ASYMMETRIC PRICE TRANSMISSION IN EU PETROLEUM MARKETS

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Doctor of Philosophy

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September 2014

ASTON UNIVERSITY

THESIS SUMMARY

Asymmetric Price Transmission in EU Petroleum Markets

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This research investigates the determinants of asymmetric price transmission (APT) in European petroleum markets. APT is the faster response of retail prices to cost increases than to cost decreases; resulting in a welfare transfer from consumers to fuel retailers. I investigate APT at 3 different levels: the EU, the UK and at the Birmingham level.

First, I examine the incidence of asymmetries in the retail markets of six major EU countries; significant asymmetries are found in all countries except from the UK. The market share data suggest that asymmetries are more important in more concentrated markets; this finding supports the collusion theory. I extend the investigation to 12 EU countries and note that APT is greater in diesel markets. The cross-country analysis suggests that vertical and horizontal concentration at least partly explains the degree of asymmetry. I provide evidence justifying scrutiny over retail markets' pricing and structure.

Second daily data unveil the presence of APT in the UK fuel markets. I use break tests to identify segments with different pricing regimes. Two main types of periods are identified: periods of rising oil price exhibit significant asymmetries whilst periods of recession do not. Our results suggest that oligopolistic coordination between retailers generate excess rents during periods of rising oil price whilst the coordination fails due to price wars when oil prices are going downwards.

Finally I investigate the pricing behaviour of petroleum retailers in the Birmingham (UK) area for 2008. Whilst the market structure data reveals that the horizontal concentration is higher than the national UK average, I find no evidence of APT. In contrast, I find that retail prices are sticky upwards and downwards and that firms with market power (majors and supermarkets) adjust their prices slower than other firms.

Keywords: Asymmetries, Pricing, Petroleum, Collusion, Sticky prices.

ACKNOWLEDGEMENTS

All praises to God for giving me courage, health and patience for what was the most challenging experience in my life so far. My heartfelt gratefulness goes to my parents Mohammad and Fatena who have sacrificed so much for their children and to my wife Hanaa who supported me in the most difficult moments. My sincere thankfulness also goes to my supervisors, colleagues and friends at Aston for their support and patience over the past 4 years.

I take this opportunity to acknowledge the guidance of Prof. Nigel Driffield who gave me inspiration to undertake a PhD as early as in 2005 during my Masters studies at Aston. I thank him for his full support as well as his expert guidance in the field of academic writing. I also thank my supervisor and friend Dr Michail Karoglou for his highly valuable technical advice in the field of econometrics. Last but not least, I am also grateful to Dr Rakesh Bissoondeeal for his very useful and quick feedback throughout my thesis.

Moreover I would like to thank the fabulous ABS Research Degree Programme team: Jeanette Ikuomola, Liz Bridges, Irene Vickers and Ranjit Judge for their fantastic administrative support.

Work resulting from this thesis

Working Papers

Al Sabbagh, O., Bissoondeeal, R., Driffield, N., Karoglou, M. (2013), Rockets and Feathers and Retail Market Concentration: Any Relation? *Aston University Working Papers*.

Al Sabbagh, O., Driffield, N. and Karoglou, M. (2014), Price Transmission Asymmetries and the Collusion Hypothesis: New Evidence from the EU Petroleum Retail Markets, *Aston University Working Papers*.

Al Sabbagh, O., Driffield, N. and Karoglou, M. (2014), Asymmetric Price Transmission in the UK Petroleum Industry: Excess Rents and Price Wars, *Aston University Working Papers*.

Al Sabbagh, O., Driffield, N. and Karoglou, M. (2014), Price Stickiness in a Competitive Retail Petroleum Market, *Aston University Working Papers.*

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1. Introduction

In the first two sections I introduce and illustrate the research topic. The third section describes the theoretical framework. The fourth section provides some background on the European petroleum markets. Finally, the fifth section motivates the present thesis and sets the research objectives.

1.1 Overview of the research topic

Oil prices have recently been subject to significant scrutiny due to the importance of oil for industrial, commercial and residential purposes. Whilst the short-run rises are often due to political crises such as conflicts in oil-rich countries, the long-run increase in the last decade is explained by economic theory. It reflects the increasing long-term demand as well as the depletion of oil reserves.

In fact, oil prices do not only vary with the availability and accessibility of oil reserves but also with the way global demand changes or is expected to change. Speculation and uncertainty about demand for oil has caused oil prices to become far more volatile in the recent years. For instance, the Brent crude price went from \$144 on the 3rd July 2008 down to \$34 on the 28th December 2008. Whilst remaining volatile to a certain extent, the oil price recovered its upward trend until the end of 2010 reaching the \$100 threshold once again. In the absence of a serious substitute to petroleum in the short-term, the long-run rising trend in oil price is expected to persist despite the significant price manipulation of the OPEC cartel.

In addition to the ever-increasing oil prices, there has been rising concern among consumers in recent years that petrol stations react to cost increases more quickly than they do for decreases. Economists have started looking at the phenomenon from the early 90s, especially Bacon (1991) who introduced the concept of "rockets and feathers" in gasoline markets. The basic assumption motivating the search for asymmetries in gasoline markets is the common belief that oligopolistic retailers belonging to vertically integrated oil companies coordinate their prices in order to increase their average margins. Consumers often observe that the retailers respond much quicker to an oil price increase than to a similar decrease; this is often associated in the press to the size of major oil companies.

Is the price transmission of crude and spot prices onto retail prices asymmetric? If so what are the reasons or mechanisms behind this phenomenon? These two questions are the focus of over 60 journal articles in the past 20 years. The petroleum markets represent by far the dominant share of the literature on asymmetric pricing; such predominance may be caused by the public interest for the topic. As far as the EU is concerned, an overwhelming share of the population owns a car and in recent year motorist organisations have attempted to raise attention on the issue of APT.

The Fédération Internationale de l'Automobile (FIA) which represents 35 million European drivers has sent a letter to call an investigation by the European Union. "The price of fuel in the UK reached record levels in April as the cost of Brent crude rose above $125 a barrel. Although the price of crude has fallen $10 since then, motoring groups say the wholesale price of petrol has not fallen as fast" (BBC, 2011). Similar articles have been recently published by several UK and EU websites, showing the rising importance of the phenomenon for the public opinion.

It is worth mentioning that interest in the topic generally arises when fuel prices are high; which denotes that controversy over asymmetries is mainly due to anger caused by 'ever-increasing' fuel prices in the long-run. Due to the combination of high taxation and ever-increasing crude prices, the fuel budget of European drivers is becoming an increasingly important part of their revenue. Not surprisingly, Bacon (1991) wrote the first "rockets and feathers" paper for the United Kingdom market; the UK being one of the countries in Europe with the higher fuel prices, especially the diesel fuel which is higher taxed compared to the other European countries.

This research will outline the controversy over the methods used and the lack of link between empirics and economic theory. So far we have abstractly defined the phenomenon of APT whilst the following section will further illustrate it within the context of the petroleum industry.

1.2 Illustration of the research topic

I focus on the two most utilised motoring fuels: diesel and unleaded gasoline. Diesel and gasoline are two fuels produced from refining crude oil alongside with jet fuel, heating fuel, kerosene and other products. The type and price of the end product depends on the different refining processes. In the petroleum industry three major pricing stages are considered: upstream, midstream and downstream.

The upstream price is the crude price, in other words the price of crude oil after exploration and extraction and before the refining process. Crude oil (e.g. Brent) is then typically shipped and processed into a refinery and subsequently the refined product enters the midstream market at a price at which wholesalers trade branded (e.g. Shell) and unbranded products.

The downstream price is the retail price at which drivers pay their fuel. The retail price typically includes the costs of marketing, logistics, the duty and the Value-Added Tax VAT. In this thesis I focus only on the transmission from the midstream "spot" prices to the downstream "retail" prices in EU countries.

Figure 1.1 below illustrates the oil product supply chain, detailing the physical flows of crude oil and its products alongside the supporting contractual relationships. The main physical stages are: the purchase of crude oil; the refining of crude oil into a range of products; the distribution and storage of those refined products; and the marketing and retail to end-users. The wholesale product market sits alongside this physical chain as a means to obtain agreement of contractual relationships between refiners and distributors as well as retailers.

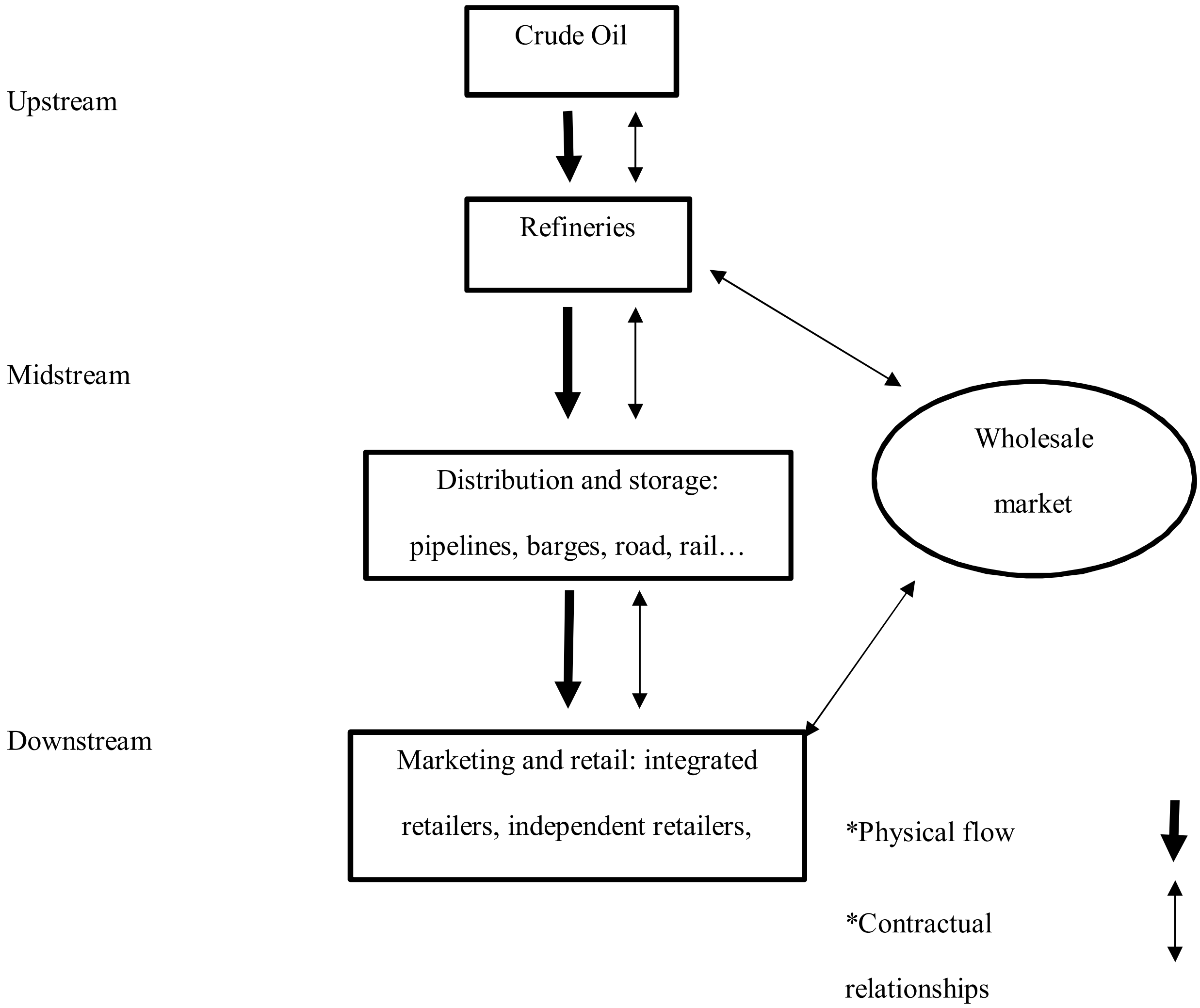

Figure 1.1 - The petroleum industry supply chain

The actual wholesale prices, 'the contract prices' are generally extremely hard to obtain and very costly; in the literature the most used midstream prices are the spot ex-refinery prices. More details about the choice of EU spot prices will be provided in section 1.4.

As far as the topic of interest is concerned, Figure 1.2 below illustrates the phenomenon of asymmetry and compares it to symmetric transmission: the welfare transfer is represented by the shaded area. In the present thesis I analyse the transmission from the wholesale to retail prices whilst the figure shows the crude to retail price transmission.

The literature has discussed the implausibility of size asymmetry alone within the ECM-type of models, as in Geweke (2004); however it is possible to find a combination of time and size asymmetry called "combined asymmetry". The distinction between time asymmetry and the combination of time and size asymmetry is only academic; in fact the models used with aggregated data will always exhibit a combined type of asymmetry. The implication is that although the models used in the literature involve a full transmission of upstream to downstream prices, the type of APT found is shown in a faster or fuller response of downstream prices to upstream prices increases than to similar decreases.

Figure 1.2 - Asymmetric Price Transmission

Source: Wlazlowski (2008)

In other words, retailers gain from the welfare transfer generated from the faster and fuller response to input prices increases and the slower response to input prices decreases. Peltzman (2000) called this type of asymmetry positive asymmetry. In a similar fashion, negative asymmetry would occur when retail prices react more rapidly/fully to price decreases than to upstream price increases; this would suggest a welfare transfer from the petroleum retailers to the end users. However, in my empirical investigation I have not observed any significant negative asymmetry for the 12 countries studied. Henceforth, in what follows APT will only refer to positive asymmetry.

1.3 Theoretical framework

The article that first attempted to present the possible causes for the phenomenon of APT is by Borenstein et al (1997) although they did not formally test them empirically. They mentioned three explanations for asymmetries: the oligopolistic coordination theory, the asymmetric inventory adjustment costs and the consumer search theory. The oligopolistic coordination theory and the consumer search theory are the principal explanations mentioned in the APT literature. The objective of the present thesis is to link the empirical evidence to these theories and to other less-mentioned theories.

In what follows, I briefly discuss the oligopolistic coordination theory, the consumer search theory and other less known explanations such as the asymmetric inventory adjustment theory. I conclude by explaining the difference between those studies focusing on APT and the growing literature focusing on the Edgeworth price cycles phenomenon.

1.3.1 The oligopolistic coordination theory

Collusive behaviour, abuse of market power, abuse of oligopolistic position: there are numerous expressions used to point at the most popular explanation for APT. This frequently mentioned explanation of asymmetries is primarily based on allegations related to mergers at the downstream, midstream or upstream level. To illustrate this, Eckert (2011) reports that there were 100 mergers in the US petroleum industry between 2000 and 2007, with around 18% occurring at the retail level. These mergers followed the wave of mergers of 1998-2000 between major oil companies forming the Big Five or Big Six of “supermajors”[1].

[1] BP plc, Chevron Corporation, ExxonMobil Corporation, Royal Dutch Shell plc and Total SA; ConocoPhillips Company can be considered as the 6th ‘major’.

In the EU, colluding to artificially increase margins is punishable by law according to the EC treaty (Wlazlowski, 2008). Whilst a cartel-like behaviour is implausible in the EU, tacit collusion could occur between petroleum retailers at the expense of the end user.

The literature often takes for granted that imperfect competition at the refining and retailing stages allows major oil companies to abuse market power. Borenstein et al (1997) argue that due to imperfect information regarding prices charged by other firms, the old retail price offers a natural focal point following changes in input price. While increases in crude oil price lead to a fast or immediate increase in retail price as margins are swiftly squeezed, a decrease in crude price may not be passed-through as quickly as long as the firms' sales remain above a certain level.

Overall, it is often assumed but rarely proved that is due to collusion that input price increases are passed through faster that input price decreases. Although most APT papers predict a positive relationship between asymmetries and market concentration, the lack of empirical testing suggests some theoretical deficiencies. Nevertheless, there have been theoretical developments that are worth mentioning; especially when they suggest that collusion does not necessarily/only lead to positive APT.

First, Lloyd et al (2006) developed a framework to model the impact of market power on price transmission in the food sector and show that market power can lead to imperfect or partial price transmission. Although they did not essentially test for APT, their model shows that market power may cause slower or partial pass-through of prices. This is further backed by Garrod (2012) who analysed collusive price rigidity with price-matching punishments. By analysing an infinitely repeated game, the results suggest that the best collusive prices are rigid over time when the two cost levels are sufficiently close, which is typically the case of the retail petroleum markets. This study provides support for the kinked demand curve theory.

Second, Ward (1982) proposed that market power may lead to negative rather than positive APT if oligopolistic firms fear losing market share in periods of increasing input prices. In an oligopoly context, their results support the view that both positive and negative APTs are possible depending on the market structure and behaviour.

Third, Peltzman (2000) attempted to test empirically the relationship between APT and market power in different markets by utilising two proxies for market power: the number of competitor and market concentration. The results suggest conflicting impact on APT; APT increased as the number of firms fell, and decreased with increasing market concentration (measured by the Herfindahl-Hirschman Index, hereinafter HHI).

The collusion hypothesis is the most commonly found in the APT literature, whereas it was rarely tested in the context of the petroleum industry. The study that most accurately tested the link is that of Neuman & Sharpe (1992) for the banking sector. They provided evidence suggesting that market concentration explained asymmetries in the consumer bank deposit sector. In a similar spirit, Hastings (2004) showed that when independent retailers were replaced by vertically integrated petroleum firms, local prices systematically rose. Combining the evidence from these two studies, APT may well be explained by retail market concentration. The evidence from the banking industry on market concentration has not been applied to the petroleum industry whereas Hastings (2004) did not discuss the issue of asymmetric pricing.

If I take the example of the retail gasoline market, each station chooses its selling price without knowing exactly what will be the price charged by others. There might be computer-based programs or websites providing real-time information about retail prices, but some stations will still take decisions more promptly than others as a result of different margins and volumes of sales. Some stations might choose to maintain a price above the competitive level until they experience a drop in sales. If I assume imperfect information of petrol stations about others' prices, the signal expected before adjusting the price down will be the decrease in sales. Even with the assumptions of newly available real-time information on retail prices (e.g.: governmental websites in the EU); stations might consider only reducing their prices if they experience a drop in sales.

This model explains how retailers maintain prices above the competitive level, but does not explicit how they coordinate on a particular price. Indeed there are multiple possible equilibriums and the model does not predict how the choice is made. Another shortcoming of the Borenstein et al (1997) model is that when coordination breaks down due to a drop of sales in one of the stations, the retailers quickly drop their prices to the competitive level. This pattern is not compatible with most of the findings in the literature where prices decline slowly.

Finally the model would predict than in periods of high volatility, retailers would be less efficient in their coordination and as a consequence margins and asymmetries would decrease. Results in chapter 2 show that the findings of Peltzman (2000) and Radchenko (2005b) support this hypothesis. Consequently in chapter 3 I provide evidence suggesting that horizontal and vertical concentration explain asymmetries better than retail margins and the results in chapter 4 suggest that APT depend on different pricing coordination regimes in periods of booms and recessions. My findings are consistent with the collusion theory and call for further research across different industries.

1.3.2 The search costs explanations

Whilst there are variations of the search costs theory, the common feature is the assumption that APT can be generated from the demand side due to the cost of searching for the cheapest petrol stations.

The standard search theory:

The standard search theory states that consumers are more likely to believe that an increase in retail price of a station is due to an increase in cost than in a change in the relative pricing position of this particular station. As a result the expected payoff from a search is lower for imperfectly informed drivers and petrol stations benefit from an increase market power for a certain time. This market power allows the retailers to respond quicker to cost increases than to cost decreases. This model implies that asymmetries will be more important in periods of high price volatility, since the signal-extracting problem is amplified. The findings in the literature generally provide little support for this version of the search costs theory. Peltzman (2000) and Radchenko (2005b) suggested that the level of asymmetries is negatively correlated to oil price volatility.

The search theory with Bayesian updating by Benabou and Gertner (1993)

Benabou and Gertner (1993) formalise a theory of costly search with an element of learning. The drivers are in this version allowed to weigh the costs and benefits of searching. They also argue that macroeconomic shocks (inflation) can change the amount of search in a given market, and in turn increase or decrease competition among retailers. They find that search is more likely to decrease due to common cost shocks if the search costs are high in the market. This applies perfectly to the European gasoline markets where the search costs are high to the high level of taxation on refined petroleum products.

On the other hand, the fact that fuel prices are published on free websites in most EU countries has often been neglected. Are search costs really high as a consequence? Another prediction of the model is developed in Johnson (2002) regarding the comparisons between fuels. In most European countries the after tax price of diesel is sensibly cheaper than the price of unleaded gasoline; and the fuel-efficiency of diesel cars makes it much more economical to drive a diesel car, especially for long-distance drivers. Diesel drivers can be considered more cost-conscious because their initial investment on the car is higher than it would be on an equivalent petrol car. As a result if the price difference between the diesel car they purchased and the equivalent petrol cars is 2000 Euros, they generally expect to justify the price difference within the first 2 or 3 years by saving a similar amount at the pump. In other words this theory would predict that asymmetries would be higher in the gasoline markets than in the diesel markets. Johnson (2002) confirms this prediction with US data.

Another consequence of the above-mentioned mechanisms is that increased volatility in oil price would change the perceptions of the consumers. Increased volatility would increase price dispersion across stations and as a result consumer search and its value would also increase. On the other hand, an increased volatility can lead to a lower probability of search if drivers believe the high prices they face might not be station-specific but industry-wide. However, the reservation price condition can be invalidated by the very frequent changes in petroleum prices and the existence of transportation costs. The US literature generally reports very small price differentials across stations and an increased volatility of downstream prices. The empirical evidence suggests little incentive to search but Marvel and Lewis (2011) have shown the growing importance of websites providing free price comparison. These websites and smartphones applications now exist in Europe, the US and Canada and the real search costs would be the cost of the time spent opening a phone application; which is close to zero.

1.3.3 Asymmetric inventory adjustment

Another theory frequently mentioned in the literature and generally associated with the production stage is the asymmetric inventory adjustment costs model. It was developed by Reagan & Weitzman (1982) who stated that profit-maximising firms utilise their inventory in order to spread the effects of unexpected changes in demand over time.

According to this model, the cost of creating inventories is a floor below which it is unreasonable to sell in periods of adverse demand shocks. In such a setting, profit-maximising firms facing lower demand start depleting their inventories and cutting their production instead of decreasing their prices. Consequently, such a shock has a limited effect on the downstream price and is translated into a minor decrease in the retail gasoline price in the context of my thesis. Conversely, a rise in demand results in a sharp price increase as production lags and limited inventories oblige the retailers to quickly increase their prices.

The consequence is that surges in demand are mitigated through higher prices whilst diminutions in demand are met through lower production and relatively small price reductions. In other words, in the short-run prices respond more to situations of excess demand than to excess supply because firms are more able to adjust their inventories in the latter case.

