# PRICE TRANSMISSION MECHANISM IN GEORGIAN RETAIL GASOLINE MARKET

Ana Mazmishvili[1]

Abstract – The objective of this study is to test for the asymmetric price behavior of retail gasoline prices in Georgia. Using weekly data for the period 24 April 2008 through 13 May 2013, retail gasoline and refined oil prices are estimated using the error correction model. Furthermore, and using the cumulative adjustment function, I analyze how Georgian retail prices react to the positive and negative price shocks. The econometric results suggest that in the long-run the positive price shocks are fully transmitted in the retail gasoline prices. There is also weak evidence to suggest that responses to the negative cost shocks are faster compared to the positive shocks.
Keywords: crude oil price, retail gasoline price, asymmetric price adjustment
JEL: Q40

## 1. INTRODUCTION

Oil is the world's most significant source of energy, and the price changes for this commodity have tremendous impact on consumers as it is passed on to them through the price of refined products such as gasoline, kerosene, diesel and heating oil. Exploring the global oil market structure and the observed price fluctuations may help in our understanding of the formation of gasoline retail prices.

The world oil market can be divided into upstream and downstream segments. The upstream segment relates to the activities that relate to extracting oil from the ground, while the downstream segment is related to delivering the final oil products from producers to consumers. The latter comprises transportation of oil to refineries, refinement of crude oil into final products, distributing these commodities to the storage terminals and finally, selling products to the final consumers (Polemis, Fotis 2011). Georgian oil companies operate in the downstream segment as they import final oil products from Europe, Russia, and Azerbaijan, and then trade on the local market.

[1]Ivane Javakhishvili Tbilisi State University and State Audit Office of Georgia. The views expressed are those of the author and do not necessarily reflect those of the State Audit Office of Georgia.

The Georgian oil market is represented by five oil importer companies. These are Socar Georgia Petroleum Ltd, JSC Wissol Petroleum Georgia, Sun Petroleum Georgia LLC (Gulf), Lukoil Georgia Ltd and Rompetrol Georgia Ltd. These companies use spot prices for trade, which are assessed by Platts, the world's leading pricing service, which is quoted by Bloomberg and Reuters. The spot price at which Georgian companies purchase final oil products is one component of the retail price of gasoline. In addition to the Platts price, the retail price includes transportation, marketing, tax, administration and inventory maintenance expenditures. The difference between Platts prices and final retail prices is the prmary focus of critics. Over the research period the share of Platts price in retail gasoline prices varied between 34% and 74%.

Much of the literature points to a price asymmetry whereby prices respond differently to the positive and negative shocks. In general, prices are sticky downward, while they are highly flexible when oil prices rise. So gasoline price transmission mechanism is a topical issue for debates in the public and of course Georgia is not an exception. Heated discussions about this theme are often conducted in media, but the consensus was not reached. Lack of information and scarcity of data complicate the study of price variations in Georgia's case, and may have hampered academic research todate.

The objective of this study is to test for the asymmetric price behavior of retail gasoline prices in Georgia using the weekly data from 24 April 2008 till 13 May 2013. This time period is interesting because Georgia experienced war, global economic crisis and government change during this time interval. Retail gasoline and refined oil priced are estimated using the error correction model, which is a standard tool for detecting the asymmetric behavior of prices. In addition to using the cumulative adjustment function, the paper analyzes how Georgian retail prices react to the positive and negative price shocks. Finally, possible explanations of the obtained results will be provided.

The paper is organized as follows. In section 2, the world and Georgian oil markets are described. Section 3 provides a brief overview of the existing literature, which discusses the asymmetry in price transmission and the estimation methodologies used in different countries. The section 4 describes in detail the empirical model, and explores the existing data. The econometric estimates, the possible interpretations, and the estimated models limitations are also analyzed. Finally, some concluding thoughts are presented in Section 5.

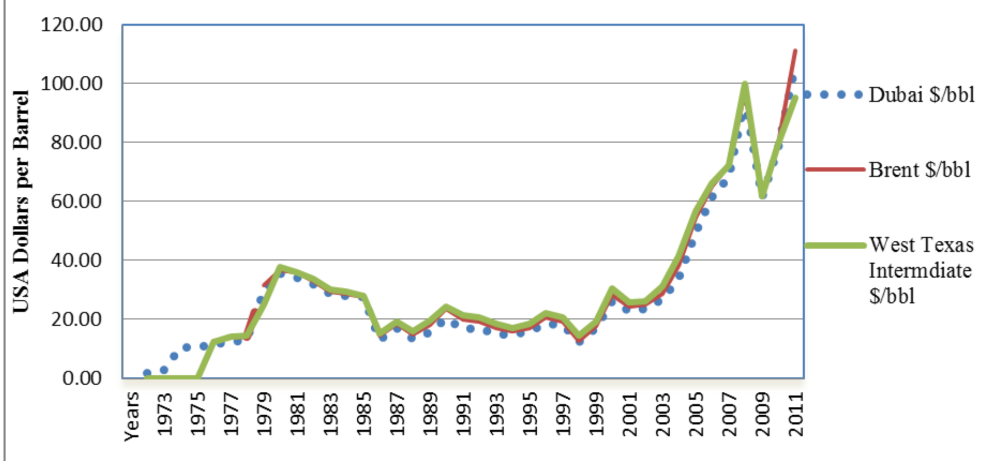
## 2. World Oil Market vs. Georgian Oil Market

2.1. **World Oil Market.** Crude oil passes different stages until it reaches to the final consumers. This begins with exploration, and then the discovered oil is extracted and transported to the refineries. Then oil is purified in refinery factories, which mainly are located close to consumer centers, next to pipelines or shipping facilities. Crude oil is refined in order to produce gasoline and other petroleum products. Finally, produced petroleum products are distributed and marketed to the final consumers. For each stage different oil prices are defined. It is followed by refinery stage after which spot refinery gasoline price is determined. If gasoline is transported by pipelines, the spot price for pipelines is established. Through pipelines petroleum is transported to the city terminals, from where gasoline is distributed in different retail stations. For the city terminals companies define rack prices. Finally, consumers purchase gasoline with retail prices from regular stations.

All stages are tightly linked to each other, because if the supply of crude oil decreases it will increase the price of crude oil and this, in turn, increases the cost for producing petroleum products. Therefore, while discussing retail market of gasoline one should also track the world crude oil market fluctuations. Despite such link, retail gasoline markets differ from the crude or refined oil markets. Retail gasoline market's participants are oil companies and final consumers, usage of different financial instruments are limited and the volume of trade is sufficiently small on this markets, while the crude oil or refined oil markets involve thousands of producers, refiners, brokers or consumers, employ various types of financial instruments and the dimension of trade is significantly large.

Markets for refined oil products are similar to the crude oil market. Transactions are held either in spot or in futures markets. Worldwide spot prices are set based on North

FIGURE 2.1. Spot Prices of Crude Oil




*Data source*- BP Statistical Review of Energy Statistics, 2012

Sea Brent crude, on West Texas Intermediates and on Dubai cruses. Thus, free on board (FOB) price of crude oil sold on European markets is defined based on Brent spot prices, while WTI and Dubai spot prices are used in the USA and in the Far East correspondingly. Volatility of the spot prices on these crude oils is represented below (see Fig., 2.1). They have the same trend, but mostly Dubai crude oil spot price is lower compared to Brent and WTI.

Unlike spot markets, futures markets involve transactions in the future, which imply the delivery of the specified quantity of oil products in the next period. Futures markets are becoming more influential by the time. The oldest futures market is New York Mercantile Exchange (NYMEX), which introduced the first futures contracts. Futures contracts rarely entail the actual delivery, therefore these markets are considered as financial markets. Prices of futures contracts are linked to spot prices in the following manner –the price of futures contracts when they end should equal to physical market price of commodity. Futures contracts are beneficial for buyers if at the time of delivery the specified price is lower than the spot price. Besides, futures contracts provide information about future expectations and help market participants to manage their risks.

