error-correcting model when price is below the long run equilibrium

The estimations are shown in table 4. The price transmissions from crude oil to all petroleum prices are significantly inequality distribution. Furthermore, all coefficients that show the speed of

adjustment rate in Error-correcting model are negative. It means that the models are convergence to the long run equilibrium.

Table 4. The Error-correcting model of price adjustment

Model	Dependent variables				
	$\Delta \ln$ (Diesel)	$\Delta \ln$ (ULG 95)	$\Delta \ln$ (ULG 91)	$\Delta \ln$ (GSH 95)	$\Delta \ln$ (GSH 91)
$\Delta \ln$ (Crude)	0.7626 (0.0350)**	0.8436 (0.0450)**	0.8841 (0.0457)**	0.7488 (0.0425)**	0.6564 (0.0428)**
λ ECM	-0.0989 (0.0285)**	0.1425 (0.0381)**	0.1452 (0.0379)**	-0.2078 (0.0509)**	-0.1889 (0.0503)**
(1- λ)ECM	-0.0841 (0.0324)**	-0.1473 (0.0376)**	-0.1398 (0.0369)**	-0.1795 (0.0549)**	-0.1892 (0.0542)**
R-square	0.5704	0.4967	0.5107	0.5578	0.5572
Log likelihood	814.8803	721.1929	714.6536	558.7172	556.8490
DW	2.11	2.18	2.16	2.24	2.26
n	375	375	375	260	260

**significant level at 0.05 and Standard deviations are in the parentheses

Compared with other petrol types, diesel has the fastest price transmission adjustment in both increasing value and decreasing value. It reflects the sensitive impact on crude oil price changes to the consumption. Although, the speed of adjustment when price is below the long run equilibrium is faster than the speed of adjustment when price is above the long run equilibrium (0.0989 > 0.0841) but the results from Wald test shows that it is insignificantly difference. In conclusion, diesel has inequality price transmission, but its asymmetry adjustments are insignificantly.

Moreover, ULG 91's and Gasohol 95's speed of adjustment when prices are below the long run equilibrium are higher than their speed of adjustment rate when price are above the long run equilibrium. However, ULG 95's and Gasohol 91's speed of adjustment when prices are below the long run equilibrium is lower than their speed of adjustment when prices are above the long run equilibrium. However, all adjustment speeds are insignificant.

5. Conclusion

Thailand faces continuously trade deficits since the increasing in imported crude oil year by year. Moreover, the government policies do not efficiently affect the better trade balance. Thailand increases importing crude oil from ASEAN countries such as Malaysia and Indonesia but the highest proportion of crude oil importing is still from the Middle East countries. Real price elasticity of imported crude oil in short run is insignificant but it is statistically significant in long run with the value of 0.0660. This inelasticity shows that imported crude oil is necessary to consumers. The real income elasticity of imported crude oil is about 0.4841 in short run and the elasticity is significantly increasing to 0.9969 in long run. This means that crude oil is the normal goods which more substitutable in the long run. As a result, Thailand's petroleum costs have been inevitability affected by the world price fluctuation. However, there are some factors which impact on domestic petroleum price such as refinery oil price, tax correcting, payments on conservation fund and oil fund as well as marketing margin. During 2004-2012, the study shows that government has strictly controlled the diesel prices because it has more effects on inflation, production and transportation costs than other energies.

The price transmissions from crude oil to other petroleum are inequality distribution. However, the asymmetry adjustments are insignificantly. The reduction in energy usage, the insignificant in short run price elasticity and the price transmission inequality have negative impacts on Thai economy. Therefore, the efficiency energy policies should be in consideration to decrease the country's energy consumption in the future.

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