Borenstein et al (1997) illustrated the theory for the gasoline market by considering the specificities of the oil industry. They argue:

"If half of all world oil reserves suddenly disappeared, the long-run competitive price of gasoline would increase greatly, and consumption would decrease greatly. Oil companies could accommodate that change quickly by raising gasoline prices. Since refinery production schedules cannot be adjusted immediately.... the results would be a short-run building up of finished gasoline inventories. In contrast, if world oil reserves doubled overnight, the short-run response in the gasoline market would be limited by available supplies of finished gasoline." (Borenstein et al, 2007: 327).

Moreover, Borenstein and Shepard (2002) remark that US refiners hold inventories of motor spirits equal to 25 days of sale to guarantee smooth refining operations. Because of transportation lags and technicalities their distribution centres hold inventories equal to several days of sales. Similarly, In the EU each member state holds inventories equal to at least 90 days of domestic consumption. Given the size of those inventories and the price of stored products, it is evident that the costs involved are consequent.

Kaufmann and Laskowski (2005) analysed the relationship between crude oil price and gasoline price and their results indicate that APT are probably generated by refinery utilisation rates and inventory behaviour. When the effects of inventories and refinery utilisation rates are removed from the model, the results indicate that gasoline prices respond asymmetrically to changes in crude oil prices. When the effects of inventories and refinery utilisation rates are included in the model, the APT disappears.

Johnson (2002) argues that most of the petrol stations in the US are supplied once a week or sometimes daily and consequently should not have substantial costs of inventory adjustments. There is a lack of evidence on EU markets but the evidence in the next section on European market structure suggests that the retail stage is unlikely to be affected by inventory adjustment costs.

Vasquez (2005) argues that given the stock rotation, inventory adjustment could be responsible for APT at the refining level but not at the retailing level. The author also predicts that refineries might create asymmetries incidentally - by postponing price decreases at times of lower crude oil prices to recover margins squeezed by the costly adjustment of production at times of increasing oil prices, or directly - by adjusting the value of their inventory. Unfortunately, direct tests of this explanation cannot be performed due to lack of storage and production data. Even though Kauffman and Laskowski (2005) attempted to test this hypothesis, they have only done so with monthly and aggregated data.

1.3.4 Other explanations for APT

Menu Costs

Some authors argued that APT might be generated by the cost of the actual pricing process. If changing retail petroleum prices involves incurring substantial costs, retailers are more likely to do so when midstream prices rise, rather than when they decline. According to Dixit's (1991) model of price determination with a fixed cost of changing prices, the history of the firm's prices and fundamentals should help forecast a price change only through the current gap between price and fundamentals.

Testing this model, Davis & Hamilton (2004) analyse the pricing decisions of nine individual gasoline wholesalers in the Philadelphia area. They first seem to find support for the menu cost model. Yet, further analysis of the data reveal that the model is not consistent with the asymmetric answer to positive and negative price gaps. In fact, when the actual price is below or above the target price by a small amount, a price increase is more likely to occur than a price decrease. In contrast, when the gap is large, reductions are more likely than increases. The probability of adjustment for positive and negative price gaps is presented in Figure 1.3 below.

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Figure 1.3 - Probability of Retail Price Changes as a Function of Disequilibrium

Source: Davis & Hamilton (2004).

Davis & Hamilton (2004) conclude that it is difficult to accept the menu-cost model as a literal description of firms' pricing behaviour. Although the size of the estimated menu costs is of a credible magnitude, the model credits to firms much more uncertainty about fundamentals than is warranted by the data, and would call for much larger price changes than firms actually make. Eckert (2002) and Noel (2007b) argued that menu costs are insignificant or even equal to zero whilst Slade (1998) points out that costs related to small price changes might actually involve costs of losing the reputation gained by keeping the prices stable.

Davis (2007) reconsiders this model focusing on four retail stations located in Newburgh, New York, USA. He analyses the probability of price changes using the same framework as Davis & Hamilton (2004) to analyse wholesale pricing, but this time for retail pricing. The results indicate that retailers are more likely to increase their prices than to reduce them for almost every price gap, which contrasts with Davis & Hamilton (2004). Furthermore, the retailers are also more likely to make large decreases than large increases. The results indicate that a menu-cost model describes the data quite well, but the author concludes that the pricing behaviour is being determined by a combination of search costs for the consumers and menu costs for the producers.

Market Perception

Pindyck (2001) first suggested that cost shocks to commodity can be permanent or temporary. Analysing the relationship between spot prices, futures prices and inventory levels for different petroleum products, he distinguishes between temporary shocks-such as a demand shock due to weather conditions- and persistent shocks such as a sustained change in price volatility. He therefore develops a model where a permanent shock will generate a new equilibrium in which price levels and inventory levels will be higher. Conversely, if the shock is deemed transitory the equilibrium for the spot prices and inventory level will remain the same.

Radchenko (2005a) further investigates the possible link between APT-that he calls 'lags in the response of gasoline prices to changes in crude oil price changes and retailers' and perception of market changes. He analyses the impact of market perception in the transmission between weekly prices of US crude oil and motor gasoline. The results indicate the presence of APT in both regimes. He finds that the majority (97%) of price changes are viewed as temporary by the market and only 3% have a long-run impact on the retail price. It is however hard to find much support for these findings in the APT literature and even elsewhere as the model is based on strong assumptions regarding the firms' perceptions of the changes and the modelling exercise considers both regimes as asymmetric by definition.

1.3.5 Edgeworth price cycles

The Edgeworth cycles phenomenon is concerned with price dynamics not driven by midstream or upstream prices. Edgeworth price cycles are purely the result of price wars over market share at the retail level. In this section, I discuss this phenomenon due to the growing number of articles including the Edgweorth cycles into the APT literature.

Although the recent wave of articles concerned with Edgeworth cycles is due to Eckert (2002), the phenomenon was first observed by Castanias and Johnson (1993) in the Los Angeles gasoline retail markets over 1968-1972. The weekly city level price data used revealed a peculiar type of APT: retail gasoline prices would increase rapidly in one week before declining slowly over the following weeks. Such an unusual pricing pattern raised a lot of interest as it was not the consequence of a causing midstream or upstream price. The authors argued that this type of price war dynamics were similar to the dynamic pricing equilibrium proposed by Edgeworth (1925) and later formalised in Maskin and Tirole (1988).

The model based on dynamic equilibrium considers 2 identical firms producing homogeneous goods and setting prices alternatively. It assumes that each firm makes its next decision on price based on other firms' prices at the time t. Maskin & Tirole (1988) showed that, in these circumstances, two types of equilibrium could occur. In the first type, the firms converge on a focal price and each firm matches the other firm's price alternatively and forever.

In the second type of equilibrium (Edgeworth), firms enter in an undercutting phase which resembles a price war until the marginal cost is eventually reached. When the marginal cost is reached, a random price setting war is initiated between the two firms; alternating between setting marginal costs and restoring price to initiate a new cycle. Figure 1.4 below illustrates the phenomenon for the city of Guelph, Ontario, Canada.

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Figure 1. 4 - Edgeworth Cycles in Guelph Ontario Mode Retail Prices: 24/10 to 24/11/2005.

Source: Eckert (2013).

However, it is worth mentioning that price cycles similar to figure 1.6 above have only been identified in a relatively small number of cities in the world. In the US, Zimmerman et al (2010) only found cycles in some Midwestern cities that began "cycling" in 2000. The seven states concerned are located in the Midwest: Illinois, Indiana, Kentucky, Michigan, Minnesota, Missouri and Ohio.

The phenomenon was chiefly identified in Canada, (Eckert, 2002, 2003; Noel 2007a, 2007b; Atkinson, 2009) and Australia (Wang, 2008, 2009a; Erutku & Hildebrand, 2010) although often associated with tacit collusion. Finally, the only European study detecting Edgeworth cycles in retail petroleum markets was conducted for Norway by Foros & Steen (2008) although it is one of several explanations. Since price cycles are usually detected with high-frequency city-level data, further investigation into EU petroleum markets is likely to be costly. A discussion of the Edgeworth phenomenon can be found in the literature review- chapter 2.

1.4 The EU Petroleum Markets

The wave of mergers in the oil industry in the late 90s raised many concerns for policy-makers given the high level of vertical concentration in the oil industry. The whole process of extracting and refining crude oil and selling its refined product to the end user is increasingly controlled by one single ‘Big Oil’ company. The increasing concentration in the oil production industry has frequently been associated with higher concentration in the gasoline wholesale and retail markets as well. Nonetheless, considering upstream (crude to wholesale) and downstream markets (wholesale to retail) as following similar trends might be erroneous. Given that the oil industry is dominated by 5 integrated “Big Oil” companies (Exxon-Mobil, Chevron, BP, Royal Dutch Schell and Total) the fact is often taken for granted.

I provide a brief overview of the crude oil market as well as the refining market and I further present the wholesale and retail petroleum markets.

1.4.1 Crude oil purchase

Although the upstream markets are outside the scope of this research, a brief presentation of the world market for crude oil is paramount to understand the position of the EU countries.

Indeed, the European Union taken as whole is highly dependent upon crude oil imports. Even though there are indigenous sources – mainly from the North Sea, Romania and northern Italy – they are insufficient to meet EU requirements. The main sources of imported crude oil include chiefly Russia, the Middle East and Northern Africa. Table 1.1 below shows the repartition of proven (a debatable concept) oil reserves in the world; one can observe that no single EU country is in the top 10 which comprises: Canada, Iraq, Iran, Kuwait, Libya, Nigeria, Russia, Saudi Arabia, the United Arab Emirates and Venezuela.

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Table 1.1 - List of the world's top 10 countries with proven oil reserves

Source: U.S. Energy Information Administration, International Energy Outlook 2013

The variety of potential sources of crude oil means refineries in diverse locations use different crude oils, which are only imperfect substitutes. Although figures differ according to sources, one can consider that there are nearly 200 varieties of crude oil traded in the world markets. In general, the European market is divided into three regions of refining and wholesale activities– North West Europe (NWE), the Mediterranean (MED) and the Central and Eastern Europe (CEE), as shown in Figure 1.5 below.

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Figure 1.5 - Oil products regions in Europe
Source: Poyry (2009)

This division is based on the consideration of transportation infrastructure, distribution markets and accessibility to different crude streams. For example, North Sea crude blends account for around 48% of the crude oil used in refineries in NWE, whereas 80% of the crude in the CEE is Urals crude (see Figure 1.6 below).

Figure 1.6 - Crude varieties and market share by source

Source: Poyry (2009)

1.4.2 Refining and wholesale markets

Refining capacity in the EU has been relatively stable over the last twenty years, and most of the activity has been centred in Western Europe. Over half of the capacity is situated in NWE where refineries are larger, enabling them to benefit from greater economies of scale. The capacity is not uniformly dispersed: refineries are often clustered around strategic infrastructure facilities such as major ports or pipelines (Figure 1.9). These clusters are at the heart of wholesale trading hubs, by far the largest of which is the Amsterdam-Rotterdam-Antwerp (ARA) market.

Figure 1.7 - Map of refinery clusters

Source: Poyry 2009

Furthermore, figure 1.8 below shows the refining capacity of the top 10 refiners in the European Union. In 2009, the top six refinery players in the EU accounted for around 50% of capacity, but the market itself is not excessively concentrated if I calculate the Herfindahl-Hirschmann Index (HHI). However, the main players differ between the regions. Whereas the International Oil Companies have a strong presence in the NWE market; they are less prominent in the MED market. In the MED region, National Oil Companies (NOCs) such as Repsol and ENI are the major players. The CEE region is also dominated by the NOCs.

The wholesale petroleum market is the non-physical market- generally centred on the refining hubs- that facilitates the contracts between refiners and retailers. The main feature of the European wholesale market is that the main reference price is the ARA (Amsterdam-Rotterdam-Antwerp) for most of Europe and there are region-specific reference price such as the MED (Mediterranean countries) and the NWE (North West Europe).

Figure 1.8 - Refining capacities of the top 10 refiners in the EU

Source: Poyry (2009)

1.4.3 Retail markets

This subsection presents some general information on the twelve countries analysed in chapter 3; further details can be found in section 3.1.

Whilst some APT often refer to the global oligopolistic position of the “majors” in the oil industry, the major oil companies have seen their market shares decreasing (or stabilising) in most countries in the last two decades. The trend is very pronounced in countries where hypermarkets play an important role in the petroleum retailing business. For instance, in the UK the volume share of oil companies (supplying the gasoline and the brand sign to the station) has shrunk from 47.5% in 2000 to 28.3% in 2011. (Experian Catalist reports, 2011)[2]. The pattern is different in Germany: the volume share of supplying oil companies in 2011 represents 35.6% (it was 66% in 2003) of the market, against 59.8% for the independent dealers (29.1% in 2003). This pattern is also observed in France where hypermarkets deliver the largest volume (61%) of

[2] All the market share figures in this chapter are taken from Experian Catalist reports, unless stated otherwise.

gasoline and diesel despite the leadership of the oil companies such as Total in number of stations (47% against 41%, UFIP)[3].

In contrast, the Dutch market presents a very different structure and has experienced an opposite trend. The volume share of oil companies in the retail market has increased from 47.1% in 2002 (32.6% of stations) to 57.4% in 2011 (47.8% of station). As the hypermarkets have insignificant market shares in the Netherlands, the major oil companies led by Shell have been able to improve their position. As far as Spain is concerned, the restructuration is not as pronounced as in the other markets; the supplying companies have lost some volume share (from 32.6% in 2003 to 30.7% in 2011) and sites share (from 29.3% to 24.8% in 2003-2011) to the benefit of hypermarkets. Finally the Italian retail market shows an overwhelming domination of NOCs, although there has been a decrease in their volume share from 83.2% in 2003 to 70.3% in the end of 2010[4].

Overall, major and international oil companies hold approximately 50% of Europe's service stations network according to recent reports (CBRE, 2013). Their share has fallen by 5% since 2009. National and independent networks are expanding their coverage at a faster pace and have grown by approximately 10% within the same period. Figure 1.9 below illustrates that 3 supermajors -Shell, Total and Esso- are the leading companies in Europe. Two NOCs, Eni (Italy) and Repsol (Spain) are also in the top 10 due to their dominance in their national markets. Nevertheless, IOCs such as Q8 and Lukoil possess almost as many petrol stations as Repsol, although their strategy is to hold a limited market share (usually less than 10%) in every EU country.

[3] www.ufip.fr: website of the French Union of Petroleum Industry.
[4] The distinction in the Experian Catalist reports is between 3 actors in the petrol retailing market: a) the supplying oil companies which are generally vertically integrated oil companies b) the independent dealers or petrol stations that are possibly branded by a Big Oil Company but never belongs to the supply chain and c) the hypermarkets chains or supermarkets which are major players in France and the UK (dominated by Carrefour, Leclerc and Intermarche in France; Tesco, Asda, Sainsbury, Morrisons in the UK). For the purpose of this thesis I distinguish three sub-categories of supplying oil companies: majors, international (IOCs) and national companies (NOCs)

Figure 1.9 - Number of sites of the top 10 petroleum retail firms in Europe, 2013

Source: CBRE (2013)

Figure 1.10 below shows that majors still dominate the EU petroleum markets and that the IOCs, NOCs and independent retailers (others) follow with similar market shares. Supermarkets (and hypermarkets) still play a relatively marginal role at the European level in spite of their dramatic growth in France and the UK. The reason is that they focus on a high-efficiency, high-volume and low-cost strategy while holding few sites compared to the major actors in the market. Indeed the data reveal that most of the increase in market share is due to the closure of many majors, IOCs and NOCs petrol stations. On the other hand, supermarkets' now sell the highest volume of fuel in France despite the dominance of Total in terms of number of sites.

Figure 1.10 - Market share by retailer type

Source: CBRE (2013)

Table 1.2 below shows the market concentration statistics for each of the countries analysed.

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Table 1.2 - HHI, Cumulative Market Share (MSTOP3) and top 3 firms

Source: CBRE (2013).

Notes: 1.HHI stands for the Herfindahl-Hirschmann index

2.MSTOP3: cumulative market share of the top 3 firms

Figure 1.11 below exhibits the important differences across Europe in terms of the market shares of majors, IOCs, NOCs, supermarkets and 'others' (independent retailers).

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Figure 1.11 - Retail Market Shares by category of firm

Source (CBRE 2013)

1.5 Motivation and research objectives

Whilst the issue of asymmetric price transmission has raised a lot of interest in the last 25 years with over 75 articles investigating the issue, I observe that more than 80% of the articles are based on the petroleum industry, mostly for the following reasons:

-The cost of fuel for the average European driver; driven mainly by high taxation but also increasing oil prices in the long-run and reduced income due to the recent periods of recession.

-The relationship between petroleum prices and the overall inflation. For example, the key role of diesel prices for the transport and travel industry is vividly demonstrated by the impact of diesel prices on groceries and supermarkets' prices.

-The increased scrutiny over the petroleum industry following the wave of mergers in the late 90's of the last century. There is an assumption that such mergers could generate oligopolistic behaviours; there is also a need to analyse the real impact of such mergers on the petroleum retailing industry.

Consequently, there are a number of gaps identified in the literature which are the basis for establishing key research objectives:

- **Aggregation over time.** The most recent papers have increasingly used disaggregated data although they focused mainly on North American petroleum markets. The next chapter will justify the necessity to use weekly and daily data for APT studies, as the results based on monthly data are less appropriate with recent data. For this reason, I use only weekly and daily data in the present thesis; the comparison between the weekly and daily models at the UK level provides some important insights.

- **Aggregation over space**. The early studies have used national averages of retail prices; the most recent have increasingly looked into the microeconomic level. Whilst complaints are often based on local observations made by drivers at the local level, most studies uncovering APT used nationally aggregated data. As a consequence this thesis analyses APT at the EU and the UK levels to conclude on the relationship between asymmetries and market structure; and the local level (Birmingham) to understand the pricing mechanisms involved in the petroleum retail markets.

- **Aggregation over the distribution chain**. Whilst this has been an issue with the early papers, most recent papers have studied the downstream relationship between spot prices and retail prices. It is also the focus of the present thesis as the existing evidence confirms that APT is a phenomenon that takes place within the downstream segment of the distribution chain.

- **Two-way causality**. There is a unanimous assumption in the literature that the relationship between spot and retail prices is structural, Geweke (2004) found little questioning of the possibility of feedback from retail to spot prices. This possibility exists when I analyse the transmission of Rotterdam spot prices to the national average prices of the major EU countries. Our preliminary results confirmed the endogeneity of mid-stream spot prices (ARA) and as a consequence the importance of using VAR/VEC type of models. This is explained in detail in Geweke (2004) who suggests that downstream markets might be small and local but they are not independent.

- **Region of study**. Whilst the first paper focusing on "rockets and feathers" is Bacon's (1991) investigation of the UK petroleum markets, most subsequent studies have focused primarily on North American markets. EU studies using weekly or daily data are underrepresented in this strand of the literature. There is also a lack of cross-country comparisons except from Galeotti et al (2003) who used monthly data for France, Germany Italy, Spain and the UK.

In line with the above, the aim of the present thesis is three-fold. First, to outline the relationship between market concentration and asymmetry using European weekly data. Second, to consider the effects of different pricing regimes during booms and recessions on APT using UK prices. Finally, to understand the pricing mechanisms and competition at a more local level with the available Birmingham (UK) data.

1.5.1 APT and market structure

The first empirical study aims at testing empirically the collusion theory with a cross-country comparison between the main 6 countries (further, 12 countries) in the EU. I argue that market concentration as measured by the Herfindahl-Hirschmann Index (HHI) is related to the degree of APT. If countries with higher concentration in retail petroleum markets exhibit higher asymmetries, this would support the collusion theory. On the other hand, the comparison between diesel and gasoline price transmission could reveal different price-setting strategies by fuel retailers depending on their customers' price elasticities. Particularly, Johnson (2002) argued that the higher degree of APT in the gasoline market than in the diesel market could be caused by the higher search costs faced by American gasoline users. Similar results would thus provide support to the search costs theory.

Further, I extend the analysis to 12 EU countries and include additional explanatory variables to analyse the determinants of APT. Vertical concentration is measured by the volume sold in retail stations by companies operating in the refining business. Margins as measured by the difference between retail and wholesale prices are considered as a proxy for the market power of the vertically-integrated firms.

1.5.2 APT, data frequency and structural break: evidence from the UK

This study aims at uncovering the determinants of APT. It shall also outline the importance of data disaggregation in the APT literature. It finally enables us to test whether volatility has a decreasing effect on the level of asymmetry as stated in the literature. Structural break tests enable us to differentiate pricing regimes. I identify two types of pricing regimes: long periods of rising prices and period of declining prices and economic recession. The overall trend is that petroleum prices are increasing and the recessive periods correspond to the dot-com bubble burst of 2000 (from January 2000 until March 2001) and the consequences of the financial crisis of 2008 (May 2008 to January 2009). I investigate the findings of Peltzman (2000) and Radchenko (2005b) on the negative relationship between volatility and the degree of asymmetry and I observe that periods of recession might be associated with higher volatility although not always. I discuss whether the presence or not of APT depends more on price volatility or on the long-run oil price trend. To conclude, I link the findings to economic theory and provide support to the collusion theory.

1.5.3 Sticky prices at the Birmingham (UK) level

This investigation slightly departs from the APT literature as the main characteristic we observe in local daily data is the fact that prices are in fact sticky downwards as well as upwards. Due to non-availability of data, we only focus on the year 2008. Although we find no evidence of significant APT, it seems that firms with market power react more slowly than competitive retailers. This is consistent with the collusion theory as well as the menu costs theory in its broader definition.

2. Literature review

What is asymmetric price transmission (APT)? The literature is unanimous: when petroleum prices respond to cost increases faster than they do to decreases, there is asymmetry. APT has been the subject of considerable attention in the last three decades, especially in the petroleum industry. The start of the APT literature in petroleum markets dates back to Bacon (1991) who introduced the concept of "rockets and feathers" in gasoline markets. From the consumers' point of view, they often observe that the retailers respond much quicker to a crude oil price increase than to a similar decrease.

The press often linked this with the collusion theory and the early literature only mentioned this explanation as the most plausible without formal testing. Economists are particularly interested in the rockets and feathers literature as it may have revealed some key gaps in economic theory. From the policy-maker viewpoint, the lack of theoretical framework explaining APT also calls for further investigation. Indeed Peltzman (2000) showed that in the great majority of the 282 products' prices he investigated, APT was predominant. It seems that the petroleum markets have been more scrutinized than other markets due to the economic weight of the industry and the recent wave of mergers.