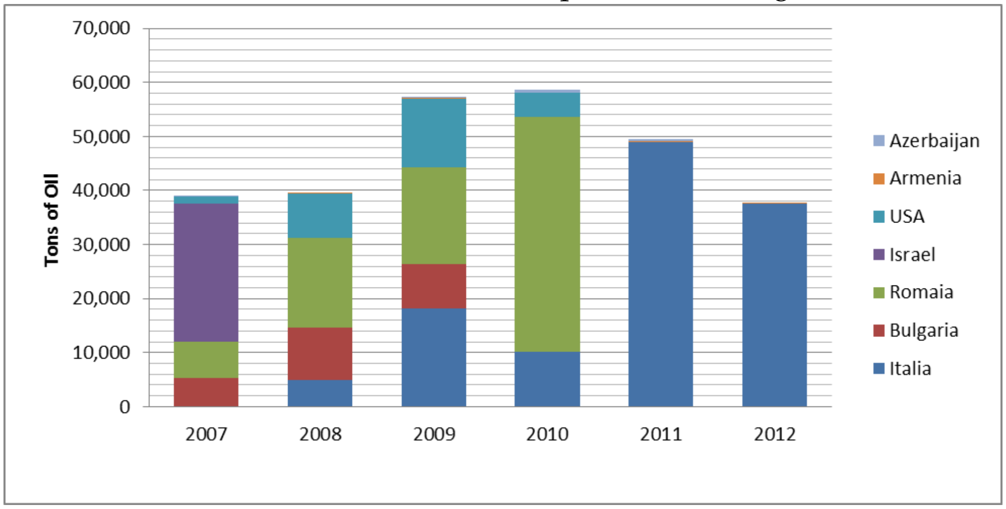
In the oil industry, besides the mentioned prices, is widely used Platts' prices, which assesses 62 grades of crude oil on every trading day under typical market conditions. Platts is the world's leading pricing service, which is quoted by Bloomberg and Reuters and intends to reflect the value of the marginal unit, the spot price and publishes assessments of these prices (Mileva, Siegfried 2007).The major advantage for using Platts data is the fact that its evaluation resembles more precisely actual physical markets compared to other markets. Therefore, in assessing the price transmission mechanism for Georgia case as the benchmark price I will use Platts data.

2.2. **Georgian Oil Market.** Georgia's role in the world oil market is quite modest, because the volume of produced and consumed oil by this country is sufficiently small. The history of Georgian oil industry started at the beginning of the 20th century. Extraction processes were carried out on the following fields - Mirzaani, Patara Shiraqi, Supsa, Norio, Satskhenisi, Taribana and Chaladidi.[2] Annual average production accounted for about 22-55 thousand tons of oil and it reached its maximum in 1980-1983, when total production was 3.2-3.3 million tons. In spite of such a long history of oil production, Georgia has gaps in the process of production of petroleum products as there are no refinery facilities inside country. Consequently, Georgia exports its own crude oil abroad and imports refined products for domestic needs. Figure 2.2 illustrates the dynamics of the Georgian crude oil exports in different countries. Export partner countries changes over time; for instance, Georgia's major trade partner was Romania until 2010, but now Italy imports major share of Georgia's crude oil.

Georgian Oil and Gas Corporation (GOGC) holds an exclusive right for oil exploration, production and transportation inside country. It monitors six investor companies' activities, those who obtained license of exploring and extracting oil across country on the mentioned oil fields. Among investor companies are Nino Tsminda Oil Company, Jindal Petroleum (Georgia) Limited, Frontera Resource Georgia Corporation, Georgian Oil and

[2]Information about Georgian oil producer companies is taken from the official web page of Georgian Oil and Gas Corporation - www.gogc.ge

FIGURE 2.2. Crude Oil Export from Georgia



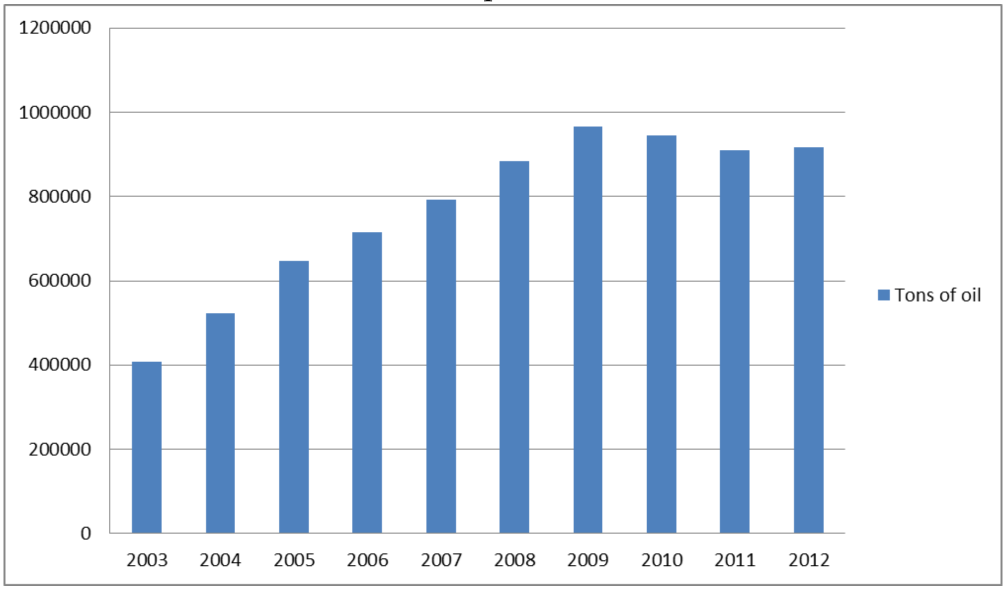

Gas Limited, Aksai BMC and VP Georgia. Until July 1, 2011 their cumulative production reached 27.7 million tons.[3]

Georgia plays a crucial role in Euro-Asian Oil Transportation Corridor Project, because it is the most reliable transit country of Caspian oil in the Caucasus region. Even in the 19th century Nobel brothers noticed Georgia's beneficial geographical location and started constructing trunk pipeline, with the diameter 203mm, from Baku to Batumi sea port to transport Caspian oil to Europe. Trunk pipeline with total length 1357 km was working before the World War I. During Soviet time constructing of new pipelines did not stop. Even more, annually they were building about 4500 km of pipelines with a diameters varying from 325 to 1420mm inside former Soviet Union's borders. Currently, two main pipelines - Baku-Tbilisi-Ceyhan (BTC) and the Western Route Export Pipeline (Baku-Supsa pipeline) cross Georgia's territory.[4] These pipelines are the shortest routes to connect Caspian oil to Mediterranean. As oil transit is quite beneficial for Georgia's economy, GOGC tries to develop further its transit potential, which implies improving the infrastructure and qualification of the workforce.

Until now, I described Georgia as an oil producer and oil transit state, but it essentially represents an oil importer country. For domestic use, Georgia imports already refined oil

[3]Georgian Oil and Gas Corporation statistics
[4]Georgian Oil and Gas Corporation annual report, 2010

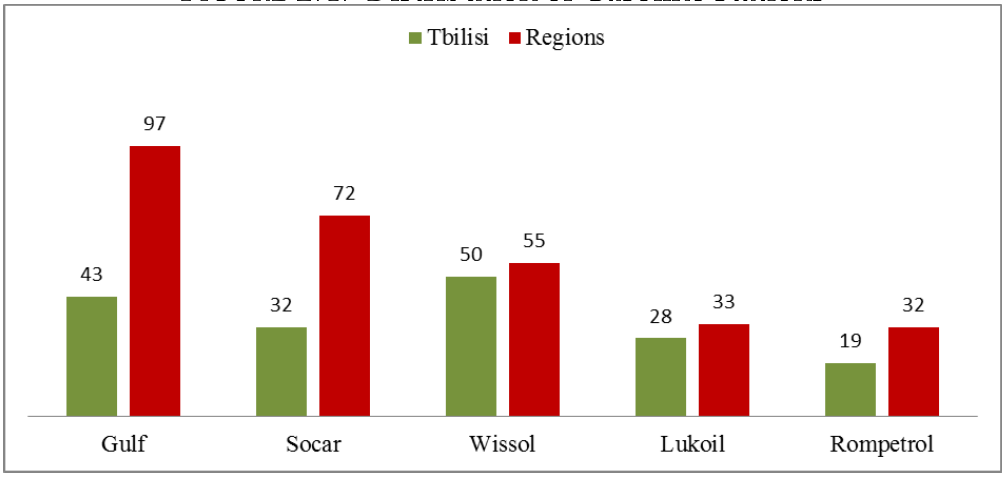
FIGURE 2.3. Imported Refined Oil




products through railway or sea. Since 2003 import of refined oil products has increased over time and reached its peak in 2009, which is about 966912.3 tons of oil. As from the Fig. 2.3 seems, peak was followed by the declining trend, but in 2012 situation has reversed. For Georgia the most large-scale exporter countries are Azerbaijan, Bulgaria, Turkmenistan, Romania and Greece. Their shares in total imports vary over time, but Azerbaijan maintains the first place for supplying gasoline and other petroleum products to Georgia's market.

Five oil importer companies operate in Georgia: Socar Georgia Petroleum Ltd, JSC Wissol Petroleum Georgia, Sun Petroleum Georgia LLC (Gulf), Lukoil Georgia Ltd and Rompetrol Georgia Ltd. Socar Georgia Petroleum Ltd entered the market in September 2006 and imports final oil products from Azerbaijan. It is a subsidiary company of the State Oil Company of Azerbaijan (SOCAR), which involves the whole chain of oil production process. However, Socar Georgia Petroleum operates only in the downstream segment, which implies the transportation, marketing and sale of the final oil products. Socar Georgia Petroleum experiences lower transportation and inventory expenditures compared to other importer companies, since it needs just 24 hours to import petroleum product in Georgia.

FIGURE 2.4. Distribution of Gasoline Stations




Wissol imports European petrol from Italian company Gruppo Api and like other importer companies use tankers for oil transportation. Wissol Company was established in Georgia and represents one of the significant players on the local oil market. Gulf entered in Georgia from March 2010 and by uniting the small independent petroleum stations, created the biggest service chain across country. Its main suppliers are Greece, Romania, Azerbaijan and Bulgaria. Lukoil Georgia Ltd is a subsidiary company of Russian oil corporation, Lukoil Oil Company, and imports oil products from Bulgaria. Rompetrol Georgia Ltd was established in December 2005 and is a partner of Rompetrol Group, which itself is Romanian oil corporation. Rompetrol Group, like SOCAR, involves the whole chain of oil production, while Georgian company only operates in downstream segment.

These companies service consumers almost in all regions, but intensively they compete for Tbilisi market. Figure 2.4 describes the distribution of service centers in the capital city and regions. Gulf is a leader with 140 gas stations, which is followed by Socar and Wissol almost the same amount of stations.

Georgian oil companies follow the Platts spot prices, which are reported daily. The Platts price fluctuates due to the changes in crude oil prices, which alters according to the supply/demand shocks or other non-economic reasons. Retail price of gasoline except crude oil expenditures includes other costs, such as transportation and operating costs, taxes and exchange rate costs. I intended to use spot prices of refined oil products rather than crude oil prices due to the joint production. Namely, from crude oil after refinery also other petroleum products are obtained, such as heating oil, diesel or kerosene. Therefore, while using crude oil price as a variable, also the demand for other purified products should be taken into account, since price changes in crude oil can be due to the demand shocks of these products. Thus, gasoline prices will depend on the demand for other refined products (Borenstein et. al. 1997).

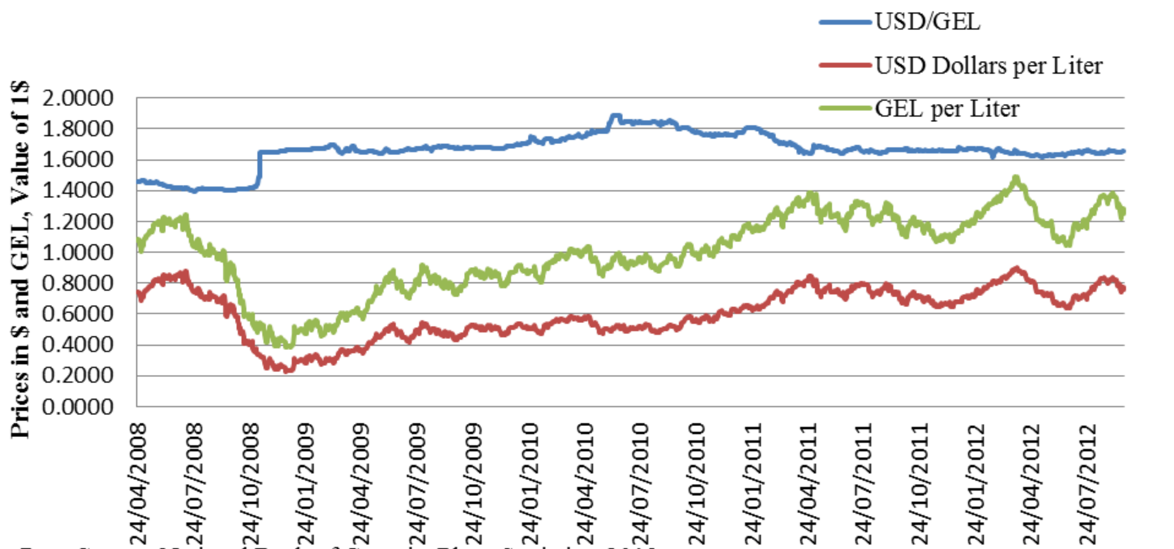
After crossing the border the price of refined oil increases due to mentioned costs. Currently, in Georgian reality, it is impossible to define the exact portion of transportation or operational costs in the retail oil price. But I am not expecting the dramatic changes in these costs across the research period; therefore I will ignore these components. Besides, we can ignore the fluctuations in the USD/GEL exchanges rate, because as the Fig.,5 shows exchange rate volatility does not influence significantly on the world oil price behavior. Mostly, exchange rate follows the stable trend, but in some intervals it experiences sharp changes. Namely, in the autumn of 2008 Lari depreciated by 0.16 points and moreover, in June, 2010 when it reached its peak, Lari depreciated by 0.49 points compared to the lowest point in the study period. The last main components of retail prices-taxes also were stable in the last decade, therefore I decided to include excise duty and value added taxes into retail prices. In Georgia value added tax is 18% of the dutiable turnover and the rate of excise tax varies according to the type of the petroleum products.

## 3. Literature Review

Wide range of literature explores gasoline retail price adjustments in different countries. The findings of these studies are heterogeneous. Some of them claim symmetric price adjustments, while others assert that price change process depends on its direction. These dissimilarities can be explained by the different ways of analyzing. Namely, studies differ in data samples, price inputs and methodology.

Robert Bacon (1991) was one of the pioneers in energy economics, who used the econometric model to test price asymmetry. He took semi-monthly data from 1982 to 1989 and

FIGURE 2.5. USD/GEL Exchange Rate, World Oil Prices in $ and GEL




*Data Source*- National Bank of Georgia, Platts Statistics, 2013

with the help of quadratic quantity adjustment function, explored price transmission process in the UK. He found evidence of the "rockets and feathers", which implies that the upward adjustment process is faster compared to the downward correction. Besides, Bacon concludes that in the long-run changes in the product prices and fluctuations in the exchange rates are fully passed on into the retail prices. In the UK before Bacon other studies also tried to test price asymmetry, but their main tool was cointegration analysis, which is not as trustworthy as the late econometric approaches are. Manning (1991) was one of them who exploited monthly data during the cointegration analysis in order to examine the price relationship between retail and crude oil prices over the period 1973-1988. Due to the results, he claims that price asymmetry in the UK is short-lived; it needs about four months to eliminate totally the deviations from the long-run equilibrium.