The present review of the literature confirms the presence of significant APT in numerous countries. Excluding those studies that provided mixed results, APT was detected in Canada, Chile, France, Germany, Italy, the Netherlands, Norway, the Philippines, Spain, Sweden, the United Kingdom and the United States. Whilst I note that the early studies using monthly data found evidence of asymmetry, when the data are more recent the results are rather mixed. I argue that as oil price volatility increased from 2000 onwards, studies covering the last 15 years shall use weekly data as the lowest frequency.

I further argue that it is unlikely that APT can be uncovered with recent monthly data; as the frequency should at least approach that of cost movements. For instance, Birmingham et al (2011) use a TAR-ECM and monthly data from 1994 to 2009 for the UK and Ireland and rejected the presence of APT. Similarly; Perdiguero (2010) used a VAR methodology with monthly Spanish data from 1998 to 2008 and found no evidence of APT.

I further discuss similar issues linked to data aggregation such as aggregation over the supply chain. I note the important number of papers (15) investigating the pass-through of crude oil prices onto retail prices through one unique structural equation. Whilst some studies investigated different tiers such as Galeotti et al (2003), other have shown how important it is to disaggregate the data along the supply chain. Meyler (2009) confirmed this fact empirically with recent European data; providing support to the critical review of Geweke (2004).

Moving to theoretical considerations, I argue that the mounting debate in the APT literature is due to the gap in economic theory it represents. Most early papers on APT were purely empirical with no link at all with theory. However, the tacit collusion explanation was often mentioned as the most plausible based on market conditions. More recent papers have departed from this theoretical assumption of tacit collusion and have actually tested alternative theories in order to explain the presence of asymmetries. So far there are few published papers supporting the search theory (4) and the collusion theory (5), whilst there are 12 published studies on the Edgeworth price cycles phenomenon. This shows how complicated it is to test the alternatives explanations for APT whereas detecting the presence of Edgeworth cycles requires to obtain some panel data. Interestingly, the Edgeworth cycles is a localized phenomenon only detected in a certain number of cities in the Midwestern USA (Lewis and Noel, 2011) and Canada (8 studies) mainly; and more recently in Australia (Wang 2008, 2009) and Norway (Foros and Steen, 2013).

2.1 Previous reviews

Although there have been four published reviews of the issue of APT, three reviews encompass various topics whereas only Perdiguero (2013) is specifically focusing on APT in petroleum markets. The first review of the issue of APT was conducted by Meyer and Cramon-Traubadel (2004), who were motivated by the “considerable attention in agricultural economics” (page

581). They note that whilst Peltzman (2000) found evidence of asymmetry in two-thirds of all the cases he investigated, the evidence of asymmetry in their review does not exceed 50%. They interestingly conclude: "the existing literature is far from being unified or conclusive, and that it has often been largely method-driven, with little attention devoted to theoretical underpinnings and the plausible interpretation of results" (Meyer and Cramon-Traubadel, 2004: 581). They particularly note the lack of link between market power and APT, an observation that is still valid today: "to date only a few attempts have been made to test the link between market power and APT empirically"… "Generally, attempts to test the link between APT and market power must deal with two major difficulties. First, most empirical studies of APT deal with only one product/market using times series data. Unless important changes in market power are known to have occurred within the study period, this sort of analysis provides no basis for comparing price transmission under conditions of more of less market power because there is no variation in the treatment variable" (Meyer and Cramon-Traubadel, 2004: 588).

They further argue that using a broad cross-section of different products similar to Peltzman (2000) would allow drawing conclusions on the link between market power and APT. Although this requires studying more than one industry one can transpose Peltzman's methodology into one unique industry but across various countries. Finally, they report the difficulty to find an appropriate proxy for market power: Peltzman (2000) used two proxies that gave him contradictory results. Whilst a higher number of competitors increased the level of APT, a higher market concentration as measured by the HHI decreased the level of APT. They conclude their review by observing that the issue of APT first emerged in the agriculture industry and that other researchers could benefit greatly from looking into this important work.

Frey and Manera (2007) analysed the econometric models of APT in general, taking a meta-analysis approach. Although the excellent discussion of the different models used in the literature is highly valuable, I hereby focus on the main results of the meta-analysis. Out of the 70 reviewed studies (34 on the US) published between 1991 and 2005, 34 focused on the petroleum industry, 18 on the agricultural industry, 16 on the alimentary industry and 2 on other industries. Out of the 70 papers considered in the survey, which provided 87 different models, only 11 models exhibited no evidence of APT at all. They also note that 72.9% of the studies conducted no causality tests between input and output prices. This and data aggregation over tiers probably explain the lack of studies (3 only) using a VECM instead of the ECM in its different forms (39). Interestingly, this review contradicts Bachmeier and Griffin (2003) and Bettendorf et al (2003) as far as data aggregation is concerned. For instance the percentage of rejection of asymmetric pricing is the same (12%) with weekly (33 papers) and monthly data (42 papers). Indeed monthly data may well be still appropriate for markets known to be less volatile than petroleum markets.

Eckert (2013) reviewed gasoline retailing whilst considering the relationship between market structure and pricing in general. Hence, the issue of asymmetric pass-through only represents one section and the Edgeworth cycles literature is discussed in greater depth. Eckert's choice to discuss different aspects of gasoline pricing rather than only APT may be explained by the fact that he instigated the recent large Edgeworth cycles (EC) literature with the two earliest papers on the topic (Eckert, 2002 and 2003). It is worth noting that APT has only been identified by Sen (2003) in the petroleum markets, who linked the presence of asymmetric pricing to market power. On the other hand, 8 out of the 12 papers uncovering EC utilised Canadian data. Eckert (2013) reviewed all articles published since 1980 and outlines more particularly the recent developments in the literature:

"Due likely in part to this regulatory and antitrust attention, a large empirical literature studying gasoline retailing has developed. Since 2000 alone, over 75 empirical studies of gasoline retailing have been published in English language academic journals, with many more studies existing in working paper form or as reports issued by governments or other agencies or institutes" (Eckert, 2013, p1).

Also he outlines the importance of providing an up-to-date survey:

"Much of the literature is very recent, with 79 of the 102 studies collected being published in the 2000s" (Eckert, 2013, p4).

In turn his study includes 102 papers of which 26 focus on asymmetric pass-through and 15 on EC. The distinction made in this survey between APT studies and EC studies is justified, considering that Edgeworth cycles can exist independently from any upstream change; whilst APT can only be detected through modelling the transmission of upstream prices to gasoline prices. In addition Edgeworth cycles are generally found with station level data (in general daily) whilst asymmetries can be found with averaged or aggregated data and lower frequency data (mainly weekly).

Nonetheless, he confirms the evident fact that crude oil prices play a larger role in the determination of the fuel retail price levels than market concentration. He goes further than Meyer and Cramon-Traubadel (2004) by stating that the precise characteristics of the retailers in a market may be more important than mere measures of concentration.

Moreover, he notes that although space does matter although the impact of local market power seems rather small. On the other hand, the impact of mergers on retail gasoline prices remains unclear and seems to depend on the data used. In general, some further theoretical developments are to be expected to better understand APT and EC. Finally he concludes that a better understanding of the retailers' pricing strategy would require estimating demand equations for a large number of individual stations at least at a daily frequency.

Perdiguero (2013) also used a meta-analysis to discuss the great heterogeneity of results in the literature focusing on APT in the petroleum industry. The focus of this meta-analysis differs from that of Frey and Manera (2007) and it provides some interesting insights. First, the results show that APT is more likely to be observed at the downstream stage of the oil industry; in other words in the transmission of spot/wholesale prices onto retail prices. Second, it shows the importance of using daily data rather than weekly or monthly data to capture the increasing volatility of petroleum prices. Third, the model type (regime-switching models or VECM/VAR) does not appear to be the cause of the heterogeneity in the results. Fourth, he finds that the papers using the most recent data are more likely to accept the hypothesis of symmetric price transmission. He argues that this might be the consequence of increased competition at the retail level. Fifth, he presents evidence suggesting that papers which analyse a specific area are more likely to find evidence of APT. Sixth, the longer the sample, the less likely is the uncovering of the APT phenomenon.

This suggests that APT might be period-dependent. Finally, he concludes that APT might be related to the level of competition in the market. He states that the retailing market is the least competitive (as compared to upstream markets) although there is no data provided to back this statement.

The 4 reviews provide various and highly valuable insights in terms of both empirical facts and theoretical implications. Frey and Manera (2007) and Perdiguero (2013) both conducted meta-analyses: whilst the former showed the predominance of APT across industries, the latter revealed that increased competition in the petroleum industry seems to have reduced the occurrence of APT. On the other hand Meyer and Cramon-Traubadel (2004) and Eckert (2013) both suggest that to better understand APT, it is necessary to focus on the link between the empirical findings and the collusion theory. The former advocates the use of cross-section studies between different countries and the latter the estimation of retailers' demand equation with high-frequency panel data.

2.2 Empirical review

This section provides a chronological overview of the empirical contributions to the APT literature. The literature focusing on asymmetries in petroleum markets is strongly related to the characteristics of the time series studied. In fact over a long time period, retail gasoline prices seem to perfectly follow the pattern of crude oil prices or spot prices. The characteristics of petroleum price data involve that the error-correction model (ECM) is chosen in most empirical papers. Asymmetries represent short-lived departures from the long term relationship between input prices and retail prices.

Apart from the recent ones using panel data, all the "rockets and feathers" papers assume a long-run stable relationship between the retail price and the input price which can be any price taken from the petroleum production chain: crude, rack, terminal or wholesale. Given that obtaining the actual wholesale prices is far from being an easy task, most studies used 'reference' input prices such as the terminal or rack prices for the US studies or the Rotterdam

(ARA) spot prices for European studies. The trend in the literature is to disaggregate the data as much as possible in order to identify in which tier asymmetries are found along the supply chain. The standard procedure is to test whether the series used are unit roots and in this case the cointegration test is performed. The data always confirms this and the long-run relationship is then written:

$$R_t = \gamma_0 + \gamma_1 W_t + e_t \tag{2.1}$$

R is the Retail price (the unleaded gasoline price is studied in most papers) and W represents the Wholesale price. The constant γ_0 represents the fixed costs implied in the gasoline retailing industry such as marketing and labour costs. The coefficient on the wholesale price γ_1 represents a proxy for the relation between the elasticity of demand and the price at the retail level and e_t is the error term.

The mainstream literature uses the standard Engle and Granger (1987) procedure to compute the constant and the coefficient γ_1. Equation (2.2) below represents the ECM without autoregressive terms.

$$\Delta R_t = \alpha + \lambda^+ (R_{t-1} - \gamma_0 - \gamma_1 W_{t-1})^+ + \lambda^- (R_{t-1} - \gamma_0 - \gamma_1 W_{t-1})^- + \Sigma \beta_i^+ (\Delta W_t)^+ + \Sigma \beta_i^- (\Delta W_t)^- + \varepsilon_t \tag{2.2}$$

$R_{t-1} - \gamma_0 - \gamma_1 W_{t-1}$ is the error-correction term; it is split into positive and negative deviations from the long-run equilibrium. The lambdas represent the speed of adjustments coefficients; in other words the speed of return to the long-run equilibrium. In many papers the restriction $\lambda^+ = \lambda^-$ is imposed; for example in Borenstein et al (1997).

Sometimes autoregressive terms are included, as for example in Johnson (2002):

$$\Delta R_t = \alpha + \lambda^+ (R_{t-1} - \gamma_0 - \gamma_1 W_{t-1})^+ + \lambda^- (R_{t-1} - \gamma_0 - \gamma_1 W_{t-1})^- + \Sigma \beta_i^+ (\Delta W_t)^+ + \Sigma \beta_i^- (\Delta W_t)^- + \Sigma \theta_i^+ (\Delta R_{t-i})^+ + \Sigma \theta_i^- (\Delta R_{t-i})^- + \varepsilon_t \tag{2.3}$$

Table 2.1 below shows the empirical studies looking at asymmetries in pricing in gasoline markets.

Author (s)	Data	Country	Panel	Model	Prices	Product	Coverage	Results
Bacon (1991)	2W	UK	N	PAM	W, R	P	1982-89	Y
Manning (1991)	M	UK	N	ECM	C, R	P	1973-88	Y
Kirchgassner & Kubler (1992)	M	DE	N	ECM	W, R	P, HO	1972-89	M
Shin (1994)	M	US	N	PAM/ARDL	W, R	P	1986-2	N
Duffy-Deno (1996)	W	US	Salt Lake City	ARDL	W, R	P	1989-93	Y
Borenstein et al (1997)	2W	US	N	ECM	C, S, W, R	P	1982-91	Y
Reilly & Witt (1998)	M	UK	N	ECM	C, R.	P	1982-95	Y
Eltony (1998)	M	UK, US	N	ECM	C, R.	P	1980-96	Y
Asplund et al (2000)	D	SE	One firm	ECM	C, R	P	1980-96	Y
Godby et al. (2000)	W	CA	N	TAR-ECM	C, R	P	1990-96	N
Peltzman (2000)	M	US	N	ECM	C, R	P	1978-96	Y
Indejehagopian & Simon (2000)	M	FR, DE	N	VECM	W, R	HO	1987-97	M
Borenstein & Shepard (2002)	W	US	N	PAM/VAR	C, R	P	1986-82	Y
Salas (2002)	W	PH	N	PAM/VECM	C, R	P	1999-02	Y
Bachmeier & Griffin (2003)	D, W	US	N	ECM	C, S, W, R	P	1985-98	M
Galeotti et al (2003)	M	EU5	N	ECM	C, W, R	P	1985-00	Y
Driffield et al (2003)	M	UK	N	ECM	C, R	P	1973-00	Y
Bettendorf et al (2003)	W	NL	N	ECM	W, R,	P	1996-01	Y
Wlazlowski (2003)	M	UK	N	ECM	C, R	P	1978-02	Y

Table 2.1 - Purely empirical APT studies

Author (s)	Data	Country	Panel	Model	Prices	Product	Coverage	Results
Chen et al (2005)	W	US	N	TAR-ECM	C, W, R	P	1991-03	Y
Ye et al (2005)	W	US	N	ECM	W, R	P	2000-03	Y
Al Gudhea et al (2007)	D	US	N	MTAR-ECM	C, W, R	P	1998-04	Y
Grasso & Manera	M	EU5	N	ECM, TAR…	C, W, R	P	1985-03	Y
Rao & Rao (2008)	M	US	N	ECM	C, R	P	1978-04	N
Bettendorf et al (2009)	D	NL	N	ECM	W, R	P	1996-04	Y
Honavar (2009)	M	US	N	ECM	C, R	P	1981-07	Y
Meyler (2009)	W	EU13	N	ECM	C, W, R	P, D, HO	1994-08	M
Wlazlowski et al (2009)	W	EU25	N	VECM	C, R	P, D, HO…	1994-05	M
Douglas (2010)	W	US	N	TAR/ECM	W, R	P	1990-08	M
Liu et al (2010)	W	NZ	N	ECM/VECM	C, R	P, D	2004-09	M
Bermingham et al (2011)	M	IR, UK	N	TAR-ECM	W, R	P, D	1994-09	N
Wlazlowski et al (2012a)	W	US	N	SETAR-ECM	W, R	P	2000-05	N
Wlazlowski et al (2012b)	D	EU	N	ESTAR-ECM	C, W	P	1994-06	Y

Table 2.1 - Purely empirical APT studies (continued)

Notes for table 2.1: [1] Data frequency - D: daily, W: weekly, 2W: bi-weekly, M: monthly. [2] Country - DE: Germany, FR: France, CA: Canada, IR: Ireland, NL: the Netherlands PH: Philippines, SE: Sweden, NZ: New Zealand. [3]Model - PAM: partial adjustment model, ARDL: Autoregressive distributed lag model, ECM: error-correction model, SETAR: self-exciting TAR model, STAR: smooth transition AR model, TAR: threshold autoregressive model, VECM: vector ECM, VAR: vector autoregressive model. [4]Prices - C: crude oil, S: spot, W: wholesale, R: retail. [5]Product – P: petrol/gasoline in its leaded or unleaded forms, D: diesel, HO: heating oil/gasoil. [6]Results - Y: Significant asymmetries detected, N: no significant asymmetries detected, M: mixed results.

Although I selected 33 published journal articles, there are numerous government reports and working papers available online. In general government reports cover large areas and use different methodologies and the results are often mixed. I avoid examining working papers for consistency of results. As there have already been recent reviews of these empirical papers, I only provide further insights towards a better understanding of the APT phenomenon.

Tables 2.2, 2.3, 2.4 and 2.5 present some features of the empirical studies. These features are only useful when compared to those of the theoretical papers presented in the next section. I briefly note that most empirical papers used monthly or weekly national data and that only Duffy-Deno (1996) used local panel data. The other exception is the study by Asplund et al. (2000) which focuses only on retail data for one petroleum retailing firm.

I also note that 14 out of 33 papers analysed the pass-through of crude oil prices onto retail prices directly. The problems associated with such a methodology are explained by Geweke (2004), Wlazlowski (2008) and Meyler (2009) and need not to be confirmed by further evidence. Perdiguero (2013) also confirms that APT is more likely to be observed at the retail level. Wlazlowski et al. (2012b) stand out as the unique empirical paper focusing solely on the upstream stage of the petroleum industry. Finally, most empirical papers have focused either on the US (15) or the UK (7) and 5 papers perform a cross-country comparison using European data. For instance, Wlazlowski et al. (2009) include 25 countries EU in the analysis, although with different samples.

Frequency	Number
Monthly	13
Weekly	12
Daily	5
Bi-weekly	2
Total	34

Table 2.2 - Empirical papers - Data frequency

Country	Number
US	15
UK	7
EU	5
DE	2
NL	2
CA	1
FR	1
IR	1
NZ	1
PH	1
SE	1
Total	37

Table 2.3 - Empirical papers - Country covered

Tiers	Number
C, R	14
W, R	11
C, W, R	5
C, S, W, R	2
C, W	1
Total	33

Table 2.4 - Empirical papers - Tiers covered

Spatial aggregation	Number
National	26
EU	5
Regional	1
Firm level	1
Total	33

Table 2.5 - Empirical papers - Type of data used

The empirical papers on APT in petroleum markets can be classified into two phases: the pioneers published between 1991 and 1999 and the proliferation phase between 2000 and 2012.

2.2.1 The pioneers of the APT in petroleum markets literature: 1991-1999

Only 8 articles have been published during these 9 years; these can be viewed as the pioneering APT investigations. Unsurprisingly, they concentrate only on the question of the presence of asymmetries or not. Bacon (1991) first used bi-weekly data for the UK for 1982-89 and a partial adjustment model (PAM) with a quadratic term to incorporate asymmetry. He found some evidence of APT from wholesale prices onto retail prices; the degree of asymmetry seems marginal and likely driven by the large drop in upstream prices in 1986 and the spike of 1989. I note how with the sample period used, increases were passed-through within two months, whilst one more week was required for decreases. With such a marginal and short-lived asymmetry, he confirmed governmental reports that UK gasoline markets were highly competitive. The methodology raises some questions whilst the main contributions are the use of the dollar/pound exchange rate and the ARA (Amsterdam-Rotterdam-Antwerp) spot price.

Manning (1991) focused on a longer timespan with UK monthly data for 1973-88 and a classical ECM instead of the PAM. Analysing the transmission of crude oil prices onto UK retail prices, he also found evidence of APT although he describes them as weak and non-persistent. The issue lies in the elasticity of retail prices with respect to crude oil prices that does not exceed 30 percent, a very partial pass-through. Given the high level of data aggregation and the elimination of coefficients in the modelling exercise, Geweke (2004) argued that there are good reasons not to trust the results. Indeed the time needed for the full pass-through of input prices is 2 years, which seems highly implausible.

Kirchgassner and Kubler (1992) also looked at West Germany using monthly data from 1972 to 1989. They analysed the response to the Spot Rotterdam price of both consumer and producer leaded gasoline prices. They fitted both symmetric and asymmetric ECMs, distinguishing between two periods chosen due to an assumed structural break: the sudden increase in liquidity in January 1980. For the 70s, they found considerable evidence of APT whilst for the 80s they did not find evidence of asymmetric adjustment of prices. They point at a possible higher monopolisation of the market before the structural break. This study calls for more investigation on the relationship between petroleum retail market concentration and the presence or not of asymmetries.

Shin (1994) used monthly US data from 1986 to 1992 to investigate the transmission of crude oil prices onto wholesale prices and of wholesale prices onto retail prices. He utilised two different models: the PAM used by Bacon and also an autoregressive distributed lags model (ARDL); both methodologies rejected the hypothesis of APT. In fact he found that if asymmetries exist at the upstream level, it is negative asymmetry as wholesale prices seem to fall faster than they rise.

In the first APT study to focus on a particular city, Duffy-Deno (1996) found evidence of asymmetries in Salt Lake City with weekly data from 1989 to 1993. Using an ARDL, he provides evidence that retail prices adjust more fully to cost increases than to cost decreases. He argues that although asymmetry is predominant, during market shocks the evidence points in the direction of symmetric pass-through.

Borenstein et al (1997) first used weekly prices at 4 different stages of the US petroleum supply chain: crude, wholesale, terminal and retail for 1986-1992; this paper is often considered as a seminal paper. The other notable improvement is the performing of endogeneity and causality tests. They find evidence of APT from crude to sport and from wholesale to retail. On the other hand, they do not find evidence of APT from spot to wholesale prices. They also provide alternative explanations without formal testing. They argue that upstream APT may be due to inventory adjustment asymmetric effects whilst APT downstream may indicate short-run market power among retailers.

Eltony (1998) also used and ECM and monthly data for 1980-96 to examine the transmission of crude oil prices onto UK and US retail prices. The empirical results strongly support the APT hypothesis in both the UK and the USA. As far as the UK is concerned there is also evidence that there is also APT of exchange rate changes.

Reilly and Witt (1998) used crude and retail UK monthly data over the time period 1982-95 with an ECM. Their empirical evidence showed strong evidence supporting the presence of APT in the UK retail markets; as they concluded that most of the increase in crude oil prices appears to be passed through within a given month with cost reductions taking somewhat longer to feed through to pump prices. The evidence on the exchange rate is less clear-cut. In the short-run, devaluations in the three month moving average of the dollar sterling exchange rate are passed on as cost decreases with an effect that is comparable to the long-run effect. In contrast to Bacon (1991), the authors did not find evidence suggesting that change in crude prices and the exchange rates are fully passed on into retail prices in the long-run.

2.2.2 The proliferation phase: 2000-2012

Twenty-five purely empirical papers were published on the topic during those thirteen years at a rate of nearly two per year; this fact shows how the papers published in the 90s have created a literature specific to the petroleum markets. The objective reasons for such a rising interest may also be the wave of mergers in the oil industry from 1998 to 2001 as well as the increasing volatility observed from 2000 onwards.