Like Bacon, Reilly and Witt (1996) also used econometric model to test pricing process in UK retail gasoline market. But for their purposes they exploited the error correction model. Based on the monthly data of the retail price, the crude oil price and the exchange rate from January 1982 to June 1995, this empirical model reports the asymmetric retail gasoline pricing behavior in UK in regard to both exogenous variables. Devaluation of dollar/sterling exchange rate causes the rise in consumer cost, while appreciation does not reduce the expenditures for them. Besides, a 10% fall in the crude oil price leads an estimated 1.9% fall in the retail price, while a corresponding rise in the crude oil price leads to a 4.1% rise in the retail price (Reilly, Witt 1996). Finally, the study claims that the changes in crude oil prices and exchange rate do not transmit on the retail price in the long-run; any shocks are eliminated maximum in three months.

In the same period, one of the influential and convincing studies was conducted by Borenstein, Cameron and Gilbert (1997) in the USA. They are called as BCG. Besides testing the same task, they also offered the possible reasons of the pricing behavior. To discover at which level the price asymmetry occurs, they analyzed each stage in the production and distribution of gasoline, from the crude oil through refinery to the retail stations. Changes in spot prices due to the crude oil price alternations appear to be accountable for some asymmetry, which is transmitted to the adjustment of wholesale prices. The source of this asymmetry can be the production/inventory adjustment lag, while the asymmetry occurred on the last distribution chain - wholesale to retail, refers to the existence of short-run market power among retailers. Furthermore, the study concludes that retail prices respond more quickly to increase in crude oil prices rather than to decrease, which was shown by estimating an error correction model for weekly data from 1986 to1992 in the USA.

In contrast to the previous study's findings, Bachmeier and Griffin (2002) found no asymmetric price adjustment in the US gasoline market over the longer period from 1985 to 1998. This paper asserts that daily regional gasoline prices adjust almost instantaneously and symmetrically to crude oil price changes (Griffin et.al, 2002). For measuring asymmetry, they used ECM equation based on the Granger two-step estimation method, for which exploited daily spot price data. The authors claimed that the main reason why results are so different is the adoption of the different approaches and the use of daily rather than weekly data.

As the USA is an oasis for data, wide range of studies are conducted in this field. Among them I can separate the studies done by George Deltas (2004) and Kuper and

Poghosyan (2008). Deltas examined 48 USA states over the period 1988-2002 for which he used monthly data. He found the high degree of asymmetry and the slow speed of adjustment between wholesale and retail prices mainly in those states, where retail-wholesale margins were high. Deltas considers that asymmetric price responses are the result of local markets power, which provokes the price stickiness. In contrast to Deltas research, Kuper and Poghosyan (2008) used weekly data to estimate gasoline prices responses to the crude oil price shocks. They divided research period before February, 1999 and post-February sample and applied threshold vector error-correction model. They found that there exists some threshold point between retail and crude oil prices, according which companies adjust their prices. Namely, gasoline companies do not adjust prices until the deviation from the long-run equilibrium between these prices is not large enough. Besides, Kuper and Poghosyan (2008) claim that the changes in the crude oil or retail prices have the reciprocal effect.

Godby et al. (2000) employed the same econometric model as Kuper and Poghosyan (2008) used, but for Canadian gasoline market. They applied the threshold vector error correction model to the weekly data for the period January, 1990 to December, 1996. While previous studies restricted threshold to zero, Godby et al. (2000) assigned it some positive value. No asymmetry was detected in Canadian oil market. The authors consider that the main reason for this different result is the differences in market structure, in the dataset and in methodology.

European gasoline markets also suffer from the asymmetric price transmission problem. Bettendorf, Geest and Varkevisser (2003) analyzed retail price adjustments in the Dutch gasoline market. To test petroleum price asymmetry, they estimated an error correction model for which were used weekly data of price changes during 1996-2001 years. The study showed that gasoline prices adjust asymmetrically in the Dutch market. Moreover, paper elucidated that the price asymmetry differs daily, which proves that the day when data are observed influences the results of the research. Finally, the study evaluated the consumers' costs of an asymmetric price adjustment of spot prices and concluded that in this sample period their expenditures were insignificant.

Asplund, Eriksson and Friberd (1997) analyzed the Swedish gasoline market based on the daily data of the retail prices, the spot prices and the exchange rates during 1980-1996. After examining the responses of retail prices in the local markets to changes in the world market, they concluded that prices are more rigid downward than upward in response to cost shocks. In this research the retail price changes are explained by the simple Ss-model, which implies that local market price alters when inputs prices and exchange rates significantly deviate after the last price adjustment. Study shows that the retail prices adjust more quickly to the changes in exchange rate rather than to volatility of the spot price, which is explained by the instability of both series. The spot prices are more volatile than exchange rates. Therefore, firms abstain to respond for the small changes in spot price, because they wait prices reverts.

The most recent research of the price asymmetry was conducted in Taiwan by Chou (2012), who followed the BCG's methodology. He employed weekly data of retail and crude oil prices and test asymmetry using the ECM. Chou found that in Taiwan retail gasoline prices responded faster to the negative shocks compared to the positive ones. For explaining this phenomenon, he used Kirchgassner and Kubler (1992) argument, which implies that oil companies hesitate to increase prices in response to positive price shocks to avoid public accusations of abusing the market power. However, public do not react negatively to the price decrease, therefore retail prices adjust quicker to the negative price shocks. This type of price asymmetry was considered as "politico-economic asymmetry".

## 4. Empirical Analysis

4.1. **Model.** Currently, the standard tool for examining dynamical price adjustment is the error correction model (ECM). This model is useful while working on cointegrated time series and it connects the short-run and long-run equilibria to each other. This study contains time series of retail gasoline and refined oil prices. The long-run equilibrium relationship between them is following:

$$RGP_t = \beta_0 + \beta_1 WSP_t + u_t \tag{4.1}$$

where $RGP_t$ denotes the retail price of one liter gasoline including the value added tax and excise duty, $\beta_0$ is the constant term, $\beta_1$ measures the long-run equilibrium relationship of permanent change to the price of world refined oil, which is referred also as the long-run pass-through. $WSP_t$ represents the spot price of refined oil and $u_t$ is an error term. All variable are expressed in Lari per liter. Mainly, retail gasoline prices are influenced by the refined oil prices and government taxation, but since the rate of taxation over the sample period remained stable it does not cause fluctuations in gasoline prices. Therefore, in the long-run equilibrium model the only explanatory variable, which I used, is a refined oil price.

After finding the error term from the long-run equilibrium equation, it is possible to construct the short-run dynamic model in error correction form, which is given below:

$$\Delta RGP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta RGP_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta WSP_{t-i} + \theta EC_{t-1} + \varepsilon_t \tag{4.2}$$

where $\Delta$ refers to the first difference (short-run dynamics are captured by the relationships in the first differences (Bettendorf et al., 2003)); $\varepsilon_t$ is an error term; $\gamma_i$ measures the short-run impact of world oil price fluctuation and $\gamma_0$ catches the instantaneous effect of variation in oil price. Thus, $\gamma_i$ shows lag effects of refined oil price variation and are considered as the short-run pass-through. $\alpha_i$ captures the short-run impact of lagged retail gasoline prices, $EC_{t-i}$ is an error correction term and $\theta$ is an adjustment coefficient of the long-run equilibrium, which is also called as catch-up speed. Engle and Granger's (1987) two-step approach was used for estimating the presented models. In the first step equation (4.1) is estimated using OLS and then obtained error term from this regression is plugged into the equation (4.2), which is also estimated using OLS.