Asplund et al. (2000) use daily data and an ECM for 1980-1996 to investigate pricing dynamics in the Swedish gasoline market. They introduce firm-level data into the APT literature and provide further insights on the role of exchange rates in APT. They find support for the hypothesis that the retail price is stickier downwards than upwards in response to the cost shocks. They also find that the retail price responds more quickly to changes in the exchange rate than to spot price movements. They explained the difference in responses by the greater volatility of the spot price. According to their conclusions, firms may wait to see whether the spot price reverts, but react faster to the less volatile exchange rate.

Godby et al. (2000) studied the Canadian market for both premium and regular gasoline, using weekly data from 1990 through 1996 for 13 Canadian cities. They used the TAR model within an ECM framework and did not find evidence of APT for several reasons. First, they pointed out that there are twice as many service stations per capita as in the US. Secondly, they underline the problem of data availability associated with several previous studies. They conclude that previous studies using biweekly or monthly date cannot be trusted.

Indjehagopian et al (2000) used monthly French and German data for heating oil prices for the period 1987-97 with a vector error-correction model and do not find evidence of APT. The main features are the use of the DM/US$ and FF/US$ exchange rates and rigorous structural break tests and weak exogeneity tests. The pass-through of spot Rotterdam heating oil prices onto retail heating oil prices appears to be symmetric; although monthly data may be too aggregated to possibly uncover APT.

Peltzman (2000) conducted an ambitious study using large samples of diverse products, 77 consumer goods and 165 producer goods. He found that asymmetric pricing occurs in two out of three cases. This study attempts at linking APT to measures of market concentration and is further reviewed in chapter 3.

Salas (2002) focused on the Philippines retail gasoline market for the period January 1999 to February 2002. The data used was daily for unleaded gasoline although the author computed weekly average to minimise the noise associated with daily changes. He used three different models; the ordered Probit regression was used to determine the appropriate lag length. He found that the decision to adjust retail prices depends on 8 weeks of previous changes in crude cost. He then used a partial adjustment model to measure the adjustment rate of retail prices to its long run equilibrium relation with crude price. He finally used an ECM to capture the effects to current retail price adjustment of current and lagged changes in crude cost and previous price movements. The results support the APT hypothesis.

Bachmeier and Griffin (2003) commented on Borenstein et al. (1997) by using daily data instead of weekly data. They argued that the results in Borenstein et al. (1997) are biased by the aggregation of the data and the use of a non-standard methodology. They conclude that there is no evidence of asymmetries in the period 1985-1998 with daily data and state that the (ECM) model's OLS estimation is superior to that of Boresnstein et al. (1997)

Galeotti et al. (2003) review the issue of APT of crude and spot prices onto retail gasoline prices. They investigate 5 key European countries: Germany, France, the UK, Italy and Spain with monthly data from 1985 through 2000. They used an ECM repeated for two stages; the first stage is concerned with the transformation of crude oil into the refined product, the second deals with the distribution of the leaded gasoline to retailers. They are the first authors to use the bootstrap procedure to overcome the low-power of the ECM. The results seem to confirm the common perception that price increases are larger than reductions, nearly for all countries and for both stages. However, the results should be treated with caution due to econometric deficiencies; as it is often the case with monthly data. Some coefficients on long-run ECM terms are either not different from zero or are greater than unity, suggesting (incompatible with an ECM) explosive behaviour.

Bettendorf et al. (2003) studied APT in the Dutch retail gasoline market. Similar to most studies in the applied literature, they used an asymmetric ECM on weekly price changes for the period 1996-2001. On the other hand, the interesting and distinguishing aspect of the study is the use of a dataset for each working day. Their results show that the choice of the dataset is not as harmless as it seems. The estimation results demonstrate that a spot price change is fully passed through to the retail price in the long run. The results do not unambiguously point at symmetry or asymmetry. The Wald tests strongly reject symmetry for Monday, Thursday and Friday, whereas for Tuesday and Wednesday symmetry cannot be rejected. They conclude that the mixed conclusions found in the literature might be explained by the lack of robustness of the outcomes. This is probably due to the fact that APT in the Dutch market is extremely marginal and might therefore depend on the day of study. In chapter 3 I find evidence of APT in the Dutch diesel market, not in retail gasoline prices.

Driffield et al. (2003) studied the UK market from January 1973 through April 2000 using monthly data for crude price, retail gasoline price and consumer price index (CPI). The model used is an asymmetric ECM, yet it is different in one aspect. It does not split the short-run term into positive and negative changes. Instead, the response of petrol prices to situations where they are above or below equilibrium are analysed in the equation. Their results show petrol prices respond differently to changes in crude oil prices depending on whether they are above or below their long-run equilibrium. When they are above equilibrium, the response is smaller than when they are below equilibrium, providing the evidence of downward stickiness. The different response to increases and decreases in oil price are then analysed in a simulation of the model. The graph provided shows a full and persistent response to increases while there is strong "clawing back" effect in case of an oil price cut and the upward adjustment to equilibrium is far more violent. They conclude that firms, instead of seeking to gain market share, seek to increase margins when prices are below equilibrium. On the other hand when prices are above equilibrium, any cost reduction involves a brief period of price competition. This result is consistent with the collusion hypothesis of Slade (1992).

Wlazlowski (2003) examined the relationship between crude oil prices, the dollar-pound exchange rate and petrol prices in the UK for the period 1982-2001. He used monthly data and three different models: a classical ECM, a TAR model and a momentum TAR model. He found that the short-run responses to cost increases were faster than responses to similar decreases and evidence of long-run APT. He also observed that the pass-through is not as full as previously assumed, confirming what previous papers uncovered partly.

Chen et al. (2005) investigate the role of future prices in addition to crude and spot prices in the observed APT from 1991 through 2003, using monthly US data. They use a threshold ECM and confirm that retail gasoline prices respond asymmetrically to crude and spot price changes; but also to future price of ex-refinery gasoline. They conclude that APT occurs downstream and not upstream, which according to them points at a search costs explanation.

Grasso and Manera (2007) revisit the paper by Galeotti et al. (2003) by using an updated dataset (1985-2003) and different models as in Wlazlowski (2003): ECM, TAR and ECM with threshold cointegration. The most interesting finding is that the APT inference depends on the type of model utilised. The asymmetric ECM provides evidence that long-run APT is most likely at the distribution level for Germany, Spain and the UK whilst it is found at all stages for Italy and France. Similarly, the ECM with threshold cointegration suggests that APT affects Spain in each stage of the supply chain and that there is no APT in Germany. The short-run asymmetries are best captured by the ECM and the TAR-ECM. The TAR-ECM suggests that all retail markets are affected by APT with the exception of the UK. They conclude by preconizing the use of TAR-ECM to better capture short –run APT and the asymmetric ECM fir long-run APT.

Bettendorf et al. (2009) innovate by using daily data for the Netherlands (1996-2004) and by considering GARCH effects through EGARCH-ECM estimation. They state that using daily data in OLS regressions leads to a loss of statistical efficiency if volatility is serially correlated over time. The EGARCH-ECM model allows capturing volatility clustering whilst keeping the cointegration that characterises the data. They confirm that there is no long-run amount asymmetry when series are cointegrated; there is however a faster reaction to upward changes (8 days) than to downward changes (9 days) in spot prices. This is confirmed when observing the pass-through 3 days after the change in spot price: increases are more fully passed-through than similar decreases.

Meyler (2009) attempted to develop the cross-country methodology of Galeotti et al. (2003) by considering 12 EU countries and 3 fuels -diesel, heating oil and gasoline- with recent weekly data (1994-2008). The EU15 countries are considered with the exclusion of Malta, Slovenia and Cyprus. The interesting finding is that spot prices are fully passed-through onto retail prices for all fuels and all countries. He also argues that using prices in raw levels improves the stability of estimates as compared to using log levels. Finally, he concludes that even where APT is statistically significant, it is not economically significant.

However, I argue in chapter 4 of the present thesis that although the welfare transfer generated by APT in the UK retail market may seem marginal from the end user viewpoint, it is significant for the big oil companies selling millions of barrels every year.

Douglas (2010) uses weekly US data for 1990-2008 and a threshold cointegration model to analyse the transmission of spot gasoline price onto retail gasoline price. He finds that the observed APT is only due to a small number of outlying observations and that once these outliers removed from the sample there is little or no asymmetry observed. Even when asymmetry is considered with the outliers, the consumer welfare loss is minimal. He concludes that retail gasoline prices depart less from traditional price theory than previously assumed.

Liu et al. (2010) examine both diesel and gasoline prices in New Zealand with weekly data from 2004 through 2009. Their results exhibit significant APT for the diesel market whilst the APT observed in the gasoline market is not statistically significant. They conclude by calling for closer monitoring of diesel pricing by the government .

Bermingham and O'Brien (2011) use a TAR model with multiple regimes to test for the presence of APT in the Irish and British fuel markets with monthly data from 1994 through 2009. They find no evidence of APT and link it to the very competitive nature of the two national markets. Although the methodology is highly advanced by allowing up to 4 different regimes, the use of recent (volatile) data at a monthly frequency the results remains highly questionable.

Wlazlowski et al. (2012b) use daily data to examine the transmission from Brent crude oil onto the ARA wholesale price from 1994 to 2006. Their analysis includes all types of refined products with the exception of liquefied petroleum gas (LPG) due to its different nature. The other interesting feature is the use of a STAR model and the comparison between the use of weekly and daily data. With weekly data, the results indicate presence of APT only for diesel oil. With daily data, the hypothesis of symmetric price transmission is rejected for all fuels. This shows the importance of using daily data to study upstream to midstream price transmissions into the EU. They also find that adjustment is faster for large disequilibria and slower for small disequilibria. This suggests that the EU suppliers have more arbitrage opportunities due to exchange rates; consequently EU petroleum markets are less integrated and less efficient than in the US. To conclude, the results provide evidence of the presence of ESTAR-type (exponential STAR) nonlinearities which they attribute to transactions costs and frictions in price transmission.

2.3 Theory-testing studies

In this section I focus on studied attempting to link empirics and theory. First I provide an overview in the form of a comprehensive table. Then, I discuss some key contributions that have attracted the attention of the research community.

2.3.1 Overview of the theory-testing APT literature

The 29 theory-testing articles chosen in table 2 are those that attempted to formally provide a link between theory and empirics. Given the total size of the literature on asymmetries in gasoline markets, this new approach is rapidly developing. Table 2 shows how the increasing availability of panel data has hugely contributed to a greater understanding of APT. 18 of those papers have used panel data whilst table 1 showed that only one empirical paper had used panel data: Duffy-Deno (1996) with Salt Lake City prices.

Moreover, table 2 shows the increasing complexity of the literature, as there is little consensus on the plausible explanations for APT. Yet, there seems to be a certain amount of specialisation required and this is showed by the studies of Eckert (2002, 2003) and Noel (2007a, 2007b, 2008, 2009, 2012), Atkinson (2009) and Atkinson et al (2009) on the Canadian market and Wang (2008, 2009) for Australia.

The general trend is the use of increasingly disaggregated and local data in models that are easier to interpret such as the regime-switching models (RSM). The RSMs rather than the traditional ECM allow having a limited number of switching regimes: up and down for instance. Geweke (2004) explained how the ECM estimates are hard to interpret due to the large number of regimes: upward deviation from the long-run deviation (downward deviation), positive change in the upstream price (negative change). These different situations make a large combination of regimes whilst the RSMs use a simple probabilistic fashion. With daily panel data it is possible to analyse the behaviour of a restricted number of stations. Noel (2009) studied 22 petrol stations for Toronto and detected the presence of Edgeworth price cycles that partly explain asymmetric pricing. He finally concludes that other phenomena are responsible for asymmetries but he could not uncover them.

I note that Edgeworth cycles (EC) papers are over-represented although the phenomenon is specific to Canada and certain US and Australian cities, as table 2 exhibits. In fact, out of the 29 APT papers 12 are EC papers. As a consequence, 17 papers only were actually looking into explaining APT outside of the EC context.

Author (s)	Data	Country	Panel	Model	Prices	Product	Coverage	Results	Theory supported
Eckert (2002)	W	CA	Windsor	ECM	W, R	P	1989-94	Y	EC
Johnson (2002)	D	US	N	ECM	W, R	P, D	1996-98	Y	Search
Eckert (2003)	W	CA	N	RSM	W, R	P	1990-95	Y	EC
Sen (2003)	M	CA	Y	OLS	W, R	P	1991-97	Y	MP
Davis & Hamilton (2004)	W	US	N	Other	W	P	1989-91	Y	M
Kauffman & Laskowski (2005)	M	US	N	ECM	C, W, R	P, HO	1986-02	Y	I
Radchenko (2005a)	M	US	N	ECM	C, W, R	P	1991-03	Y	Perception
Radchenko (2005b)	W	US	N	ECM/VAR	C, R	P	1991-03	Y	MP
Noel (2007a)	W	CA	19 cities	RSM	W, R	P	1989-99	Y	EC
Noel (2007b)	12H	CA	Toronto	RSM	W, R	P	2001	Y	EC
Balmaceda and Soruco (2008)	W	CL	Santiago	ECM	W, R	P	2001-04	Y	MP (local)
Deltas (2008)	M	US	N	ECM	W, R	P	1988-02	Y	MP (local)
Hosken et al (2008)	D	US	Washington DC	ECM	W, R	P	1997-99	Y	M
Oladunjoye (2008)	D	US	N	ECM	C, W	P	1987-04	Y	MP
Verlinda (2008)	W	US	Southern CA	ECM	W, R	P	2002-03	Y	MP (local)
Wang (2008)	D	AU	Firm data	RSM	R	P	1999-00	Y	EC

Table 2.6 - Theory-testing studies

(Continued on next page)

Author (s)	Data	Country	Panel	Model	Prices	Product	Coverage	Results	Theory supported
Atkinson (2009)	8*D	CA	Guelph	FE	W, R	P	2005	Y	EC
Atkinson et al (2009)	8*D	CA	Guelph	FE	W,R	P	2004	Y	EC
Contin et al (2009)	W	SP	N	ECM	W, R	P	1993-04	Y	M
Noel (2009)	12H	CA	Toronto	RSM	W, R	P	2001	Y	EC
Wang (2009)	D	AU	Perth	RSM	W,R	P	2001-2003	Y	EC
Douglas and Herrera (2010)	D	US	Philadelphia	ACB	C, W	P	1989-91	Y	M
Perdiguero (2010)	M	ES	N	VAR	S, R	P	1998-08	M	M
Chandra and Tappata (2011)	D	US	CA/FL/NJ/TX	Other	W, R	P	2006-07	Y	Search
Lewis and Noel (2011)	D	US	Midwestern	ECM/RSM	W, R	P	2004-05	Y	EC
Lewis (2011)	W	US	LA, San Diego	RSM	W, R	P	2003-04	Y	Search
Lewis and Marvel (2011)	D	US	N	Other	R	P	2006-07	Y	Search
Noel (2012)	D	CA	Toronto	RSM	W, R	P	2001	Y	EC
Foros and Steen (2013)	D	NO	Y	FE	W.R	P	2003-05	Y	EC

Table 2.6 – Theory-testing studies (continued)

Notes for table 2.6:[1] Data frequency –H: hourly, D: daily, W: weekly, M: monthly. [2] Country – AU: Australia, CA: Canada, CL: Chile. ES: Spain, NO: Norway [3]Model - PAM: partial adjustment model, ACB: autoregressive conditional binomial ARDL: Autoregressive distributed lag model, ECM: error-correction model, FE: fixed effects, OLS: ordinary least square, RSM: regime-switching model TAR: threshold autoregressive model, VECM: vector ECM, VAR: vector autoregressive model. [4]Prices - C: crude oil, S: Spot market, W: wholesale, R: retail. [5]Product – P: petrol in its different form leaded or unleaded, D: diesel, HO: heating oil/gasoil. [6]Results - Y: Significant asymmetries detected, N: no significant asymmetries detected, M: mixed results: symmetry/asymmetry depending on the country, the model or the fuel/stage considered. [7]Theory supported – EC: Edgeworth Cycles, I: Inventory adjustment, Perception: Market perception theory, MP: market power/collusion, search: search costs.

Frequency	Number
Monthly	5
Weekly	10
Daily	10
12H	2
3H	2
Total	29

Table 2.7 - Theory-testing studies - Data frequency

Country	Number
US	14
CA	9
AU	2
SP	2
NO	1
CL	1
Total	29

Table 2.8 - Theory-testing studies - Country covered

Geographic aggregation	Number
National aggregated	11
1 city	11
Regional	3
National panel	2
19 cities	1
Firm level	1
Total	29

Table 2.9 - Theory-testing studies - Type of data used

Tiers	Number
W, R	20
C, W, R	2
C, W	2
C, R	1
R	1
W	1
Total	29

Table 2.10 - Theory-testing - Tiers studied

Tables 2.7, 2.8, 2.9 and 2.10 above show the dramatic shift in the type of investigation conducted in order to link the empirical results to theory. Whilst studies using monthly data were predominant in the purely empirical papers, the theory-testing studies primarily use weekly, daily or even twice-daily data. Table 2.7 demonstrates the fact that monthly data is only marginally used for this purpose (5/29). Furthermore, table 2.8 shows the dominance of North American markets in the theory-testing papers (23/29). More particularly, I note the dramatic increase of Canadian studies (9/29); whilst only one empirical Canadian APT was listed in the previous section. Whilst to my knowledge APT had never been documented in Canada, Sen (2003) found evidence of APT and linked it to the collusion theory. One should be cautious with this study as monthly data was used, whilst the other 8 Canadian studies all documented the presence of Edgeworth price cycles with higher frequency data.

Table 2.9 suggests that theory-testing studies tend to use panel or city-level data rather than national aggregated data as it was the case with the purely empirical papers. This can be explained by the need to look at a more local level in order to understand the mechanisms behind APT. On the other hand, only local or panel data allow to uncover the presence of Edgeworth cycles. Finally, table 2.10 confirms that APT is mostly studied at the retail level and the literature has clearly taken the direction of examining more precisely the pass-through of wholesale/spot prices onto retail prices. As the overall direction is towards disaggregation of the data, only one study directly examined the pass-through of crude prices onto retail prices (Radchenko, 2005b). Crude prices are only used in 5 studies and I note the presence of one study using only wholesale prices and two studies only retail prices. The latter are not APT studies but EC studies whilst the former is a test of the menu-cost theory at the wholesale level.

2.3.2 Discussion of the most significant theory-testing contributions

Eckert (2002) examines the pass-through of wholesale prices onto Canadian retail prices for the period from 1989 to 1994 and the city of Windsor, Ontario. Whilst standard time-series methods suggest the presence of APT, he observed cyclical patterns consistent with the

Edgeworth cycles theory of Maskin and Tirole (1988). He argues that asymmetries between the responses over different portions of the price cycle can be mistaken for APT. He also suggests that new prices cycles are more likely to be initiated when retail prices are near cost. Retail prices appear to be rather insensitive to cost over the decreasing phase of the cycle (the undercutting phase). This has an important theoretical implication as in the alternating-move model of price cycles; cycles equilibria generate fewer profits for the firms than the collusive models such as that of Green and Porter (1984). In the latter model, retailers set prices near the monopoly prices and match each other forever. In Edgeworth cycle equilibria, retailers engage in an undercutting war over market share until they reach a price near the marginal cost. In conclusion, aggressive pricing patterns can be linked to price cycles within competitive markets and no policy response is justified.

Johnson (2002) uses US daily/weekly prices and included diesel prices to formally test the search costs hypothesis. He found that upstream diesel prices are passed through more quickly than gasoline prices and that the asymmetries are more important in the gasoline case. He finds that evidence of APT is independent of market size which he considers an indicator of market power. He acknowledges that market size is not the only relevant variable for competition but performs correlation tests. He concluded that as diesel drivers have lower search costs, they are more likely to engage in an intense search for a cheaper price whilst petrol drivers have less incentive as they usually purchase smaller volumes of fuel.

Sen (2003) used monthly data and an OLS methodology in an attempt to link market concentration to gasoline retail prices. Although it is not an APT investigation, it carries some interesting findings that could be used in APT studies. He investigated the impact of local market concentration and wholesale prices on average retail gasoline prices. In addition he examined the relationship between the number of wholesale competitors and crude oil prices on average wholesale prices. Interestingly, the results suggest different patterns at the upstream and the downstream markets. He finds that the variance of wholesale prices (43.92%) is a more important determinant of the variance of retail prices than the variance of local market concentration (34.09%). Conversely, changes in crude oil prices (43.35%) are a much more important determinant of wholesale prices than market competition (13.67%). He concludes that as retail market competition has some impact on retail prices, government policies aiming at enhancing competition downstream should be encouraged.

Kauffman and Laskowski (2005) revisit the issue of APT in the US with monthly data from 1986 to 2002; they attempt to link APT to refinery utilization rates and inventory levels. They find APT in the home heating oil market and little evidence of APT in the gasoline market. However, there are good reasons not to trust the results. Particularly, the lack of cointegration may have resulted in the over-rejection of the APT hypothesis. Also, the definition of utilisation rates does not account for the increases in the short-run level of supply. Finally, monthly data is too aggregated for such a long period with segments of high volatility.

Radchenko (2005b) empirically found with US weekly data that asymmetries tend to decrease when volatility increases. According to his findings, increased volatility makes it harder for collusive firms to coordinate their prices, hence decreasing the level of asymmetries. More recently, two papers assumed that local market power translates into collusion between retailers; resulting in asymmetry in the pass-through of wholesale prices to retail prices.

The following studies are only briefly presented as they will further analysed in the next subsection as they most likely represent a basis for the future directions in the literature:

Verlinda (2008) looked at the influence of local market power on the degree of asymmetry in Southern California; using weekly data over the period running from July 2002 to May 2003. He found that brand identity, proximity to rival stations and local market features and demographics all play a role in the degree of asymmetric response of a given station.

Balmaceda and Soruco (2008) used a weekly time-series panel of 44 retail stations in Chile and found a similar pattern of asymmetries and collusive behavior. Brand identity and local market power as measured by average margins partly explained asymmetric pricing.

Deltas (2008) also considered average margins as a proxy for local market power, found a positive correlation between asymmetries and average margins for 48 US contiguous states with monthly data from 1988 to 2002.

Lewis (2011) developed a search model that assumes consumers' expectations of prices are based on prices observed during previous purchases. This model predicts that consumers search less when prices are falling. He conducted an empirical study with a mix of weekly station data in San Diego and Los Angeles daily price averages and his findings backed the theory.

Lewis and Marvel (2011) measured consumer search directly from traffic statistics for web sites that provide gasoline prices. They also found that consumers search more as prices rise than they do when prices fall.

2.3.3 Likely future directions in the literature

Throughout the literature, I observe a lack of studies linking empirical evidence to explanations. Overall, only few studies have taken advantage from the increasing availability of station-level daily data. In contrast, the use of such data has been extensively used in recent years to uncover the presence of Edgeworth price cycles principally located in Canada and Midwestern states in the US.

The most promising link between theory and empirics has been made by industrial economics studies. Balmacedo and Soruco (2008), Deltas (2008) and Verlinda (2008) made an interesting attempt by linking local market power to margins. All three studies suggest that market power as measured by retail margins is correlated with the degree of asymmetry at the local level. This is a key contribution as it explains at least partly APT with a well-defined measure of market power.

Although their assumptions are rather strong, the models used are backed by the empirical evidence respectively from Chile and the US. Retail margins can be used as a measure of local market power provided that the real cost faced by each firm is known, which is not necessarily the refinery price. The real cost faced by each firm is the contract prices; obtaining these prices allows computing the real margins. This is well-explained in Balmaceda and Soruco (2008) and a major limitation in Deltas (2008).

Moreover, Deltas (2008) also argues that sticky prices are linked to market power: he observes that markets with high average retail-wholesale margins experience a slower adjustment. He concludes that market power at least partially explains APT and slower price adjustment. In addition, Verlinda (2008) demonstrates that branding, geographical isolation and other characteristics are consistent with tacit coordination in pricing among stations. Balmaceda and Soruco (2008) also find that brand identity contributes measurably to increase APT. They show it by comparing price responses of branded stations versus unbranded stations.

In the absence of a formal model encompassing APT and market concentration, few studies have actually explained the presence or absence of asymmetries. However the contribution of the above-mentioned studies suggests market power at least partly explains asymmetries, and as Deltas (2008) argues, sticky prices.

As far as the search costs theory is concerned, there have been some recent contributions with potential for the future development of a formal model. Lewis (2011) presents a model of consumer search where consumers form their price expectations based on a reference price; he assumes that this reference price is the average price level of the previous period. The resulting asymmetric price transmission is due to a straightforward mechanism: a cost increase will generate upward pressure on retailers whilst consumers' expectations will tend to be too low. Their resulting higher search translates into lower margins and less price dispersion. Conversely, a cost decrease will generate less search; resulting in higher margins and price dispersion.

The empirical investigation of Lewis (2011) shows that prices respond faster to cost changes during periods of high margins. It also reveals that margins may be more important than the direction of the cost change in determining the speed of price response. When controlling for the size of the current margins he finds little evidence of APT.

Lewis and Marvel (2011) measure consumer search directly from traffic statistics for web sites that report gasoline prices. They observe that consumers search more when prices rise than they do when prices fall. Their results suggest that when consumers who do not know the distribution of prices, an increase in a station's price could be particular to this station; rendering search worthwhile. In contrast, a lower price faced at a local station does not justify any additional search.

3. The relationship between market concentration and APT

The topic of APT has taken a new direction in the past fifteen years. Whilst the earlier studies of the 90s were purely empirical and focused on the existence of the phenomenon, the most recent papers have attempted to search for the causes of asymmetries. Despite the proliferation of studies on the topic, there is an ongoing debate on which theory best explains the phenomenon. Questions have been often raised[5] about the robustness of the results due to a lack of consideration for technical issues such as data aggregation over time and over the distribution chain, exogeneity and bi-directional causality.

In this chapter I intend to provide evidence supporting either the collusion theory or the search costs theory. I take into consideration most of the modelling issues raised in the literature. Based on evidence suggesting some feedback and bi-directional causality I consider the wholesale price as endogenous. As a result I choose to use the Vector Autoregression (VAR) methodology modified into an asymmetric form of the Vector Error-Correction (VEC) model due to cointegration. I generate impulse response functions for two different fuels (diesel and unleaded gasoline) and six European markets: France, Germany, Italy, the Netherlands, Spain and the UK. Finally I innovate by investigating the possible relationship between different measures of concentration and the degree of asymmetry as measured by the asymmetry index. This new approach intends to link the market structure to the phenomenon of asymmetric pricing in fuel markets. Finally I provide evidence suggesting a possible relation between vertical integration and asymmetries.

The contribution of the present investigation is three-fold. Firstly, it extends the literature on asymmetries in European gasoline markets with up-to-date weekly data. I observe that 13 out of 17 papers focussing on one or several EU countries used monthly data and the basic ECM; in contrast I utilise a VECM with weekly data. I therefore answer the question: to what extent to I do find asymmetries in the diesel and gasoline retail markets of the six major European

[5] See for example Bachmeier and Griffin (2003) and Geweke (2004)

countries? Secondly, by comparing the degree of asymmetry and the concentration indexes across countries I provide evidence suggesting a positive correlation between the degree of asymmetry and the level of concentration of a given retail market; thus supporting the collusion theory. Thirdly, I compare the degree of asymmetry between gasoline and diesel markets and provide evidence contradicting the assumptions and conclusions of Johnson (2002) about search costs.

Whilst station-level data has been often used in recent papers to improve our understanding of the determinants of asymmetric pass-through at the local level, I use national-level data as I intend to show to which extent the average European driver is affected by the phenomenon. In fact the reality and importance of the phenomenon has been often based on studies with mixed results due to low-frequency data or on studies which were never published in academic journals. As my weekly data show bi-directional causality and feedback I treat both the retail and the wholesale prices as endogenous whilst many studies considered the input price as exogenous. In turn use a Vector Error Correction Model (VECM) and construct Cumulative Response Functions (CRFs) based on it. To date, no study has tested this combination of methodology and data for European fuel retail markets.

In addition, its cross-sectional aspect allows us to draw conclusions on the importance of market structure in explaining asymmetries. In fact, this study intends to link the presence or not of asymmetries to the market concentration measures through a cross-country comparison. Thus far all the studies that have attempted to link the empirics to the theory have done it for North American gasoline markets. The different regions or cities studied have implied different theoretical explanations and this raises the question: where and to what extent do I find asymmetries in the EU and why? The explanatory variables considered are retail market concentration measures; I compare them between the six countries and test them against the level of asymmetries found.

Finally the comparison between gasoline and diesel markets provides further insights on whether asymmetries are explained by market power or by search costs. For this purpose I use the assumptions and the comparative methodology of Johnson (2002); implying that diesel drivers have lower search costs and in turn that asymmetries would be greater in gasoline markets than in diesel markets. Is the pass-through of cost changes to diesel prices also quicker than in the case of unleaded gasoline prices?

3.1 Market concentration in the EU

The market structure data comes principally from Experian Catalist reports, they are available only from 2003 (and only for the UK and the Netherlands they were available from 2000)[9]. The latest reports obtained are those covering the year 2010 and issued early in 2011, the data are highly informative about the different main actors in each country[10]. The wave of mergers between IOCs in the late 90s is often associated with decreased competition in the oil industry. Despite the claims that fuel retail markets are becoming overly concentrated, investigations and reports have contradicted these concerns. The Poyry (2009) report analyses the competitive aspects of EU refining and retail markets and also uses Experian Catalist and other data. Poyry (2009, p14) reports that in general:

"The level of horizontal integration at refining and retail levels does not appear excessive. While there has been some consolidation in both markets, concentration ratio measures such as the HHI are typically low to moderate"[11].

This is backed by the available European market share data which show that the proportion of retail stations belonging to International Oil Companies (IOCs) has been rather shrinking in the

[9] Experian Catalist has developed a database of retail stations information covering 13 European Member States. However French data could not be obtained because at least 40% of stations are hypermarkets and would not collaborate. Each site is visited every two years and information is continually collected during the intervening period through: telephone surveys, internet and client supplied data.

[10] The reports differentiate between four key ownership categories: (a) multinational vertically-integrated oil companies (IOCs), (b) national vertically-integrated oil companies (NOCs) (c) the independent dealers are small to medium enterprises or single petrol stations that are possibly branded by a IOC but never belongs to the supply chain and (d) the hypermarkets or supermarkets which are major players in French and British fuel markets.

[11] HHI is the Herfindahl-Hirschmann Index defined as the sum of the squared market shares of the different companies. Poyry (2009) studied a larger number of EU countries, and such consolidation is not obvious in the 6 countries investigated in the present study.

past 10 years, due to intense competition from supermarkets such as Tesco in the UK and Carrefour in France; or National Oil Companies (NOCs such as ENI in Italy and Repsol in Spain).

This restructuring is very pronounced in countries where supermarkets and hypermarkets play an important role in the fuel retailing business. For instance, in the UK the volume share of major oil companies has shrunk from 47.5% in 2000 to 28.3% in 2011(Experian Catalist reports, 2010)[12]. The outstanding feature of the British fuel market is the very high effectiveness of the supermarkets stations with a site share of only 14.4% but a volume share of 38.4% in 2010.

Some of these characteristics are also observed in France for which I have less data available. As in the UK, French hypermarkets deliver the largest volume (61%) of gasoline and diesel in spite of the leadership of IOCs such as Total in number of stations (47% against 41%, UFIP, 2010)[13]. The pattern is different in Germany: the volume share of IOCs in 2010 represents 37% (a sharp decrease from 66% in 2003) of the market, against 58.4% for the independent dealers (29.1% in 2003).

Meanwhile, the Dutch market has experienced an opposite trend. The volume share of oil companies in the retail market has increased from 47.1% in 2002 (32.6% of stations) to 57.4% in 2010 (47.8% of stations) whilst independent retailers have lost market share. Besides, supermarkets play a very marginal role in German and Dutch fuel markets. As far as Spain is concerned, the restructuration is not as pronounced as in the other markets; IOCs have lost some volume share (from 32.6% to 31.2%) and sites share (from 29.3% to 25.6% between 2003 and 2011) and NOCs still dominate the market. Finally the Italian market shows an overwhelming domination of national (mainly ENI) oil companies in the retail markets, although there has been a decrease in their volume share from 83.2% in 2003 to 70.3% in 2010.

[12] All the figures related to market structure in the fuel retailing industry mentioned in this chapter are taken from Experian Catalist reports, unless stated otherwise. Poyry (2009) used the same source and added data from country-specific data providers.
[13] www.ufip.fr: website of the French Union of Petroleum Industry. Experian Catalist reports are not available for France.

Table 3.1 below shows indicators of market concentration for the year 2008; the reports available from year 2000 to 2010 show that both indexes and positions between countries do not change and the year 2008 is chosen for French data availability[14]. The 3 concentration measures available are the Herfindahl-Hirschmann Index (HHI), the market share of the three leading retail companies (MS TOP3) and the market share of the leader in the retail fuel markets (MS Leader); they do not change sensibly during this period of time. In some markets leading actors have been facing competition from hypermarkets and supermarkets; however there is no evidence of monopolisation of the fuel retails markets. Besides, positions are stable if I accept the fact that France, Germany and Italy have very similar measures of concentration (respectively 2nd, 3rd and 4th). In general Spain has the most concentrated fuel retail markets (1st) whilst the British (6th) and Dutch (5th) fuel markets are the least concentrated.

2008	SPA	FRA	ITA	GER	NED	UK
HHI-VOLUME	2219	1514	1460	1420	1096	999
MS TOP3	69%	56%	55%	56%	44%	41%
MS Leader	40%	32%	27%	23%	20%	16%
Concentration rank	1	2	3	4	5	6

Table 3.1 - Concentration Measures

Note for table 2.1: 2008 is chosen as an indicator of the average measure of concentration, any other year would provide an identical ranking. All the measures are provided in terms of share of the total volume of fuel delivered in the retail market. HHI-VOLUME is the Herfindahl-Hirschmann Index as measured by volume share. MS TOP3 is the total of volume shares of the top 3 firm in each country.
MS Leader is the volume share of the leading retailer in each country.
The concentration rank is easily chosen by looking at the HHI-VOLUME and MS Leader.

3.2 Methodology and price data

The methodology used is consistent with most of the literature. I first check that the variables are I(1) and if they are I test for cointegration. Secondly I use the Engle and Granger (1987) procedure to write the ECM transformed into a Vector ECM (VECM) due to clear evidence bi-

[14] Econ Pôyry report no R2010-LGH-EU Oil Review, Project no. 6A080018. This report presents the advantage of using other reports to check the robustness of the data provided by Catalist reports.

directional causality and feedback. Thirdly I use the lag length criteria to find the best lag order for the VECM. Fourthly the best VECM is estimated and impulse responses are built for positive and negative changes in the search for asymmetric responses. Finally I present the data used.

3.2.1 The long-run relationship between variables.

Following the existing literature, I test for a long-run relationship between the retail price of gasoline (*G*) and its corresponding wholesale spot price (*S*) of the form:

$$G_t = \gamma_0 + \gamma_1 S_t + e_t \tag{3.1}$$

The constant term $\boldsymbol{\gamma_0}$ reflects the marketing costs at the retail level; the slope $\boldsymbol{\gamma_1}$ can be equal to one; finally e_t is the random error term.

In the first instance, I test the stationarity properties of the all variables under investigation using Augmented Dickey-Fuller and Phillips-Perron tests. Both tests suggest that all the variables are I(1). Given that the variables are found to be I(1), I test for the existence of equation (1) using a cointegrated vector autoregressive (VAR) model framework based on Johansen's (1988) maximum likelihood method.

I then write a similar equation for the diesel market where *P* is the retail price and *W* the wholesale gas oil price:

$$P_t = \gamma_0 + \gamma_1 W_t + e_t \tag{3.2}$$

For equations (3.1) and (3.2), the gammas γ are obtained through the Engle and Granger (1987) procedure[16]. In order to simplify I use the gammas $\boldsymbol{\gamma}$ in the long-run relationships for all markets; although they take different values in each case.

[16]The use of the normalized coefficients of the Johansen (1988) cointegration test provides similar results.

3.2.2 The Vector Error-Correction Model (VECM)

Given that I am able to establish cointegrating relationships, I specify an error-correction model (ECM) to allow adjustment to the long-run equilibrium.

$$\Delta G_t = \alpha + \lambda(G_{t-1} - \gamma_0 - \gamma_1 S_{t-1}) + \Sigma\beta_i^+(\Delta S_{t-i})^+ + \Sigma\beta_i^-(\Delta S_{t-i})^- + \varepsilon_t \qquad (3.3)$$

I also consider the lagged changes in the retail gasoline price G and I obtain:

$$\Delta G_t = \alpha + \lambda(G_{t-1} - \gamma_0 - \gamma_1 S_{t-1}) + \Sigma\beta_i^+(\Delta S_{t-i})^+ + \Sigma\beta_i^-(\Delta S_{t-i})^- + \Sigma\theta_j(\Delta G_{t-j}) + \varepsilon_t \qquad (3.4)$$

The lagged changes in the retail price can also be split into positive and negative changes; for consistency I tested both versions without noticing any difference in the results. Similarly, in the literature some papers split the error-correction term into positive and negative changes; which is unlikely due to the underlying assumptions of the ECM. It is the version used by the seminal paper of Borenstein et al. (1997) and by Peltzman (2000) and my tests confirm that the hypothesis of symmetry in the long-term adjustment coefficients can never be rejected in all the markets considered.

For diesel prices a similar equation with lagged changes of the retail diesel price P is written:

$$\Delta P_t = \alpha + \lambda(P_{t-1} - \gamma_0 - \gamma_1 W_{t-1}) + \Sigma\beta_i^+(\Delta W_{t-i})^+ + \Sigma\beta_i^-(\Delta W_{t-i})^- + \Sigma\theta_j(\Delta P_{t-j}) + \varepsilon_t \qquad (3.5)$$

As pointed by Geweke (2004), there is an unquestioned assumption in many studies that the relation between wholesale prices and retail prices is structural by nature; as a consequence the upstream price (generally the wholesale or crude oil price) is often treated as exogenous. Geweke (2004) notes that it is possible and even likely that shocks to downstream prices impact upstream markets. The literature review in the previous chapter outlined the fact that there has been little concern for two-way causality. The exceptions are Borenstein et al. (1997), Balke et al. (1998) Indejehagopian and Simon (2000), Salas (2002), Wlazlowski et al (2009) and Liu et al (2010) who conducted endogeneity tests and found a two-way causality.

One could mention many articles that rejected endogeneity tests but with monthly data that does not match the frequency of price change the result is not surprising. Hence that is why most papers mentioned in chapter 2 used a classical ECM assuming a structural relation. Whilst retail markets are small and local, they are not independent from global markets. They are often subject to macroeconomic shocks that affect demand for diesel and petrol; when demand for oil is globally reduced, crude oil prices are likely to decrease. Consequently, it is important for the validity of the results to conduct such tests.

I perform Granger causality/block exogeneity tests. As I expected wholesale prices Granger cause retail prices but more surprisingly, retail prices also Granger cause wholesale prices. The results show strong evidence of lead-lag interactions between the wholesale and the retail prices. In all cases there is evidence of bi-directional causality and feedback within a week at least, in some countries within 2 or 3 weeks. In turn the model estimated should treat the wholesale price as endogenous in both the diesel and the gasoline case. I therefore use a bivariate VAR in first differences with k lags transformed into a VECM by including the error-correction term Y_{t-1}:

$$\Delta\mathbf{Y}_t = \mathbf{\Pi Y}_{t-1} + \mathbf{\Phi}_1 \Delta\mathbf{Y}_{t-1} + \mathbf{\Phi}_2\Delta\mathbf{Y}_{t-2} + \ldots + \mathbf{\Phi}_q \Delta\mathbf{Y}_{t-q} + \nu_t \tag{3.6}$$

Where Y_t is x×1 vector of the retail and wholesale variables of interest: respectively G_t and S_t for the gasoline market; and P_t and W_t for the diesel market. ν_t is x×1 vector of errors terms, $\mathbf{\Phi}_1,\ldots, \mathbf{\Phi}_q$ are n×n coefficient matrices, and Π is the long run coefficient matrix, which could be decomposed into product of matrices α and γ (matrix of r cointegrating vectors):

$$\mathbf{\Pi} = \alpha_{n\times r}\, \gamma'_{r\times n} \tag{3.7}$$

In order to include asymmetric price transmission into the model, I modify (6) and split the vector into positive and negative prices changes:

$$\Delta\mathbf{Y}_t = \mathbf{\Pi}\, \mathbf{Y}_{t-1} + \mathbf{\Phi}_1^{+}\Delta^{+}\mathbf{Y}_{t-1} + \mathbf{\Phi}_1^{-}\Delta^{-}\mathbf{Y}_{t-1} + \ldots + \mathbf{\Phi}_q^{+}\, \Delta^{+}\mathbf{Y}_{t-q} + \mathbf{\Phi}_q^{-}\, \Delta^{-}\mathbf{Y}_{t-q} + \nu \tag{3.8}$$

3.2.3 Estimation

I perform the estimation after selecting the appropriate lag order for the 12 VECMs. The Schwarz criterion is carefully used. The Schwarz criterion (SBIC) is the most used in the literature. For all of the 12 VECMs analyzed, the time period suggested by the SBIC criterion varies between week 2 and week 3. In other words any change in wholesale price in any given week is passed-through to the corresponding retail price in 2 to 3 weeks. This is consistent with the literature using weekly data.

My tests with different lag orders and different versions of the models show that it is preferable to use the SBIC rather than the Akaike or Hannan-Quinn (HQ) criteria in order to avoid estimating larger-than-required models. I also performed lag exclusion tests to check whether the SBIC's penalty on additional lags was not too exaggerated. Nevertheless my conclusions did not differ when using the other criteria; although the asymmetries were unrealistically long-lived when using larger models.

As in Borenstein et al. (1997) my empirical analysis is based on the cumulative response functions (CRFs) rather than on the parameter estimates. I use the cumulative orthogonalised impulse response functions (COIRFs) of the VAR. Hamilton (1994, p 322) provided further details on the COIRFs their definition and interpretation. Here the recursive ordering of the variables is straightforward as I am primarily interested in the pass-through of the wholesale to the retail price; although I take into consideration the feedback in the underlying model.

3.2.4 COIRFs and Asymmetry Index (AI)

To date there is little agreement on the definition of asymmetry; Geweke (2004) argues that amount asymmetry in the long-term is implausible in the context of cointegrated series as it would imply that input and output prices drift apart. In the literature the papers testing for possible asymmetries in the long-run coefficients never rejected the hypothesis of symmetry; consistently with the assumptions of the ECM. The VECM enables us to uncover combined asymmetry as defined in chapter 1; the framework we use does not distinguish between time or amount asymmetry. As discussed in chapter 1, the distinction is purely academic when using aggregated data.

To measure and compare the extent of the asymmetry, I use the cumulative orthogonalised impulse response functions (COIRFs) of the VECM. The details on the definition and interpretation of the COIRFs are found in Hamilton (1994, p 322). Any significant difference between price responses to cost increases and cost decreases is considered APT. The straightforward implication is to take into consideration for each country x the difference in COIRFs which is significant at the 95% CI; respectively:

$\mathrm{Max}(\Delta P_{\tau+i}^{+} - \Delta P_{\tau-i}^{+})_x^{**}$ for diesel markets; and $\mathrm{Max}(\Delta G_{\tau+i}^{+} - \Delta G_{\tau-i}^{+})_x^{**}$ for gasoline markets.

Table 3.2 in the section 3.3 (results) provides the full account of the computed asymmetry and I subsequently comment on the measures of asymmetry in the results and discussion. In general, the impulse response functions generated from VAR-type models suffer from very large confidence intervals and require further restrictions. For instance, Hamilton (1994: 339-340) noted:

"In practice the dynamic inferences based on VARs often turn out to be disappointingly large ...To gain more precision, it is necessary to impose further restrictions".

Given the use of the appropriate data and methodology, the confidence intervals are satisfactory up to week 2 which is rather predictable through an analysis of the structural relation between wholesale and retail prices. The recent data is rather volatile and I did not expect any significant asymmetry more than 2 weeks since the change.

Additionally, I take into consideration different speeds of pass-through to compare asymmetries across countries. I observe that prices are stickier in Italy and Spain, and that prices adjust much quicker in France, Germany and the Netherlands. It is likely that the use of the MED spot price for Italy and Spain would have resulted in a faster adjustment; however it would have been more difficult to make a cross-country comparison. To smooth out differences in speed of adjustment, I create an index for each fuel: respectively called Diesel Relative Asymmetry and Gasoline Relative Asymmetry based on the significant difference between the positive and negative CRFs for each country x:

$$DRA_x = \underset{\tau}{Arg\,Max}\,[ln\,(\Delta P_{\tau+i}^{+} / \Delta P_{\tau+i}^{-})]_x \tag{3.9}$$

$$GRA_x = \underset{\tau}{Arg\,Max}\,[ln\,(\Delta G_{\tau+i}^{+} / \Delta G_{\tau+i}^{-})]_x \tag{3.10}$$

As I want to consider the total asymmetry at the pump for a given country, I then create the Asymmetry Index:

$$AI_x = DRA_x + GRA_x \tag{3.11}$$

Table 3.2 in the results section provides these indexes.