Asymmetric ECM model should be estimated to explore the short-run responses to price changes, which looks as follows:

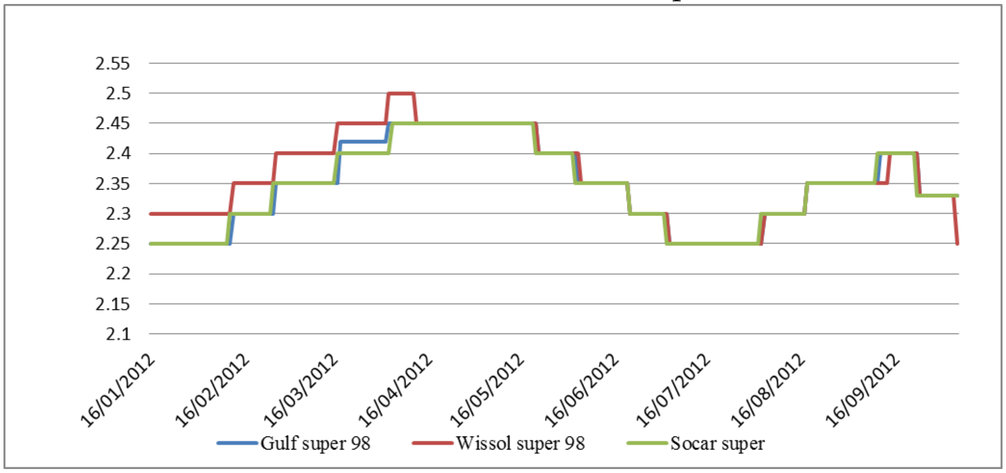
$$\Delta RGP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta RGP_{t-i} + \sum_{i=0}^{m} \gamma_i^{+} \Delta WSP_{t-i}^{+} + \\ + \sum_{i=0}^{m} \gamma_i^{-} \Delta WSP_{t-i}^{-} + \theta^{+} EC_{t-1}^{+} + \theta^{-} EC_{t-1}^{-} + \varepsilon_t \tag{4.3}$$

where positive and negative variations in the refined oil prices and the error correction term is separated. Other terms are the same. This model is used to identify the type of asymmetric price transmission (APT) on the Georgian oil market. Due to Peltzman (2000), positive asymmetric price transmission happens when retail price of oil reacts more fully or rapidly to an increase in refined oil price than to a decrease. Likewise, negative APT implies that retail price adjusts quicker to refined oil price decrease compared to an increase. This model is also estimated by the two step approach. Optimal number of lags is defined using the Akaiki Information Criterion.

Finally, cumulative adjustment function is used to measure the scale of cumulative adjustment in gasoline price. I followed the methodology, which firstly was used by Borenstein, Cameron and Gilbert (1997) for the USA market and currently by Chou (2012) for Taiwan retail gasoline market. If refined oil price decreases by one unit at time $t$, then $K_i^-$ shows the cumulative adjustment process of the retail gasoline price at time $t+i$ (Chou, 2012).The cumulative adjustment function, which is presented below measures the cumulative effect of negative refined oil shocks on the retail price. The same method can be used to calculate the cumulative effect of positive or symmetric shocks on domestic prices.

$$\begin{gathered} K_0^- = \Upsilon_0^- \\ K_1^- = K_0^- + \gamma_1^- + \theta^- \times (K_0^- - \beta_1) + \alpha_1 \times K_0^- \\ K_2^- = K_1^- + \gamma_2^- + \theta^- \times (K_1^- - \beta_1) + \alpha_1 \times (K_1^- - K_0^-) + \alpha_2 \times K_0^- \\ K_m^- = K_{m-1}^- + \gamma_m^- + \theta^- \times (K_{m-1}^- - \beta_1) + \sum_{i=1}^{n} \alpha_i \times (K_{n-i}^- - K_{n-i-1}^-) \end{gathered} \tag{4.4}$$

FIGURE 4.1. Retail Price of Super 98




4.2. **The Data.** This paper examines the daily prices of the retail gasoline and refined oil prices. Retail prices are obtained from the official web pages of the gasoline companies from 24 April 2008 till 13 May 2013 and the Platts spot prices of the refined oil, also was provided by the official statistical database of Platts, which are available only after the registration on the Platts official webpage. As Georgian firms follow the same trend of price adjustments, the analysis employs the retail price, which the Socar Georgia Petroleum Ltd. provides. Figure 4.1 presents the three biggest oil importer companies' retail prices of gasoline Super98. Correlation between Gulf and Socar retail prices is 0.9749, while the same indicator between Socar and Wissol is 0.9375. Wissol's high prices are explained by the higher transportation cost compared to other companies. The same trend is maintained in different petroleum products' retail prices.

The study uses "regular" type gasoline, because its share in the total turnover is 73.7%. Figure 4.2 presents the gasoline import dynamics according to the petroleum types, which also confirms that regular with octane number 91-93, is the most demanded form of petroleum in Georgia.

Platts data was expressed as unit price per tons in the USA dollar terms, but for the study purposes they were converted in Lari terms per liter. Daily exchange rate was taken from the National Bank of Georgia's statistics. According to the above figure, retail prices

FIGURE 4.2. Imported Oil in Georgian Market

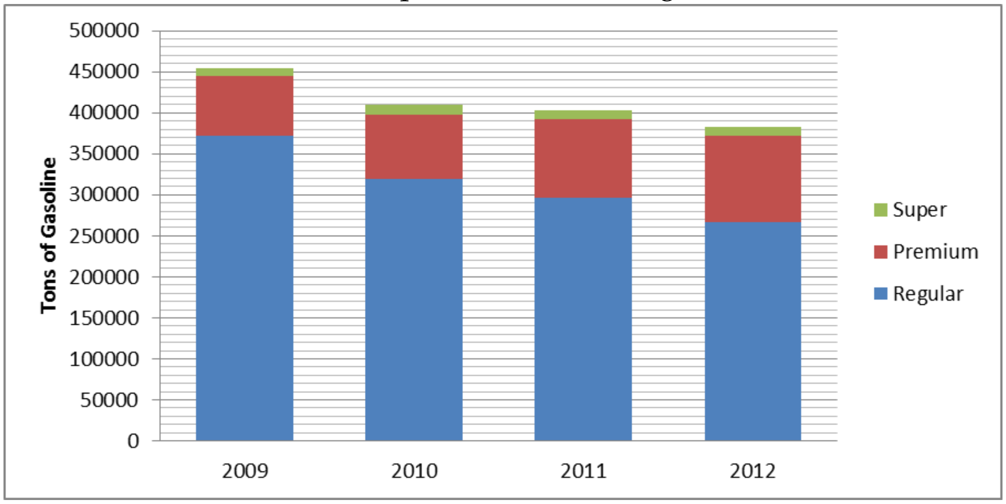



TABLE 1. Number of Price Adjustments

| | 2008 | 2009 | 2010 | 2011 | 2012 | Total |
|---|---|---|---|---|---|---|
| Total | 14 | 16 | 9 | 13 | 15 | 67 |
| Increase | 4 | 14 | 7 | 8 | 6 | 39 |
| Decrease | 10 | 2 | 2 | 5 | 9 | 28 |

adjust quite rarely, namely in the Table 1 is presented the number of price adjustments per year by Socar.

Presented data shows that retail prices are sticky in Georgia. 2010 characterizes with the very rare price adjustments, while in 2009 prices are twice flexible. Besides, according to the table, prices are mostly downward sticky, because only 28 cases of price decrease occurred over the research period, while retail gasoline prices increase 38 times from 2008 till 2012. The price stickiness is one of the most influential determinants of the asymmetric price transmission. While the refined oil prices alter daily, domestic price of gasoline changes on average once a month, which refers to the strong price rigidity in Georgian oil market.

Since I used only Socar price data for analyzing the price asymmetry, I also explored if there were differences in speed of price adjustments across companies. As the data shows in 2012 out of 15 changes in 8 occasions Socar altered its prices one day, once 2 days and once 4 days earlier than Wissol or Gulf did. In 3 cases all of them changed

FIGURE 4.3. World Refined Oil and Retail Prices in Georgia


prices simultaneously. Gulf was the first in changing price only once, while Wissol two times has altered its prices before others did.