3.2.5 Price Data

I use weekly prices for 6 major European markets: Germany, France, the UK, Italy, Spain and the Netherlands[23]. The sample period starts on Tuesday 4/01/1994 and ends on Tuesday 28/12/2010. The total number of observations for each series is 887, an ample number when compared to the existing literature using an ECM with weekly data; particularly since it can plausibly address the small sample problems that may arise with an ECM specification (see Galeotti et al. 2003, for example). Also the use of weekly data with the ECM is considered as the best fit by Geweke (2004), who considers all the possible issues in the literature. Due to non-availability of country-specific wholesale contract prices on a weekly basis, the available spot prices are the ARA[24] (Amsterdam-Rotterdam-Antwerp) prices which are dominantly used in Europe: S is used for gasoline markets and W for the diesel markets as follows:

- S, for spot price: Gasoline ARA Reg FOB Conventional; UC/GAL (US cent/gallon).

[23] All the price data are from Datastream
[24] ARA is a transparent reference point used for wholesale prices, the study could also have used the NWE (North West Europe) prices for the UK, the Netherlands, Germany (although the eastern part of Germany uses Central and Eastern Europe , CEE prices) and the North of France; MED (Mediterranean) prices for Italy, Spain and the South of France. Estimations performed with NWE and MED returned similar results and ARA is the most suitable for my comparative approach.

- W, for wholesale price: Gasoil ARA Spot FOB; UC/GAL.

The two wholesale prices are converted into USD/barrel. The retail prices considered exclude taxes in order to remove the effects of different taxations between countries and over time. I convert them to USD/barrel for consistency with the input prices.

- G, for unleaded Gasoline price: the retail unleaded gasoline prices are provided in Euros/kilolitres (£ for the UK).

- P, for diesel price: the retail diesel prices are provided in Euros/kilolitres (£ for the UK).

3.3 Results

The detailed results are in Appendix A.

The 6 graphs in figure 3.1 show the CRFs of retail diesel and gasoline prices in France (3.1.a and 3.1.b), Germany (3.1.c and 3.1.d) and Italy (3.1.e and 3.1.f) to a standard deviation cost change whilst the 6 graphs in figure 3.2 show the results for the Netherlands (3.2.a and 3.2.b), Spain (3.2.c and 3.2.d) and the UK (3.2.e and 3.2.f). Reading on the graphs, asymmetries are represented by the difference between the positive change line and the negative change line. Some degree of asymmetry is found in all cases. However, in 3 cases asymmetry is not statistically significant and the hypothesis of symmetry cannot be rejected; indeed in the Dutch gasoline (Fig.3.2.b) and the UK diesel (Fig.3.2.e) and gasoline (Fig.3.2.f) markets the graphs show no evidence of asymmetry at the 95% confidence index. For the other 9 cases the asymmetries are significant and proportionately the most important one week after the change. In general, prices are passed through quite rapidly in the first week after the cost change and the cumulated asymmetry in the subsequent weeks is marginal.

Given the nature of dynamic inferences based on VAR such as the COIRFs, I strictly analyse the results according to 95% confidence indexes (CIs). In the 12 graphs below the lower line of the CIs for an increase meets the upper line of the CIs for a decrease one or two weeks after the change. This greatly simplifies the comparison between countries as I hereby analyse the cost of asymmetric price response one week or two weeks after a wholesale price change. Prior to the cross-country comparison using a computed measure of asymmetry, I shall first assess the cost of asymmetries for consumers using the COIRFs table. Table 3.2 below shows the different in adjustment of retail prices to an increase or a decrease in wholesale price that occurred at time τ.

Do these have asymmetries substantial effects on consumers? Due to methodological considerations, only Borenstein et al. (1997) and a few other papers using CRFs answered this question. Our results provide a rather clear answer: although asymmetries do not seem to have an excessive impact on the consumer's budget, they are important in relative terms. Spain diesel is found to be the most asymmetric market in terms of significant relative asymmetry at the pump. Indeed the response to a one dollar cost increase after a week (0.76$) is twice as great as a similar decrease (0.38$).

A comparable pattern is found in France, Germany and Italy with a relatively smaller difference in proportion but not in absolute cost to the consumer. As explained briefly in the previous section, the relative asymmetry is important to take into account different rates of pass-through. In terms of cost to the consumer the German gasoline market is the most asymmetric one week after the change in wholesale price. A one dollar per barrel increase in spot wholesale price is expected to increase German gasoline retail prices on average by $1.17 whilst a similar decrease is estimated to decrease diesel retail prices by $0.66 (Table 3.2). Therefore a dollar increase in wholesale price costs German gasoline users $0.51/barrel (0.32¢/litre) more than a dollar decrease in wholesale price would have benefited them.

Considering an average motorway user in Germany consuming one barrel or 159 litres per month, the cost of asymmetries for a dollar increase in wholesale price is 51¢. The asymmetry found in the German diesel market and in France is only marginally smaller; in turn for drivers using similar volumes of diesel/gasoline the effect will be quite similar. However for a transport company utilizing 100,000 litres per month, the cost rises to $320 for a one dollar increase. This means that in a period of very high volatility[25], a \$15 increase in wholesale price would cost this driver (company) \$4.8 (\$4,800) more than a similar decrease would benefit. Our results suggest that only in volatile periods asymmetries will have sensible effects on the consumers' welfare whilst their effects are never negligible for companies using high volumes of fuel. To sum up, asymmetric pricing in fuel markets seem to be predominant in all of France, Germany, Italy and Spain. In the market where asymmetries are the most important, I have shown that the cost for a normal driver is generally marginal. However it is much more important for transport companies and in periods of high volatility, provided that the model holds in such periods. In the Netherlands and the UK asymmetries are smaller (Figure 3.2.c) or statistically non-significant (Figure 3.2.d, 3.2.e and 3.2.f).

Finally, in all the six countries the level of asymmetries is greater in the diesel case than in the gasoline case. According to Johnson (2002), diesel drivers who have lower costs than petrol drivers are more likely to search for the lower prices. In all the countries studied apart from the UK the after-tax price of the litre of diesel is cheaper than that of gasoline. Therefore as diesel cars are also sensibly more fuel-efficient diesel drivers are substantially advantaged by lower search costs. The theory implies that diesel drivers search more and as a result diesel prices would be passed-through more quickly and more symmetrically. In fact table 3.2 shows that in the 6 countries the pass-through is quicker in the gasoline case than in the diesel case. In addition, in all countries but Germany the asymmetry is greater in the diesel market than in the unleaded gasoline market. In conclusion my results do not support the search costs theory developed by Johnson (2002).

[25] Although the average change in wholesale price is less than 10¢, the maximum change culminates at almost \$15. The use of a VAR methodology for such a large sample implies that CRFs behave identically in periods of high and low volatility. Of course this is a strong assumption as Peltzman and Radchenko (2005) showed that asymmetries decrease in period of high volatility. Radchenko (2005) linked this observation to the collusion theory, arguing that oligopolistic retailers fail to coordinate their prices in periods of high volatility.

Diesel price impulse response ΔD in US$ to a one US$ change in wholesale price at τ [Standard deviation in W+ = 1.73 ; W- = 1.72]						
	France	**Germany**	**Italy**	**The Ned**	**Spain**	**The UK**
$\Delta D_{\tau+1}^{+}$	1.02**	1.13**	0.67**	0.83*	0.76**	0.19
$\Delta D_{\tau+1}^{-}$	0.57**	0.67**	0.38**	0.56*	0.38**	0.13
$\Delta D_{\tau+2}^{+}$	1.65**	1.58	1.16**	1.03	1.27	0.58
$\Delta D_{\tau+2}^{-}$	1.15**	1.3	0.77**	0.87	0.9	0.43
$\Delta D_{\tau+3}^{+}$	1.99	1.86	NA	NA	1.57	0.87
$\Delta D_{\tau+3}^{-}$	1.48	1.32	NA	NA	1.12	0.66
Max($\Delta D_{\tau+i}^{+}$ - $\Delta D_{\tau+i}^{-}$)	**0.50****	**0.46****	**0.39****	**0.27***	**0.38****	**0**
DRA	**0.58**	**0.52**	**0.57**	**0.39**	**0.69**	**0**
Gasoline price impulse response ΔG in US$ to a one US$ change in wholesale price at τ [Standard deviation in S+ = 1.60 ; S- = 1.65]						
	France	**Germany**	**Italy**	**The Ned**	**Spain**	**The UK**
$\Delta G_{\tau+1}^{+}$	1.08**	1.17**	0.67**	0.92	0.73**	0.22
$\Delta G_{\tau+1}^{-}$	0.65**	0.66**	0.40**	0.81	0.45**	0.19
$\Delta G_{\tau+2}^{+}$	1.63	1.61	1.05	1.04	1.14	0.6
$\Delta G_{\tau+2}^{-}$	1.27	1.18	0.8	1.08	1.01	0.58
$\Delta G_{\tau+3}^{+}$	2	NA	NA	NA	1.53	0.92
$\Delta G_{\tau+3}^{-}$	1.5	NA	NA	NA	1.21	0.8
Max($\Delta G_{\tau+i}^{+}$ - $\Delta G_{\tau+i}^{-}$)	**0.43****	**0.51****	**0.27****	**0**	**0.28****	**0**
GRA	**0.51**	**0.57**	**0.52**	**0**	**0.48**	**0**
AI	**1.09**	**1.09**	**1.09**	**0.39**	**1.17**	**0**

Table 3.2 - Asymmetric adjustment showed by COIRFs
Notes:**indicates significant asymmetry at the 5%level;
* indicates significant asymmetry at the 10% level (for the Dutch diesel market)

See Appendices A1 to A13 for the detailed results.

Figures 3.1 and 3.2 show the overall faster response of retail prices to increases than to decreases. The black line in figures 3.1 and 3.2 represents the cumulative orthogonalised impulse response of the retail price in US$ in response to a standard deviation US$ change in wholesale price. Changes in wholesale prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI (dark grey for the positive impulse and light grey for the negative impulse). The underlying VECM with either 2 or 3 lags implies that robust conclusions can only be drawn from the graphs from week 1 to week 3 since the change. The significant asymmetries are only visible when there is a white area between the dark grey (positive impulse) and the light grey (negative impulse) confidence intervals.

The overlapping confidence intervals raise a traditional issue associated with the used VECM. In general, the impulse response functions generated from VAR-type models suffer from very large confidence intervals and require further restrictions. As mentioned above, Hamilton (1994: 339-340) noted:

"In practice the dynamic inferences based on VARs often turn out to be disappointingly large ...To gain more precision, it is necessary to impose further restrictions".

Some papers i0n the literature (see Galeotti et al., 2003) have attempted to use the bootstrap procedure to overcome this problem; nevertheless it seems to be associated primarily with monthly data and the use of a basic ECM. In the present study, the confidence intervals generated from the VECM are satisfactory up to week 2 which is rather predictable through an analysis of the underlying structural relation between wholesale and retail prices. The recent data used are rather volatile and I did not expect any significant asymmetry more than 2 weeks since the change.

The overlapping confidence intervals demonstrate the importance of using the appropriate lag length for the VECM model. Throughout the present empirical investigation, the CIs have been consistently overlapping after the chosen lag length in the underlying model. This greatly simplified the analysis although the use bootstrap methods to construct confidence intervals would have been an interesting addition.

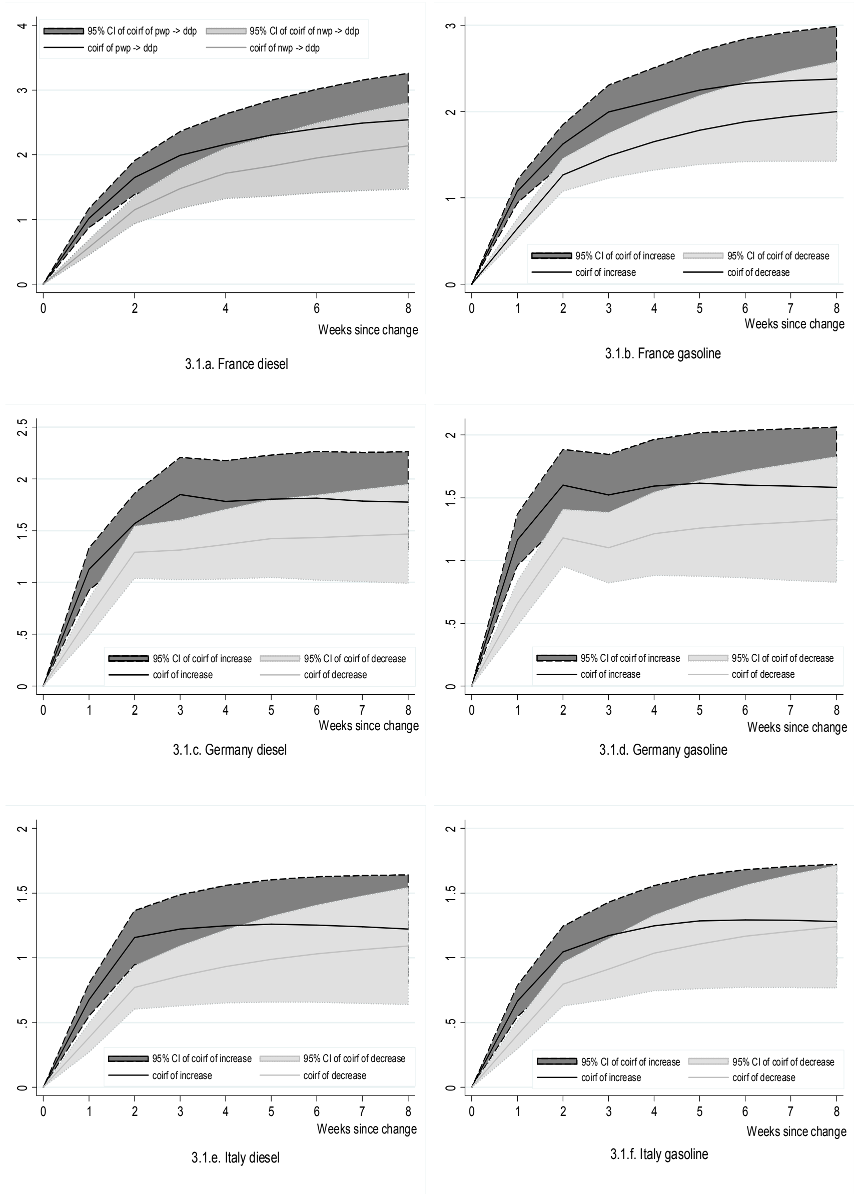


Figure 3.1 (graphs 3.1.a to 3.1.f) - COIRFs for France, Germany and Italy

Note: The black line represents the cumulative orthogonalised impulse response of the retail price in US$ in response to a standard deviation US$ change in wholesale price. Changes in wholesale prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI (dark grey for the positive impulse and light grey for the negative impulse). The underlying VECM with either 2 or 3 lags implies that robust conclusions can only be drawn from the graphs from week 1 to week 3 since the change. The significant asymmetries are only visible when there is a white area between the dark grey (positive impulse) and the light grey (negative impulse) confidence intervals.

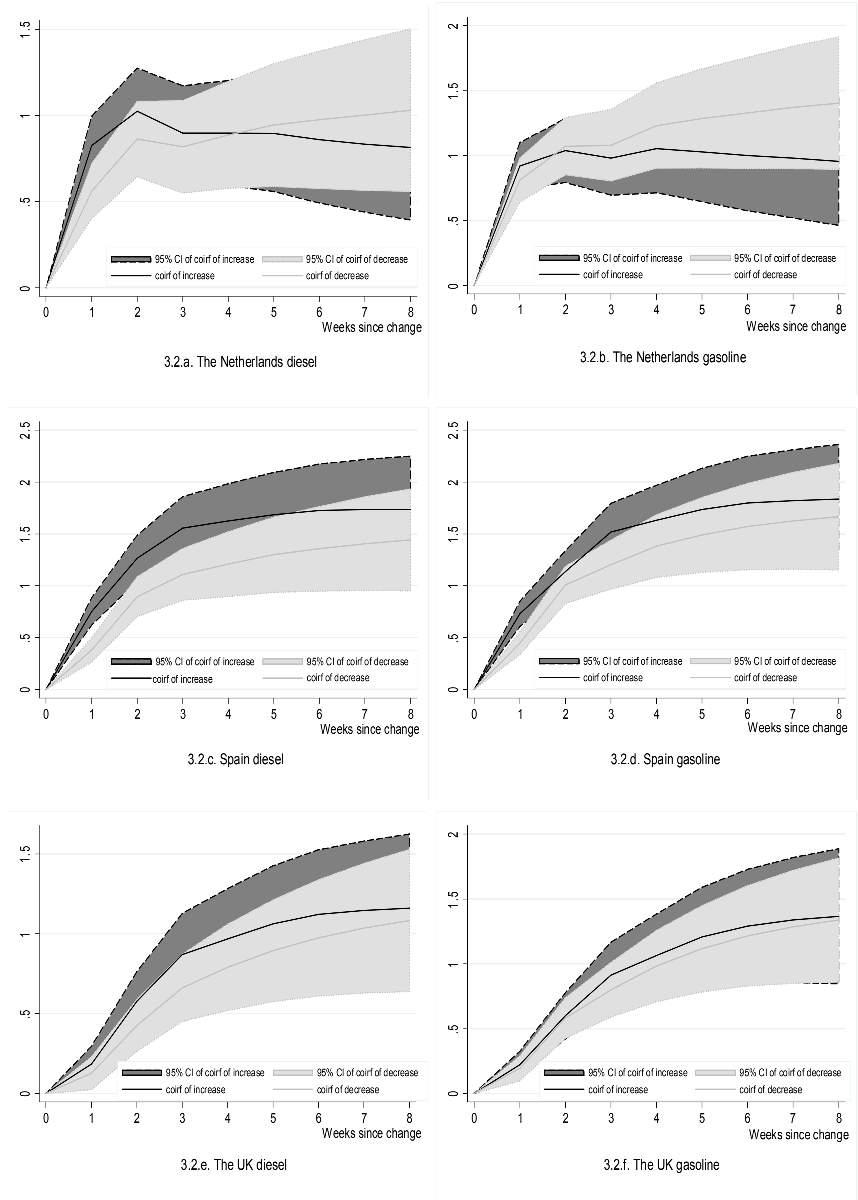


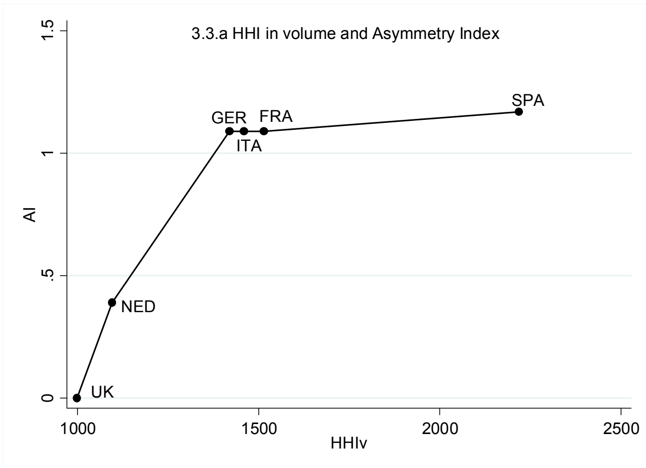
Figure 3.2 - (graphs 3.2.a to 3.2.f) - COIRFs for the Netherlands, Spain and the UK

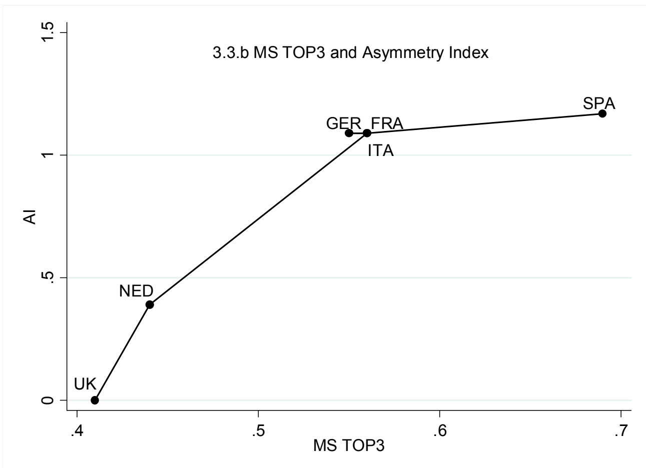
Note: The black line in figures 3.1 and 3.2 represents the cumulative orthogonalised impulse response of the retail price in US$ in response to a standard deviation US$ change in wholesale price. Changes in wholesale prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI (dark grey for the positive impulse and light grey for the negative impulse). The underlying VECM with either 2 or 3 lags implies that robust conclusions can only be drawn from the graphs from week 1 to week 3 since the change. The significant asymmetries are only visible when there is a white area between the dark grey (positive impulse) and the light grey (negative impulse) confidence intervals.

3.4 Evidence supporting the collusion theory

Figure 3.3 below shows three graphs suggesting a relationship between market concentration measures and the degree of asymmetry as measured by the AI. The three graphs suggest that the degree of asymmetry in any given market in positively related to its concentration as measured by the HHI (3.3.a), the market share of the dominant 3 firms (MSTOP3 shown in 3.3.b) and the market share of the leading firm (MS Leader shown in 3.3.c).

In figure 3.3 below, the horizontal axis represents the corresponding concentration measure (and the corresponding scale) whilst the vertical axis represents the Asymmetry Index (AI) defined in section 3.2.4. The graphs show that the AI is higher in countries with higher concentration, namely Germany, Italy, France and Spain than in countries where AI is close to zero, namely the Netherlands and the UK.





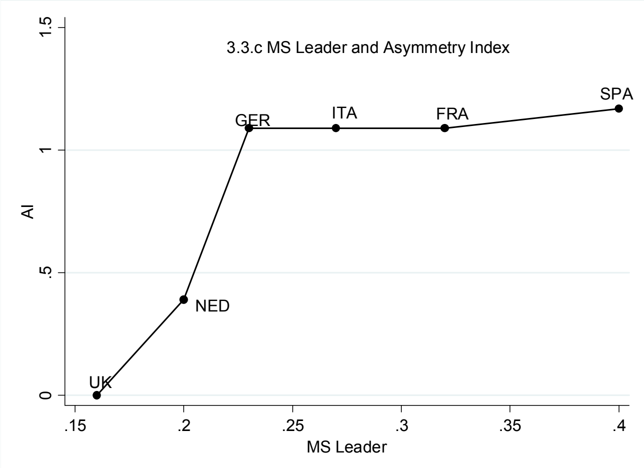


Figure 3.3 - Asymmetry index and concentration measures

3.5 Discussion

According to my results, asymmetric pricing is predominant in France, Germany, Italy and Spain; it is not statistically significant in the Dutch gasoline and the UK. This indicates that countries with higher market concentration in retail fuel markets such as France, Germany, Italy and Spain exhibit more asymmetries than countries with less concentration such as the Netherlands and the UK. For instance, the Spanish market (HHI= 2219 in 2008) is approximately twice as concentrated as the Dutch market (HHI= 1096 in 2008)[26] and about thrice as asymmetric when I consider the Asymmetry Index which takes into account both fuels. In fact, the cross-country comparison points out the importance of considering both fuels, to my knowledge only Johnson (2002) attempted to compare asymmetries between both fuels and found asymmetries in both cases with opposite conclusions to ours.

As far as the European Union is concerned, the Competition Commission is the regulatory body which intervenes in case of barriers to entry or oligopolistic behaviour. The lack of European studies utilising a robust methodology might explain the absence of regulatory intervention although asymmetries are certainly felt by diesel-intensive companies, especially

[26] The HHI of each country varies only marginally over time if I take the available data from 2000 to 2010, I intentionally omit this factor.

when I consider that diesel prices are more asymmetric than gasoline. While the phenomenon has been often denounced by motorists' organization and by the press; it is often considered as a secondary issue with the constant rise in fuel prices and the high taxation rate having much more impact on the average European driver.

Furthermore, I remark that the pass-through of gasoline prices is faster than that of diesel prices. I also note that cost decreases are passed-through to the retail market more slowly than in the gasoline case for all countries. This translates into more asymmetry in the diesel case than in the gasoline case in France, Italy, the Netherlands, Spain and the UK.

Overall, the slower pass-through in all diesel markets and more pronounced asymmetries in most diesel markets show that market concentration is not the only variable explaining asymmetries. Indeed all gasoline stations in these countries provide diesel as well as unleaded gasoline; in turn the same concentration measures apply in both cases. Some recent rockets and feathers studies examined consumer search and found that consumers search more when prices are rising than when they are falling.

Interestingly my findings show little support for the empirical evidence and the assumptions made by Johnson (2002) regarding search costs. It might be that although their search costs are lower, diesel car drivers search less because they consider their savings sufficient compared to petrol cars drivers who have more incentive to search.

In addition there are now websites that provide a price comparison in most EU countries and finding the cheapest retailer around has become free and much easier. For instance petrolprices.com in the UK compares all stations in a given city or region, an application for smart phones exists and provides real time prices for the cheapest petrol stations by postcode. In this spirit Lewis and Marvel (2011) used these web sites' statistics and showed empirically that consumers search more when prices rise than when they fall. This version of the consumer search theory or that of Lewis (2011) seems compatible with my conclusions as several factors are likely to explain the presence of asymmetries. This methodology could be extended and further conclusions could be drawn from comparing search for diesel and gasoline prices; this seems essential in the EU where the proportion of diesel vehicles is much higher than in the U.S. or Canada.

I also note that asymmetries are not necessarily caused by a particular type of dominant firm at the retail level as it has been assumed in newspapers. BBC (2011) and recent press articles have directed accusations towards vertically-integrated major companies; these accusations may be justified by the increased scrutiny after the wave of mergers in the late 1990s. In fact a similar level of asymmetry is found in France, Germany and Italy; three countries with different market structure. The French petroleum retail market is dominated by hypermarkets (in volume) and majors (in number of sites) whilst the Italian market is dominated by NOCs and the German market by independent dealers.

The following section tests the robustness of these results with an updated dataset (until 2013) and more countries studied (twelve). At the start of this thesis, only Experian Catalist reports were available and covered only five countries. With recent market reports from other consulting firms such as CBRE (2012, 2013), I have been able to extend the analysis to include vertical integration in the analysis.

3.6 APT and market structure: investigation across 12 EU countries

3.6.1 APT, margins and vertical concentration

In this section, I further investigate the relationship between APT and market structure. In addition to the HHI used in the previous sections of the chapter, I also include vertical integration and margins as possible explanatory variables.

Few studied have empirically studied the relationship between market concentration and asymmetries. Balmaceda and Soruco (2008) and Verlinda (2008) used average retail margins as a proxy for local market power and found that margins partly explained asymmetric pricing respectively in Santiago (Chile) and in Southern California.

Deltas (2008) modified the mainstream model to allow for an asymmetric adjustment that depends on average margins and found a positive correlation between asymmetries and average margins for 48 US states. Both the speed of adjustment and the degree of asymmetry were found to be dependent on average margins; suggesting that market power at least partly explains asymmetries. Although monthly data does not realistically capture the frequency of price changes, the results are plausible when linked to previous research.

An important econometric issue with the findings of Balmaceda and Soruco (2008), Deltas (2008) and Verlinda (2008); is that the average margin included in the ECM contains the current period poses the problem of correlation. However, Deltas (200) shows that by computing the average margins for one set of years and estimating the model from another set of years would completely eradicate the problem. Additionally, Deltas (2008) notes that if some US states (countries in the present case) were characterised by higher APT than others, the average margin in those states would be higher due to the welfare benefits generated by APT. This does not represent an issue for studies using an ECM or a VECM as the adjustment speed coefficient is always negative; hence within the ECM framework margins cannot be primarily generated by APT. Deltas (2008) and the above-cited studies actually measured the effect and found it to be insignificant. As cited in chapter 1, Geweke (2004) argues that amount asymmetry in the long-term is implausible in the context of cointegrated series as it would imply that input and output prices drift apart. In the literature the papers testing for possible asymmetries in the long-run coefficients never rejected the hypothesis of symmetry; this further confirms that margins in the most used model cannot be a result of APT.

Whilst the use of retail margins as a proxy for market power is appropriate with an ECM, this does not necessarily mean that margins are the best proxy for market power. Rather, other measures that were not applied to the petroleum industry seem more suitable. For instance, Neumark and Sharpe (1992) provided evidence suggesting that market concentration explained asymmetries in the consumer bank deposit sector. In addition, Hastings (2004) showed that when independent retailers were replaced by vertically integrated petroleum firms, local prices systematically rose. Combining the evidence from these two studies, asymmetries in fuel markets might not be explained by retail margins as well as by retail market concentration. The evidence from the banking industry on market concentration has not been applied to the petroleum industry whereas Hastings (2004) did not discuss the issue of asymmetric pricing.

In the present subsection, I provide evidence suggesting that horizontal and vertical concentration explain asymmetries better than retail margins. My findings are consistent with the collusion theory and call for further research across different industries, in the spirit of the work of Neumark and Sharpe (1992) for the banking industry.

3.6.2 EU 12 data

I use weekly data from Thomson-DataStream for 12 European markets: Austria, Belgium, Denmark, France, Finland, Germany, Italy, the Netherlands, Portugal, Spain, Sweden and the UK from Tuesday 3/01/1995 to Tuesday 30/04/2013. The reference wholesale price used is the NWE[31] (North West Europe): S for gasoline markets and W for diesel markets. The retail prices considered are net of taxes to remove the effects of different taxations between countries and over time: G for Gasoline and P for diesel Price. Both are labelled in Euros/litre and then converted to US$/barrel using the WMR&DS exchange rate. The retail margins are the average difference between retail and wholesale prices:

$$\textit{Retail Gasoline Margin: } RGM = Av\,(G_t - S_t) \qquad (3.9)$$

$$\textit{Retail Diesel Margin: } RDM = Av\,(P_t - W_t) \qquad (3.10)$$

The average retail margin (ARM) for each country is:

[31] Diesel: Gas Oil-European Economic Community Cost, Insurance and Freight Cargos NWE in U$/MT; Gasoline: Unleaded Regular Cost Insurance and Freight NWE in U$/MT. They are converted in US$/barrel using the conventional formulas in the industry.

$$ARM = (RGM + RDM)/2 \tag{3.11}$$

As far as market structure data is concerned, only Swedish reports dated back to 1995. Based on data available from 2000 onwards for Germany, Italy, the Netherlands, Spain and the UK I observe the same trend of replacement of IOCs by NOCs in retail markets. Although some consolidation is observed in all countries, the data showed no change in positions between countries. As observed in the previous sections, The HHI of each country varies only marginally over time from 2010 to 2013. Once again, I intentionally omit the variation of HHI over time and I chose the year 2012 for the availability of Austrian and Belgian data. Table 3.3 below shows the market structure data for 2012.

	HHI (MS)	HHI (VS)	MSTOP3	VSTOP3	VI	MSTOP3 and VI	VSTOP3 and VI
AUT	1150	1550	0.45	0.51	0.67	1.12	1.18
BEL	1050	1100	0.4	0.46	0.82	1.22	1.28
DEU	900	1300	0.39	0.58	0.79	1.18	1.37
DNK	2005	1853	0.65	0.67	0.61	1.26	1.28
ESP	2200	2188	0.64	0.69	0.75	1.39	1.44
FIN	2149	2503	0.72	0.7	0.55	1.27	1.25
FRA	1700	1500	0.61	0.51	0.3	0.91	0.81
ITA	1550	1600	0.56	0.56	0.75	1.31	1.31
NLD	905	1162	0.32	0.45	0.64	0.96	1.09
PRT	1975	1950	0.71	0.69	0.66	1.37	1.35
SWE	1470	1450	0.6	0.6	0.47	1.07	1.07
UK	710	1035	0.37	0.41	0.12	0.49	0.53

Table 3.3 - Market structure data (2012)

Notes for Table 3.3: Data come from a variety of resources such as Experian Catalist reports, the Finnish and Swedish Petroleum Institute and consulting firms Poyry and CBRE. Abbreviations: HHI-MS is the HHI computed by market share (number of sites); HHI-VS is the HHI computed by volume share. MSTOP3 represents the market share of the 3 leading firms whilst VSTOP3 is the volume share of the 3 leading firms. VI is the volume of fuel sold in the retail market by companies having refining activities in the country or refining and selling from a bordering country. DEU stands for Germany and ESP stands for Spain.

3.6.3 Results

The detailed results are in Appendices: A1 to A25. The results for France, Germany, Italy, the Netherlands and the UK are similar to those of the previous subsection as there is only an extension of the sample. For brevity I did not report those very similar results in the appendices.

Based on the lag length criteria the best model is then estimated for each market. Given the very high number of estimates required for the 24 VECMs I present the results in the form of impulse responses. Tables 3.4 and 3.5 below show the Cumulative Response Functions (CRFs) of retail prices to a one U$ positive and negative change in wholesale price. The measure of asymmetry I use corresponds to the maximum significant (within the 90% confidence bands) cost to the consumer at the pump; for both diesel and gasoline fuels.

The phenomenon of APT from wholesale to retail prices is predominant and in general relatively important in the EU. This is particularly obvious in diesel markets, in which margins are otherwise smaller. Retail diesel prices often respond to a wholesale price increase twice as fast as they do after a similar decrease. Gasoline prices are passed-through more quickly with less asymmetry observed. The results show that diesel prices must be considered in the analysis of the determinants of price transmission asymmetry in the EU.

Diesel price impulse response ΔD in US$ to a US$ change in wholesale price at τ [a]

	AUT	BEL	DEU	DNK	ESP	FIN
$\Delta D_{\tau+1}^{+}$	1.02**	0.96*	1.12*	1.37*	0.87**	0.92**
$\Delta D_{\tau+1}^{-}$	0.58**	0.54*	0.75*	0.98*	0.46**	0.38**
$\Delta D_{\tau+2}^{+}$	1.45*	1.66**	1.7*	1.81	1.48**	1.08*
$\Delta D_{\tau+2}^{-}$	1*	0.77**	1.13*	1.38	0.89**	0.54*
$\Delta D_{\tau+3}^{+}$	1.82**	1.96	2.07**	2.01*	1.86**	1.03
$\Delta D_{\tau+3}^{-}$	1.17**	1.29	1.16**	1.27*	1.06**	0.49
$\Delta D_{\tau+4}^{+}$	1.94*	2.25	2.17*	2.04	2*	1.15
$\Delta D_{\tau+4}^{-}$	1.26*	1.45	1.26*	1.47	1.21*	0.65
$\Delta D_{\tau+5}^{+}$	2.15**	2.23	2.22	2.1	2.14	1.56
$\Delta D_{\tau+5}^{-}$	1.28**	1.3	1.33	1.36	1.28	0.56
$\mathrm{Max}(\Delta D_{\tau+i}^{+} - \Delta D_{\tau+i}^{-})$*[b]	0.87	0.89	0.91	0.74	0.80	0.54
Mean diesel retail margin in U$/brl	23.10	23.50	23.50	22.90	22.90	26.70

Gasoline price impulse response ΔG in US$ to a US$ change in wholesale price at τ [a]

	AUT	BEL	DEU	DNK	ESP	FIN
$\Delta G_{\tau+1}^{+}$	0.99	1.04*	1.08	1.61*	0.92*	0.75**
$\Delta G_{\tau+1}^{-}$	0.78	0.58*	0.7	1.23*	0.66*	0.3**
$\Delta G_{\tau+2}^{+}$	1.44	1.76	1.5	1.67	1.41	0.75
$\Delta G_{\tau+2}^{-}$	1.16	1.42	1.34	1.49	1.18	0.43
$\Delta G_{\tau+3}^{+}$	1.85	2.36	1.95	1.85	1.77	0.81
$\Delta G_{\tau+3}^{-}$	1.41	1.67	1.32	1.54	1.46	0.35
$\mathrm{Max}(\Delta G_{\tau+i}^{+} - \Delta G_{\tau+i}^{-})$*[b]	0.00	0.46	0.00	0.38	0.26	0.45
Mean gasoline retail margin in U$/brl	26.70	26.30	26.30	29.60	26.80	26.30
Mean gasoline retail margin in eurocent /l	13.32	13.12	13.12	14.76	13.37	13.12
Total pump asymmetry cost in U$ /brl	0.87	1.35	0.91	1.12	1.06	0.99
Total pump asymmetry cost in €/brl	0.73	1.14	0.77	0.94	0.89	0.83
Pump average retail margin in eurocent/l	12.42	12.42	12.42	13.09	12.40	13.22

Table 3.4 - Austria, Belgium, Germany, Denmark, Spain and Finland

Notes for table 3.4: a. Cumulative Orthogonalised Impulse Response Functions derived from the VECM. They show the response of retail prices after a change in wholesale prices at time τ. The lags are chosen according to the Schwarz criterion. b. Indicates the maximum value of asymmetry within the 90% confidence interval. ** indicates values significant within the 95% confidence interval. * indicates values significant within the 90% confidence interval.

Diesel price impulse response ΔD in US$ to a US$ change in wholesale price at τ [a]						
	FRA	ITA	NLD	PRT	SWE	UK
$\Delta D_{\tau+1}^{+}$	0.99**	0.73*	0.96*	0.26	1.39**	0.11
$\Delta D_{\tau+1}^{-}$	0.59**	0.49*	0.6*	0.17	0.84**	0.08
$\Delta D_{\tau+2}^{+}$	1.71**	1.32*	1.36	0.97	1.66*	0.43
$\Delta D_{\tau+2}^{-}$	1.04**	0.89*	0.91	0.62	1.11*	0.31
$\Delta D_{\tau+3}^{+}$	2.11**	1.71**	1.49	1.44**	1.85*	0.59
$\Delta D_{\tau+3}^{-}$	1.28**	1.05**	1.05	0.83**	1.16*	0.43
$\Delta D_{\tau+4}^{+}$	2.3	1.93*	1.62	1.69**	1.83	0.64
$\Delta D_{\tau+4}^{-}$	1.44	1.18*	1.22	0.94**	1.28	0.48
$\Delta D_{\tau+5}^{+}$	2.52	2.14*	1.7	1.90**	1.9*	0.72
$\Delta D_{\tau+5}^{-}$	1.55	1.32*	1.17	1.07**	1.18*	0.53
$\mathrm{Max}(\Delta D_{\tau+i}^{+} - \Delta D_{\tau+i}^{-})^{*b}$	0.83	0.82	0.36	0.83	0.72	0.00
Mean diesel retail margin inU$/brl	16.20	26.70	24.40	23.60	25.40	17.40
Gasoline price impulse response ΔG in US$ to a US$ change in wholesale price at τ [a]						
	FRA	ITA	NLD	PRT	SWE	UK
$\Delta G_{\tau+1}^{+}$	1.15**	0.67*	1.08	0.38	1.33	0.17
$\Delta G_{\tau+1}^{-}$	0.79**	0.5*	0.94	0.37	1.2	0.04
$\Delta G_{\tau+2}^{+}$	1.89*	1.16	1.43	1.25	1.35	0.52
$\Delta G_{\tau+2}^{-}$	1.44*	0.97	1.37	1.05	1.35	0.32
$\Delta G_{\tau+3}^{+}$	2.21	1.57	1.62	1.71*	1.43	0.62
$\Delta G_{\tau+3}^{-}$	1.71	1.22	1.56	1.32*	1.39	0.38
$\mathrm{Max}(\Delta G_{\tau+i}^{+} - \Delta G_{\tau+i}^{-})^{*b}$	0.45	0.17	0.00	0.39	0.00	0.00
Mean gasoline retail margin in U$/brl	19.70	31.10	31.40	29.90	23.10	18.00
Mean gasoline retail margin in euro-cent /l	9.83	15.51	15.66	14.91	11.52	8.98
Total asymmetry cost in U$/brl	1.28	0.99	0.36	1.22	0.72	0.00
Average asymmetry cost in €/brl	1.08	0.83	0.30	1.03	0.61	0.00
Pump average retail margin in euro-cent/l	8.95	14.42	13.92	13.34	12.10	8.83

Table 3.5 - France, Italy, the Netherlands, Portugal, Sweden and the UK.

Notes for table 3.5: a. Cumulative Orthogonalised Impulse Response Functions derived from the VECM. They show the response of retail prices after a change in wholesale prices at time τ. The lags are chosen according to the Schwarz criterion. b. Indicates the maximum value of asymmetry within the 90% confidence interval. ** indicates values significant within the 95% confidence interval. * indicates values significant within the 90% confidence interval.

Furthermore the investigation on the determinants of the degree of price transmission asymmetry is based on a graphical analysis. In figures 3.4 to 3.7 below, the horizontal axis represents the corresponding concentration measure or proxy whilst the vertical axis represents the cost of asymmetry computed in the above-mentioned tables 3.4 and 3.5. The graphs show that the AI is higher in countries with higher concentration, namely Germany, Italy, France and Spain than in countries where AI is close to zero, namely the Netherlands and the UK.

Figure 3.4 shows that in 9 out of the 12 countries the cost of asymmetry at the pump and the retail margins are both high. Although figure 3.4 seems to confirm the findings of Deltas (2008), it also suggests looking at other variables. Instead of a clear-cut positive relationship between margins and asymmetries, I observe a clustering of 9 countries where both asymmetries and margins are high. These countries are mainly dominated by National Oil Companies (NOCs) or majors. NOCs are well-established companies involved in the refining as well as in the wholesale and retailing sectors such as Eni in Italy, Repsol in Spain, Galp in Portugal or Nestle Oil in Finland.

In all the countries but France and the UK, the retail margins can be considered as high. Vertically integrated firms generated higher prices than independent dealers in Hastings' (2004) study of the petroleum industry. In France and the UK hypermarkets and supermarkets play the price-cutting role of independent dealers in the study of Hastings (2004).

Nevertheless figure 3.4 does not explain why asymmetries are higher in France than in the UK. This suggests that the findings of Neumark and Sharpe (1992) regarding the banking industry could be generalized to the petroleum industry. Market concentration rather than margins could better explain differences in the degree of APT. Figure 3.5 shows the relationship between asymmetries and the market share of the three largest retailers. Although there seems to be a positive correlation, the dispersion remains too high and other market structure variables could be considered.

Similar to the finding of Hastings (2004) I provide evidence suggesting that vertical concentration is a major determinant of price-setting strategies. Figure 3.6 suggests a positive relationship between vertical concentration and the cost of asymmetries. Hastings (2004) concludes that the acquisition of an independent gasoline retailer by a vertically integrated firm is associated with significant price increases at competing stations. The effect is attributed to a combination of vertical integration and rebranding of the retail stations. The present findings on APT corroborate this hypothesis.

Furthermore if I combine the variables used in figures 3.5 and 3.6, I can test an index of market concentration which combines horizontal concentration in sites share and vertical concentration in volume share. Figure 3.7 shows the relationship between this constructed index and the degree of asymmetry. Except from Belgium, France and the Netherlands; the degree of asymmetry seems to increase proportionately with the market concentration index. For Belgium and France the degree of asymmetry seems higher than average whilst the Dutch market is characterized by high vertical concentration and relatively smaller asymmetries.

Both the French and Belgian markets are dominated by Total in both the retail and the refining sector. As far as the Dutch market is concerned, it is characterized by the presence of the five Big Oil companies as the five most important retailers. The absence of significant asymmetries in the UK also confirms that the Big Oil companies generate less asymmetry than NOCs, is we assume that Total plays a role of NOC in France and in Belgium.