The simple correlation between the price of world refined oil and the retail price of regular gasoline in Georgia is 0.9125. The evolution of these price series is presented in the Figure 8 for period 2008-2013. Even from this graph one can observes the not all fluctuations are transmitted to the domestic market, but such analysis are not sufficient to draw the solid results. Until now all findings were based only on the empirical data, afterwards, to reinforce these results I will employ the econometric tools.

In order to use traditional ECM, initially some tests should be conducted. Firstly, the time series should be checked for unit root and cointegration. According to the Dickey Fuller unit root test (including only constant term), retail and refined oil price series are non-stationary, but the same test shows that the first-order difference of these variables, $\Delta RGP_t$ and $\Delta WSP_t$ , are stationary. Thus, $RGP_t$ and $WSP_t$ are $I(1)$ series. The test results are presented in the Table 2.

Residual from the (1) equation was tested for unit root to check cointegration relationship between these series. Augmented Dickey Fuller test claims the stationarity of the residual, which confirms that $RGP_t$ and $WSP_t$ are cointegrated time series. The Johansen cointegrating test was employed to verify the obtained results, which also refers to the

TABLE 2. Unit Root Test

| Series | Dickey Fuller Test (Augmented DF with 1 lag for $u_t$) | | | |
|---|---|---|---|---|
| | Test Statistics | 1% critical value | 5% critical value | 10% critical value |
| $RGP_t$ | -0.626 | -3.459 | -2.879 | -2.570 |
| $WSP_t$ | -1.223 | -3.459 | -2.879 | -2.570 |
| $\Delta RGP_t$ | -9.609 | -3.459 | -2.879 | -2.570 |
| $\Delta WSP_t$ | -13.113 | -3.459 | -2.879 | -2.570 |
| $u_t$ | -4.066 | -3.459 | -2.879 | -2.570 |

TABLE 3. Johansen Cointegration Test on $RGP_t$ and $WSP_t$

| Maximum Rank | Eigen value | Trace Statistic | 5% critical values |
|---|---|---|---|
| 0 | | 39.5781 | 15.41 |
| 1 | 0.13526 | 1.5026* | 3.76 |
| 2 | 0.00572 | | |

TABLE 4. Sensitivity to the Lag Structure

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| n | 2 | 3 | 2 | 5 | 2 | 5 | 1 |
| m | 3 | 3 | 1 | 5 | 4 | 3 | 3 |
| AIC | -1283.6 | -1281.689 | -1280.425 | -1279.003 | -1277.661 | -1276.641 | -1276.354 |

Note: n refers to the number of lags for retail gasoline prices and m is a number of lags for the world spot prices. AIC stands for Akaike Information Criterion.

existence of only one cointegrating equation between these variables. Table 3 shows the test output.

For estimating the ECMs, optimal lag structure should be chosen, for which Akaike Information Criterion was employed. I considered 32 different lag structures, ranging from the no lag to one with 5 lags. That model was chosen, which had the lowest AIC. Table 4 describes models' sensitivity toward the various lagged variables combinations. Other information criteria, such as BIC suggested almost the same results. Finally, I employed the model with 2 lags for retail oil prices and 3 lags for refined oil prices.

The chosen model is quite comparable to the reality in Georgia case, because as the oil companies claim, maximum 3 weeks are needed to transport gasoline from Europe. Besides, they are changing inventories approximately once a month, which increases the chance of price change exactly the same period when the inventories are refilled. Socar does it more frequently since it has almost no barriers to import gasoline whenever it is needed.

TABLE 5. Test results for SC

| Breush-Godfrey test for SC | | Symmetric model | Asymmetric model |
|---|---|---|---|
| Critical value | chi2 (1,0,05) | 3.8414588 | 3.8414588 |
| Test statistics | LM | .6475 | 0.045 |

TABLE 6. Cointegration Relationship

| Variable | Coefficient | Standard Deviation | p-value |
|---|---|---|---|
| $WSP_t$ | 1.270131 | .0351856 | 0.000 |
| Constant | .5036108 | .0371657 | 0.000 |

Moreover, error terms in the equation (4.2) and (4.3) was tested for serial correlation and appeared that none of the residuals suffer from SC. The null hypothesis of no SC was not rejected.

4.3. **Results.** The estimation results of the cointegrating relationship are presented in the Table 6, which refers to the significant long-run equilibrium link between the price of refined oil and retail gasoline price. The long-run pass-through coefficient is 1.270131, which shows the amount by which the domestic price will change in the long-run in response to the one-time change in refined oil price by one unit. Thus, when international price increases by one Lari at some point in time, Georgian retail market price will increase by 1.270131 Lari in the long-run.

Results from estimating the main equations are presented in the Table 7, which distinguishes the findings for symmetric and asymmetric models. For both ECM models, it is obvious that the immediate effect of refined oil price shock is not significant. However, refined oil price shocks have significant distributed lag effects on the retail price by the first and third lags in the symmetric model. Thus, when international price changes by one Lari, the response of local gasoline price will be .0987215 Lari in the following week. But for asymmetric model refined oil price shocks have significant lag effect only for the negative shocks. According to the results, if negative refined oil price shock occurs on the international market, it will decrease domestic gasoline price by .1198122 Lari in the following week and by .1644797 Lari after three weeks. Moreover, $\gamma_i^-$ effects are stronger

TABLE 7. Estimation Results

| | Symmetric ECM | | | Asymmetric ECM | | |
|---|---|---|---|---|---|---|
| Variable | Coef. | St. Dev. | p-value | Coef. | St. Dev. | p-value |
| Constant | .0010067 | .0012568 | 0.424 | .0124495*** | .0036222 | 0.001 |
| $\Delta RGP_{t-1}$ | .239273*** | .057888 | 0.000 | .2109521 *** | .057171 | 0.000 |
| $\Delta RGP_{t-2}$ | .171622*** | .0568207 | 0.003 | .1576714*** | .0557382 | 0.005 |
| $\Delta WSP_t$ | -.0120515 | .0339513 | 0.723 | | | |
| $\Delta WSP_t^-$ | | | | .00733 | .0590153 | 0.901 |
| $\Delta WSP_t^+$ | | | | -.0310362 | .0659692 | 0.638 |
| $\Delta WSP_{t-1}$ | .0987215*** | .0357137 | 0.006 | | | |
| $\Delta WSP_{t-1}^-$ | | | | .1198122** | .0605574 | 0.049 |
| $\Delta WSP_{t-1}^+$ | | | | -.0135991 | .0672869 | 0.840 |
| $\Delta WSP_{t-2}$ | .0477867 | .036301 | 0.189 | | | |
| $\Delta WSP_{t-2}^-$ | | | | .037897 | .0616606 | 0.539 |
| $\Delta WSP_{t-2}^+$ | | | | .0052318 | .0665768 | 0.937 |
| $\Delta WSP_{t-3}$ | .1098687*** | .0358925 | 0.002 | | | |
| $\Delta WSP_{t-3}^-$ | | | | .1644797*** | .0612671 | 0.008 |
| $\Delta WSP_{t-3}^+$ | | | | .0001899 | .0663229 | 0.998 |
| $EC_{t-1}$ | -.0442569*** | .0112397 | 0.000 | | | |
| $EC_{t-1}^-$ | | | | -.0094143 | .0150248 | 0.532 |
| $EC_{t-1}^+$ | | | | -.1154034*** | .0228818 | 0.000 |

*** indicates significance at the 1% level, ** at 5% and * at 10% level.

compared to the $\gamma_i^+$ effects, which implies that short-run impact of a decrease is stronger than the short-run impact of an increase in refined oil prices in the same periods.

While lagged refined oil prices suffer from insignificance problems, lagged retail price have strong and significant impact on its current value. One of the explanations of this impact can be that the oil companies care about consumers reactions about price changes and they try to smooth prices so that it will not cause the sharp fluctuations from the previous price level. Thus, they take into consideration existing prevailing retail prices of gasoline, while making the decision about price changes.

Moreover, adjustment parameters of the error correction term are significant, except negative one. They are negative as they were expected, which indicates that the system converges to the equilibrium. For example, if local retail gasoline price is above its long-run level, it will make 11.54% difference in each week and finally will return to that level.

TABLE 8. Asymmetric Test

| | F-Statistics | Prob> F |
|---|---|---|
| $H_0 : \gamma_0^- = \gamma_0^+$ | 0.13 | 0.7163 |
| $H_0 : \gamma_1^- = \gamma_1^+$ | 1.61 | 0.2055 |
| $H_0 : \gamma_2^- = \gamma_2^+$ | 0.1 | 0.7574 |
| $H_0 : \gamma_3^- = \gamma_3^+$ | 2.41 | 0.1218 |
| $H_0 : \theta^- = \theta^+$ | 12.19*** | 0.0006 |
| $H_0 : \sum_{i=0}^{m} \gamma_i^+ = \sum_{i=0}^{m} \gamma_i^-$ | 3.34* | 0.0687 |

***, ** and * indicate that null hypothesis is rejected at 1%, 5% and 10% levels

But if the domestic retail price is below its long-run equilibrium point, it will reach that level by making up 1% of the difference each week.

While analyzing the asymmetric price transmission, I utilize the strategy of Frey and Manera (2007) to categorize price asymmetries, which are represented by the equation (3). Initially, I found out if there was contemporaneous impact asymmetry of refined oil price shocks on the retail prices by testing the null hypothesis $\gamma_0^- = \gamma_0^+$. As the Table 8 shows the null hypothesis is not rejected, which implies the contemporaneous impact symmetry for this model. Then I checked existence of distributed lag effect asymmetry by following hypothesis $\gamma_i^- = \gamma_i^+ \, \forall i = 1, \ldots, m$. Hypotheses are tested using the Wald test. It is evident that the distributed lag effect asymmetry does not occur on different lag levels, which refers to the distributed lag effect symmetry. However, the asserted hypothesis is not very strong, because at 15% of confidence level there is distributed lag effect asymmetry. Cumulative impact asymmetry of refined oil price shocks on retail prices can be found by testing the null hypothesis $\sum_{i=0}^{m} \gamma_i^+ = \sum_{i=0}^{m} \gamma_i^-$ . At 10% confidence level test result confirms the existence of cumulative impact asymmetry, which presumably, is driven by the first and third lags. Finally, by rejecting the hypothesis $H_0 : \theta^- = \theta^+$, I strengthen the doubt that catch-up speed is asymmetric. Frey and Manera (2007) define such type of asymmetry as equilibrium path asymmetry.

More comprehensive analysis of the adjustment path is given by the cumulative adjustment function. Table 9 reports the cumulative responses of retail prices on positive, negative and symmetric refined oil shocks over ten weeks. Following table and Figure 9

TABLE 9. Cumulative Adjustments

| | Period after 1 Lari Change in World Refined Oil Price (Week) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Negative $K_i^-$ | 0.007 | 0.141 | 0.218 | 0.430 | 0.495 | 0.549 | 0.578 | 0.599 | 0.614 | 0.627 |
| Positive $K_i^+$ | -0.115 | 0.007 | 0.165 | 0.345 | 0.515 | 0.666 | 0.795 | 0.901 | 0.986 | 1.053 |
| $K_i^+ - K_i^-$ | -0.123 | -0.134 | -0.053 | -0.085 | 0.020 | 0.117 | 0.217 | 0.302 | 0.372 | 0.426 |
| Symmetric | -0.012 | 0.141 | 0.273 | 0.485 | 0.593 | 0.685 | 0.751 | 0.806 | 0.851 | 0.890 |

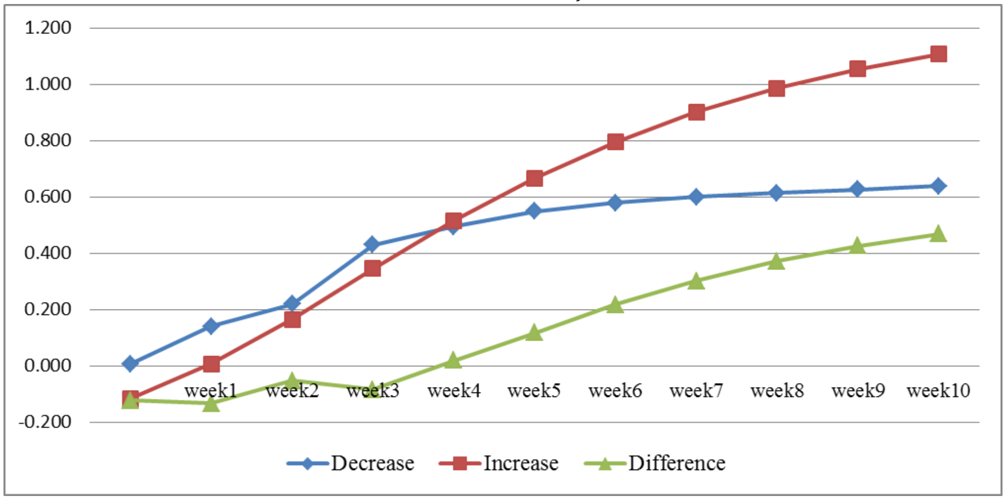
present the retail price response in Lari per liter to a one time one lair per liter increase or decrease in the refined oil price.

Instantaneous response, as already was mentioned, is insignificant and very weak in both directions. However, a one lair decrease in the refined oil price leads to a 0.141 lair decrease of retail price in the first week, whereas the response to a one lair increase is only 0.007 lair. In the first four weeks the functions are not significantly different from one another, which refers to the price adjustment symmetry. However, I should notice that cumulative effect of the lags refers to the asymmetry. Until fourth week adjustment on negative shocks is faster, but after this point opposite holds. In positive shock case, long run equilibrium price is reached after eight weeks, while in negative shock case the retail price is declined only by 0.63 lair after the same period. Thus, in Georgia retail gasoline price responses to negative shocks is faster but in positive price shock case, local price adjust more fully.

Thus, price adjustments are not clearly asymmetric in the short-run, while Georgian oil market faces the price asymmetry in the long-run, since cost changes are not fully passed to the retail prices. Namely, after the positive price shocks increased costs are fully transmitted into the retail prices, while in negative price shock case only 60% of change is eliminated.

4.4. **Explanations for Asymmetric Retail Price Adjustments and the Limitations of the used Model.** Identifying the precise reasons that describes the actual price transmission process from refined oil to retail gasoline prices is quite difficult in Georgia's case. However, I will discuss some causes which can be applied this specific model. Literature

FIGURE 4.4. Cumulative Adjustment Function




proposes non-competitive markets, adjustment costs, political intervention, asymmetric information and inventories as the possible causes of this phenomenon. But presented hypotheses, which can be considered as a triggering force of APT, have more suggestive rather confirmatory character.

The most widespread explanation of the asymmetric price transmission is an existence of non-competitive market structure. Consumers often suspect that imperfect competition allows middlemen to abuse market power. This doubt is quite solid in the reality of Georgia, because domestic prices of gasoline are very sticky while worldwide oil prices changes daily. Therefore, the public claim openly that Georgian oil companies act like oligopolies. Due to the results, in retail prices the cost changes, which are induced by the positive price shocks, are fully eliminated, while in negative shocks case are not. This result is widely used to claim that oil companies abuse market power, but we should notice that all oil companies track the same strategy. This refers to the oil companies coordinating reactions to the cost changes, but it is too early to blame them in cartel behavior. However, there is some probability that the implicit agreement exists between them. This doubt is strengthened by the finding. Namely, oil companies change retail price only after their competitors alter the price. Over the research period, Socar appeared to be the leader, which was an initiator in adjusting the prices and others followed it. Such type of coordination is considered as a “tacit collusion”.

Moreover, we should not overlook the results from the cumulative adjustment function which shows that oil company responses to negative refined oil price shocks are faster. As Ward (1982) suggests oligopolies often delay the price responses to the positive shocks to maintain their markets shares. Namely, by increasing the retail prices companies put under risk their market shares and those which maintained lower prices are better off. Besides, according to the Kirchgassner and Kubler (1992), such type of behavior was explained by the phenomenon of the “politico-economic asymmetry”, which implies that companies does not increase prices immediately to the positive prices shocks in order to avoid public accusations of abusing the market power. The same argument was used in Taiwan’s case, when Chou (2012) detected the negative price asymmetry. Thus, Georgian companies such behavior can be explained by the same argument.

Adjustment and menu cost is another major explanation for asymmetric price transmission, but in oil market case it does not play a significant role. Retail price change does not demand much effort from oil companies to report these changes publicly. However inventories can be considered one of the reasons of Georgian retail prices stickiness. Oil companies state storage as a major cause of asymmetric price responses when faced with complaints about abuse of market power. Unfortunately, the exact information about Georgian companies’ inventory policy was inaccessible; therefore it is difficult to analyze how they adjust their inventories. They just claim that storage facilities are refilled at least one a month. One of the reasons of price stickiness is the utilization of forward contracts, which are widely used in contemporary world oil markets. However, as Georgian companies report, they still are not using such type of contracts.

Government intervention is another explanation of APT. Namely, when government uses price support policies it leads the asymmetry. Over the research period, Georgian government apparently did not use such policies, but in the autumn of 2012, the new Georgian government publicly demanded from oil companies to decrease retail gasoline prices by 5 Tetri. By this act, the government artificially changed the price and retail price behavior cannot explained by the used model.

The presented study cannot be considered as a perfect piece of research, because it suffers from the following limitations. Namely, data are not ideal for this type of model, because they are sticky across the long period, which causes the loss of observations. In ECM are used differences of prices, which are zeros in most cases. For future research one can try the threshold error correction model or Ss-model. Besides, testing the retail prices of the other oil companies and different type of gasoline product prices will be interesting. But, unfortunately there was no chance to get the price history for them.

## 5. Conclusion

The price setting mechanism in retail gasoline markets is an interesting topic, but until now this type of research was not conducted in Georgian retail market case. Supposedly, the main problem was the lack of information and less transparency of the oil importer companies. Therefore, the public often blame them in abusing the market power. My main goal to conduct this research was to find out who was right in this severe fight.

The presented study uses the ECM to test the asymmetric price behavior of the Georgian oil companies. The results suggest that, in the long-run, positive price shocks are fully transmitted in the retail gasoline prices. Responses to negative cost shocks seem to be faster compared to the positive shock cases, but are not precisely measured. Future studies employing longer time series may provide better evidence on the latter.

## REFERENCES


[1] Annual reports of Georgian Oil and Gas Corporation (2006, 2008, 2009, 2010), / www. gogc.ge/

[2] Asplund, Marcus, Rickard Eriksson, and Richard Friberg (2000). "Price Adjustment by a Gasoline Retail Chain," *Scandinavian Journal of Economics* 102(1): 101-121.

[3] Bacon, Robert W. (1991). "Rockets and Feathers: the Asymmetric Speed of Adjustment of UK Retail Gasoline Prices to Cost Changes," *Energy Economics* 13(3): 211-218.

[4] Bettendorf, Leon, Stephanie A. van der Geest, and Marco Varkevisser (2003). "Price Asymmetry in the Dutch Retail Gasoline Market," *Energy Economics* 25(6): 669-689.

[5] Borenstein, Severin, and Andrea Shepard (2002). "Sticky Prices, Inventories and Market Power in Wholesale Gasoline Markets," *RAND Journal of Economics* 33(1): 116-139.

[6] Borenstein, Severin, A. Colin Cameron and Richard Gilbert (1997). "Do Gasoline Prices Respond Asymmetrically to Crude Oil Price Changes?" *The Quarterly Journal of Economics* 112(1): 305-339.

[7] BP Statistical Review of World Energy (2012) /www.bp.com/

[8] Chou, Kuowei (2012). "Price Adjustment in Taiwan Retail Gasoline Market," *International Journal of Economics and Finance* 4(7): 132-140.

[9] Daily Newsletter from Platts (2013) /www.platts.com/

[10] Deltas, George (2008). "Retail Gasoline Price Dynamics and Local Market Power," *The Journal of Industrial Economics* 56(3): 613-628.

[11] Engle, Robert F., and Clive W. J. Granger (1987). "Co-integration and Error Correction: Representation, Estimation and Testing," *Econometrica* 55(2): 251-276.

[12] Frey, Giliola, and Matteo Manera (2007). "Econometric Models of Asymmetric Price Transmission," *Journal of Economic Surveys* 21(2): 349-415.

[13] Godby, Rob, Anastasia M. Lintner, Thanasis Stengos, and Bo Wandschneider (2000). "Testing for Asymmetric Pricing in the Canadian Retail Gasoline Market," *Energy Economics* 22(3): 349-368.

[14] Grant, Kenneth, David Ownby, and Steven R. Peterson (2006). "Understanding Today's Crude Oil and Product Markets," Policy Analysis Study by Lexecon, an FTI Company

[15] Huang, Alex YiHou, and Yi-Heng Tseng (2010). "Is Crude Oil Price Affected by the US Dollar Exchange Rate?" *International research journal of finance and economics* 58: 109-120, 1535-1541.

[16] International Energy Agency (2012), World Oil Supply /www.iea.org/

[17] Ivaldi, Marc, Bruno Jullien, Patrick Rey, Paul Seabright, and Jean Tirole (2003). "The Economics of Tacit Collusion," Final Report for DG Competition, European Commission.

[18] Kirchgassner, Gebhard and Knut Kubler (1992). "Symmetric or Asymmetric Price Adjustment in the Oil Market: An Empirical Analysis of the Relations Between International and Domestic Prices in the Federal Republic of Germany, 1972-1989," *Energy Economics* 14(3): 171-185.

[19] Kuper, Gerard H., and Tigran Poghosyan (2008). "Non-linear price transmission between gasoline prices and crude oil prices," SSRN Working Paper 1265569.

[20] Manning, D.N. (1991). "Petrol Prices, Oil Price Rises and Oil Price Falls: Some Evidence for the UK since 1972," *Applied Economics* 23(9): 1535-41.

[21] Meyer, Jochen, and Stephan von Cramon-Taubadel (2004). "Asymmetric Price Transmission: A Survey," *Journal of Agricultural Economics* 55(3): 581-611.

[22] Mileva, Elitza, and Nikolaus Siegfried (2007). "Oil Market Structure, Network and the Choice of Currency for Oil Invoicing," ECB occasional paper 77.

[23] Organization of the Petroleum Exporting Countries (2012), World Oil Outlook

[24] Organization of the Petroleum Exporting Countries (2013), Monthly Oil Market Report /www.opec.org/

[25] Peltzman, Sam (2000). "Prices Rise Faster than They Fall," *Journal of Political Economy* 108(3): 466-502.

[26] Polemis, Michail, and Panagiotis Fotis (2011). "The Gasoline Industry in European Union and the USA," Munich Personal RePEc Archive, Paper no. 35097 (accessed November 29, 2011)

[27] Reilly, Barry, and Robert Witt (1998). "Petrol Price Asymmetries Revisited," *Energy Economics* 20(3): 297-308.

[28] The information bulletin of Platts, the Structure of Global Market, June 2010

[29] U.S Energy Information Administration (2013), Short-term Energy Outlook /www.eia.gov/

[30] Von Cramon-Taubadel, Stephan (1998). "Estimating Asymmetric Price Transmission with the Error Correction Representation: an Application to the German Pork Markets," *European Review of Agricultural Economics* 25(1): 1-18.