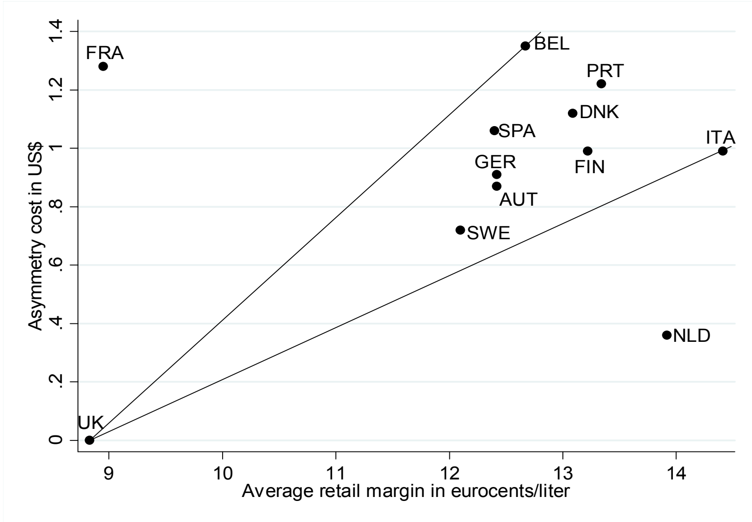


Figure 3.4 - Asymmetry cost and average retail margins

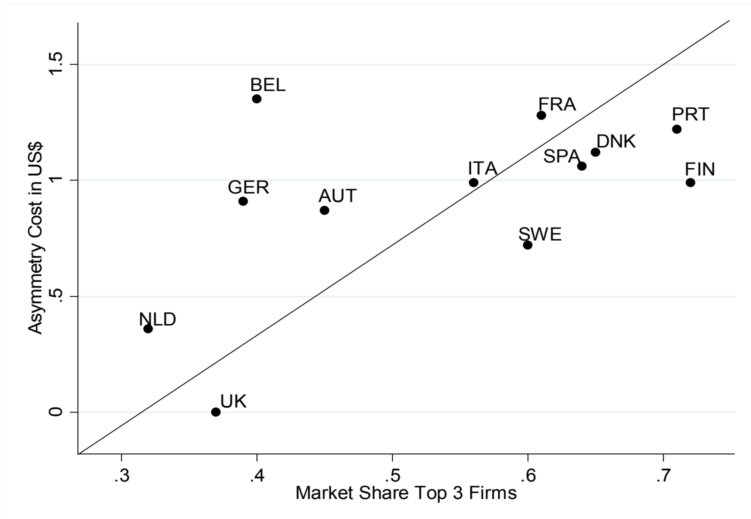


Figure 3.5 - Asymmetry cost and MSTOP3

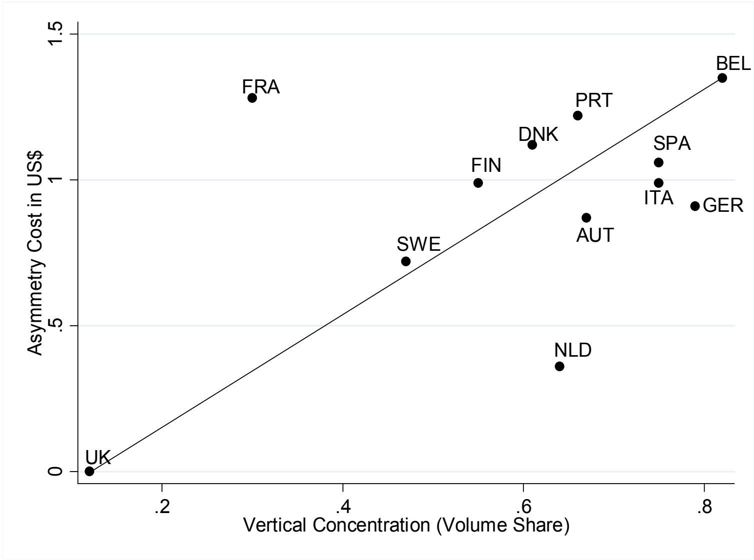


Figure 3.6 - Asymmetry Cost and Vertical Integration

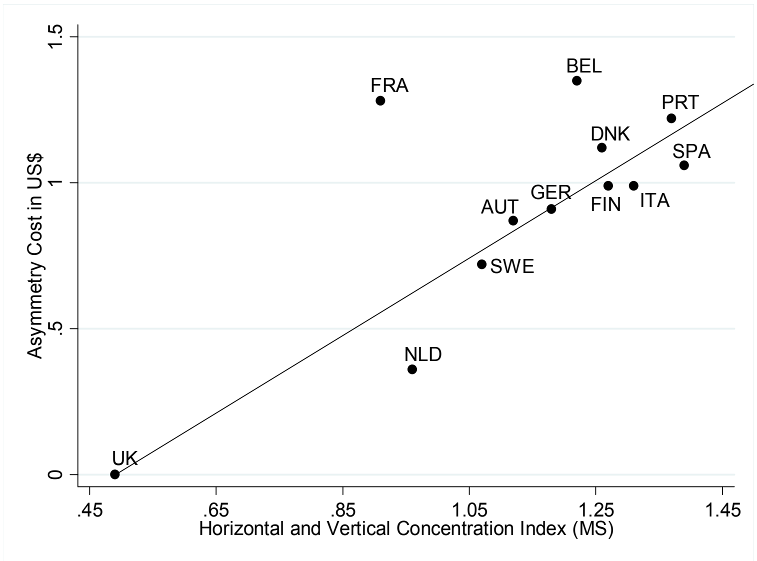


Figure 3.7 - Asymmetry cost and MSTOP3 +VI

3.7 Conclusion

In this additional investigation I provided evidence suggesting that asymmetric pricing is predominant in Europe and that its main determinant is market concentration. Whilst previous studies suggested a relationship between the degree of asymmetry and retail margins, my results do not support this. However my graphical analysis suggests that both horizontal and vertical concentration explain rather closely the level of asymmetry. This confirms that the choice of an inappropriate measure of concentration can flaw the results, as noted in Peltzman (2000)

NOCs benefit from high retail margins and important profits from asymmetries whilst major oil companies seem less involved in the rockets and feathers phenomenon. All the countries dominated by NOCs present these features of high margins and level of APT. In contrast, margins are much smaller in countries where supermarkets are important (France and the UK) and asymmetries are smaller in countries dominated by international majors (the Netherlands and the UK).

I conclude that APT is likely to increase in retail petroleum markets characterised by vertical integration. As discussed at length in Hastings (2004), any acquisition of unbranded retailer by a large refiner is likely to increase average retail prices.

4. APT in the UK petroleum industry

Although Bacon (1991) conducted the first APT investigation on the British gasoline market; there has been little evidence of significant asymmetries in the UK. Manning (1991) used an error-correction model (ECM) to analyse the transmission of monthly crude oil prices to retail prices in the UK from 1973 to 1988. The results showed once again little evidence of significant asymmetry. Reilly and Witt (1998) also used an ECM and monthly data from 1982 to 1995 and found some evidence of asymmetries. Looking at both upstream (crude to wholesale) and downstream (wholesale to retail) price transmission, Galeotti et al (2003) also used monthly data for the UK as well as for France, Germany, Italy and Spain. They found some marginal evidence of asymmetries in the UK retail market as well as in other markets. The Office of Fair Trading (OFT, 2013) delivered a thorough report on the petroleum sector in the UK. Using weekly data from 2000 to 2012 they found no statistical evidence of asymmetries in neither the petrol nor the diesel market.

These mixed findings raise the question of the appropriateness of the methodology and the frequency used. Whilst oil price volatility has increased over the past twenty years due to increased speculation, utilising the appropriate data frequency is crucial. According to Eckert (2011), only the higher frequency (daily) data can capture the price volatility observed in recent years in the US. Geweke (1978, 2004) showed that aggregation over time can create a type of omitted variables bias problem and this represented a major issue for many studies in the literature due to the non-availability of daily data until recently. For instance, Bachmeier and Griffin (2003) used the methodology and data of Borenstein et al (1997) with daily data and found little evidence of APT in the US.

This chapter contributes to the literature on several counts. First, I provide evidence suggesting that previous UK studies may have suffered from the use of over-aggregated data. The weekly model confirmed most of the UK literature's reported results (no asymmetries), whilst the daily model contradicted them (significant asymmetries). Secondly, I take into consideration the endogeneity of wholesale spot prices and the feedback from retail prices onto spot prices; unlike most previous studies. In turn a VECM is used and orthogonalised impulse response functions are drawn in order to interpret the results; meanwhile technical issues such as contemporaneously correlated residuals and Cholesky ordering of variables are considered. Third, I identify structural breaks which allow us to allow me to link the empirical results to economic theory.

Particularly, I observe significant asymmetries in periods of rising price and demand and no asymmetries in periods of declining price and demand; this provides support for the collusion hypothesis. Haltiwanger and Harrington (1991) showed that firms find it more difficult to collude during recessions than during booms. Holding constant the level of current demand, they show that firms' incentives to deviate are strengthened when future demand is falling; given that the value of the forgone collusive profits is smaller as compared to when demand is rising. Fabra (2006) found that this prediction can be overturned when firms' capacities are sufficiently small. I analyse and discuss the significance of APT in periods of booms and recessions and I draw important conclusions taking into consideration market characteristics.

My results are then compared to the findings of Peltzman (2000) and Radchenko (2005) with regards to the role of oil price volatility. Finally the UK results reveal more asymmetric pricing in the gasoline than in the diesel case; this finding is consistent with the search costs explanation developed by Johnson (2002).

4.1 Methodology

The initial methodology is similar to the previous chapters: unit root tests, cointegration tests, Granger causality and exogeneity tests. The tests call for the use of a vector error-correction model (VECM) whilst most studies in the literature used a simple ECM. The break detection tests allow me to split the sample into 5 segments for each fuel. Then the VECM is replicated for each segment and the results per segment are presented.

The VECM used is similar to the previous chapters and includes the error-correction matrix Y_{t-1}:

$$\Delta \mathbf{Y}_t = \mathbf{\Pi Y}_{t-1} + \mathbf{\Phi}_1 \Delta \mathbf{Y}_{t-1} + \mathbf{\Phi}_2 \Delta \mathbf{Y}_{t-2} + \ldots + \mathbf{\Phi}_q \Delta \mathbf{Y}_{t-q} + \nu_t \tag{4.1}$$

Where Y_t is x×1 vector of the retail and wholesale variables of interest: respectively G_t and S_t for the gasoline market; and P_t and W_t for the diesel market. ν_t is x×1 vector of errors terms, $\mathbf{\Phi}_1, \ldots, \mathbf{\Phi}_q$ are n×n coefficient matrices, and Π is the long run coefficient matrix, which could be decomposed into product of matrices α and γ (matrix of r cointegrating vectors):

$$\mathbf{\Pi} = \alpha_{n\times r}\, \gamma'_{r\times n} \tag{4.2}$$

In order to include asymmetric price transmission into the model, I modify (6) and split the vector into positive and negative prices changes:

$$\Delta \mathbf{Y}_t = \mathbf{\Pi}\ \mathbf{Y}_{t-1} + \mathbf{\Phi}_1^{+} \Delta^{+} \mathbf{Y}_{t-1} + \mathbf{\Phi}_1^{-} \Delta^{-} \mathbf{Y}_{t-1} + \ldots + \mathbf{\Phi}_q^{+}\ \Delta^{+} \mathbf{Y}_{t-q} + \mathbf{\Phi}_q^{-}\ \Delta^{-} \mathbf{Y}_{t-q} + \nu \tag{4.3}$$

The model based on equation (4.3) is estimated for both the daily and weekly datasets.

4.2 Structural break detection

In order to identify the determinants of asymmetric pricing in the UK petroleum markets, I chose to split the sample into different segments through structural breaks detection. I use the Awarding-Nominating procedure of Karoglou (2010). This procedure involves two stages: the "Nominating breakdates" stage and the "Awarding breakdates" stage. I perform the tests on both wholesale and retail prices for both the diesel and gasoline markets.

4.2.1 Nominating breakdates

This first step involves defining a procedure based on one or more statistical tests to identify some dates as potential breakdates. A number of statistical tests with various properties (for example, Sansó et al., 2003) have been developed for that reason although the empirical literature is still persistently using only one (predominantly the test of Inclàn and Tiao, 1994). The procedure presents the advantage of using a battery of these tests in order to take advantage of the special properties of each test and particularly the trade-off between size distortions and low power. For this empirical investigation I use the following break tests:

(a) I&T (Inclàn and Tiao, 1994)

(b) SAC_1 (The first test of Sansó et al., 2003)

(c) SAC_2^{BT}, SAC_2^{QS}, SAC_2^{VH} (The second test of Sansó et al., 2003, with the Bartlett kernel, the Quadratic Spectral kernel, and the Vector Autoregressive HAC or VARHAC kernel of den Haan and Levin, 1998 correspondingly)

(d) $K\&L_{BT}$, $K\&L_{QS}$, $K\&L_{VH}$ (The refined by Andreou and Ghysels, 2002 version of the Kokoszka and Leipus, 2000 test with the Bartlett kernel, the Quadratic Spectral kernel, and the VARHAC kernel correspondingly).

The above tests can also be used to discover multiple breaks in a series. I incorporate the breaks in an algorithm and apply these breaks to sub-samples of the series. The employed algorithm consists in the subsequent six steps:

1. Calculate the test statistic under consideration using the available data.
2. If the statistic is above the critical value split the particular sample into two parts at the date at which the value of a test statistic is maximized.
3. Repeat steps 1 and 2 for the first segment until no more (earlier) change-points are found.
4. Mark this point as an estimated change-point of the whole series.
5. Remove the observations that precede this point (i.e. those that constitute the first segment).
6. Consider the remaining observations as the new sample and repeat steps 1 to 5 until no more change-points are found.

This procedure is used with each of the above-mentioned test statistics and is applied to each series. The most important characteristic of the algorithm that differentiates it from a simple binary division procedure such as the procedure of ICSS algorithm is that it detects the breaks in a time-orderly mode. As a consequence the first break suggested by the algorithm is also the earliest break in the series, the second break proposed is the second earliest break, and so forth.

This is particularly important when transitional periods exist (e.g. a year of falling demand for oil) in which case a simple binary division process is expected to generate more breaks in this temporary period. Without such transitional periods both procedures will produce the same breaks. The nominated breakdates for each series are all those which have been detected in each case. At this stage I am not really concerned with detecting more breaks than those that actually exist because whichever is not an actual breakdate will be disqualified in the "awarding breakdates" phase.

4.2.2 Awarding breakdates

As far as this model is concerned, a final selection stage is required in order to eliminate any breakdates that over-segmented the sample. To this aim I adopt two criteria. First, a breakdate needs to be associated with the timing of a substantial political or economic event. This criterion effectively capitalises on the stylised fact that the crude oil price is an international and politically sensitive issue. Second, a breakdate must generate segments that are not too small in size; each segment should at least cover 120 observations or 6 months[34]. This criterion is based on the fact that two segments can be merged is the data characteristics are identical before and after the breakdate.

[34] Each segment should at least cover 6 months to be plausible.

4.3 Data

I focus on the transmission of spot prices to retail prices for both the diesel and the gasoline markets. I use the same series for both the daily and the weekly model for comparison. The sample period starts on Tuesday 4/01/2000 and ends on Tuesday 28/12/2010[35]. The total number of observations for each series is 574 for the weekly model.

As far as the daily model is concerned, the sample period covers 2777 non-consecutive days from 3/01/2000 to 30/12/2010 as Saturdays, Sundays and bank holidays are not included. Due to the non-availability of UK-specific contract prices, the closest proxy for wholesale prices is the cost insurance and freight-North-West Europe (CIF-NWE) price. This spot price is a close substitute to the Amsterdam-Rotterdam-Antwerp (ARA) price. The two spot prices use a slightly different definition as follows[36]:

- S: Gasoline, Unleaded Regular CIF-NWE published in U$/Metric Ton.
- W: Gas Oil-European Economic Community-CIF Cargos NWE also published in U$/Metric Ton.

According to the oil industry's common conversions, in order to obtain the price in U$/barrel I divide the MT price by 8.92 for regular gasoline and by 7.41 for gas oil.

The retail prices obtained in GBP/barrel include the duty and the VAT. For consistency with the weekly prices, the duty and the VAT are removed[37]. This presents the advantage of removing the effects of different duty rates over time. Using retail prices including VAT would not have any effect as the VAT rate remained at 17.5% over the sample period. It only went up to 20% on the 4th of January 2011 which occurred shortly after the last day of my sample.

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[35] Tuesdays are the best choice for the weekly model as wholesale prices are not published on Saturdays and Sundays; hence the main adjustment for the week occurs on Tuesday.

[36] The two wholesale prices are obtained from Datastream.

[37] Using retail prices including VAT would not have any effect as the VAT rate remained at 17.5% over the sample period. It only went up to 20% on the 4th of January 2011 which occurred shortly after the last day of my sample. Meanwhile the duty on fuel price went up from 47.21 pence per liter on the 9th March 1999 to 58.19 pence per liter on the 1st October 2010.

Meanwhile the duty on fuel price went up from 47.21 pence per litre on the 9th March 1999 to 58.19 pence per litre on the 1st October 2010.

- G, for unleaded Gasoline price: the retail unleaded gasoline prices are published in pence per litre and they are then converted into GBP/barrel.

- P, for diesel Price: the retail diesel prices are published in pence per litre and they are then converted into GBP per barrel.

In table 4.1 and table 4.2 below, the retail prices are shown in USD for comparison with their corresponding upstream price.

	W	P	S	G	X	P (£)	G (£)
Mean	*63.6*	*81.7*	*55.5*	*73.8*	*1.7*	*47.7*	*43.1*
Std. Dev.	*32.3*	*33.6*	*25.3*	*29.5*	*0.2*	*16.9*	*15.0*
Skewness	*0.9*	*0.9*	*0.6*	*0.6*	*0.2*	*0.8*	*0.6*
Kurtosis	*3.9*	*3.8*	*2.6*	*2.6*	*1.7*	*3.0*	*2.2*
Jarque-Bera	*101.7*	*93.9*	*36.9*	*37.3*	*43.3*	*58.7*	*47.4*
	ΔW	ΔP	ΔS	ΔG	ΔX	ΔP (£)	ΔG (£)
Mean	*13.1%*	*12.5%*	*11.5%*	*11.9%*	*0.0%*	*8.4%*	*8.0%*
Std. Dev.	*329.3%*	*228.0%*	*316.6%*	*222.6%*	*2.3%*	*96.5%*	*101.4%*
Skewness	*-0.3*	*-1.4*	*-0.3*	*-1.3*	*-0.3*	*-1.0*	*-1.0*
Kurtosis	*5.1*	*13.4*	*4.9*	*12.2*	*5.3*	*9.7*	*8.6*
Jarque-Bera	*112.9*	*2757.7*	*93.7*	*2191.1*	*137.9*	*1170.0*	*856.2*

Table 4.1 - Weekly data descriptive stats

	W	P	S	G	X	P (£)	G (£)
Mean	*63.7*	*69.9*	*55.5*	*64.6*	*1.7*	*47.8*	*43.4*
Std. Dev.	*32.2*	*20.4*	*25.3*	*18.2*	*0.2*	*16.9*	*14.9*
Skewness	*0.9*	*0.8*	*0.6*	*0.6*	*0.2*	*0.8*	*0.6*
Kurtosis	*3.8*	*2.9*	*2.5*	*2.3*	*1.8*	*3.1*	*2.3*
Jarque-Bera	*465.7*	*294.2*	*175.7*	*237.1*	*206.3*	*317.9*	*230.6*
	ΔW	ΔP	ΔS	ΔG	ΔX	ΔP (£)	ΔG (£)
Mean	*2.7%*	*2.3%*	*2.3%*	*2.2%*	*0.0%*	*1.8%*	*1.7%*
Std. Dev.	*150.6%*	*36.7%*	*134.5%*	*34.5%*	*1.0%*	*33.0%*	*30.2%*
Skewness	*0.2*	*-2.2*	*0.0*	*-1.6*	*-0.1*	*-1.7*	*-1.9*
Kurtosis	*9.0*	*30.9*	*7.8*	*31.5*	*6.1*	*45.8*	*34.4*
Jarque-Bera	*4140.6*	*92578.6*	*2635.1*	*95246.8*	*1120.8*	*213065.5*	*115357.5*

Table 4.2 - Daily data descriptive statistics

Table 4.3 and table 4.4 show the descriptive statistics for respectively the five segments of the diesel market and the five segments for the gasoline markets.

	Mean			Standard Deviation			Skewness			Kurtosis		
	W	X	P(£)	W	X	P(£)	W	X	P(£)	W	X	P(£)
D1	*34.5*	*1.5*	*33.5*	*5.0*	*0.1*	*2.2*	*0.9*	*0.6*	*0.5*	*2.4*	*2.2*	*2.6*
D2	*33.4*	*1.6*	*31.7*	*7.0*	*0.1*	*2.5*	*0.7*	*0.5*	*1.0*	*3.3*	*2.0*	*3.5*
D3	*74.0*	*1.9*	*50.3*	*10.5*	*0.1*	*5.9*	*-0.3*	*0.1*	*-0.4*	*2.4*	*1.9*	*2.2*
D4	*121.3*	*1.9*	*75.4*	*30.6*	*0.2*	*14.1*	*-0.1*	*-1.3*	*0.2*	*2.4*	*3.3*	*1.9*
D5	*81.1*	*1.6*	*62.9*	*13.7*	*0.1*	*8.6*	*-0.6*	*-0.4*	*0.2*	*2.6*	*2.2*	*1.5*
	Mean			Standard Deviation			Skewness			Kurtosis		
	ΔW	ΔX	ΔP(£)	ΔW	ΔX	ΔP(£)	ΔW	ΔX	ΔP(£)	ΔW	ΔX	ΔP(£)
D1	*-0.1%*	*-0.1%*	*0.8%*	*81.1%*	*0.8%*	*43.5%*	*-0.2*	*0.4*	*3.1*	*3.9*	*4.0*	*52.4*
D2	*2.4%*	*0.0%*	*0.6%*	*78.3%*	*0.8%*	*13.5%*	*-0.4*	*-0.1*	*-3.5*	*6.3*	*4.2*	*65.9*
D3	*5.6%*	*0.0%*	*1.8%*	*145.7%*	*0.9%*	*28.1%*	*-0.1*	*0.0*	*-2.4*	*4*	*3.6*	*32.4*
D4	*-8.8%*	*-0.2%*	*-0.9%*	*282.6%*	*1.5%*	*57.4%*	*0.4*	*-0.1*	*-2.5*	*5*	*5.4*	*14.6*
D5	*6.5%*	*0.0%*	*6.2%*	*163.1%*	*1.2%*	*35.3%*	*0.0*	*0.1*	*-1.9*	*3.0*	*5.2*	*34.2*

Table 4.3 - Descriptive statistics for the five segments detected for diesel prices.

* Spot gas oil price W in $ and the retail diesel price P in £.

	Mean			Standard Deviation			Skewness			Kurtosis		
	S	X	G(£)	S	X	G(£)	S	X	G(£)	S	X	G(£)
G1	*29.5*	*1.5*	*29.4*	*5.4*	*0.1*	*3.8*	*-0.5*	*0.5*	*-0.2*	*3.0*	*2.0*	*2.9*
G2	*43.8*	*1.8*	*34.2*	*10.6*	*0.1*	*5.3*	*0.5*	*-0.6*	*0.7*	*2.5*	*2.1*	*2.8*
G3	*75.6*	*1.9*	*51.7*	*14.4*	*0.1*	*7.1*	*0.3*	*-0.4*	*0.3*	*2.4*	*1.9*	*2.5*
G4	*90.3*	*1.8*	*65.1*	*34.5*	*0.2*	*15.3*	*-0.5*	*-0.4*	*-0.8*	*1.6*	*1.7*	*2.1*
G5	*73.1*	*1.6*	*58.6*	*13.0*	*0.1*	*10.9*	*-1.0*	*-0.4*	*-0.5*	*-1.0*	*-0.4*	*-0.5*
	Mean			Standard Deviation			Skewness			Kurtosis		
	ΔS	ΔX	ΔG(£)	ΔS	ΔX	ΔG(£)	ΔS	ΔX	ΔG(£)	ΔS	ΔX	ΔG(£)
G1	*0.8%*	*0.0%*	*0.8%*	*71.0%*	*0.7%*	*25.2%*	*0.3*	*0.2*	*0.0*	*8.9*	*4.2*	*28.0*
G2	*6.1%*	*0.0%*	*2.4%*	*106.6%*	*1.0%*	*19.7%*	*-0.2*	*-0.2*	*-0.9*	*4.3*	*3.4*	*16.2*
G3	*6.6%*	*0.0%*	*3.1%*	*161.0%*	*1.0%*	*28.4%*	*0.3*	*-0.1*	*0.7*	*5.6*	*3.8*	*28.0*
G4	*-45.5%*	*-0.3%*	*-23.3%*	*255.0%*	*1.8%*	*62.0%*	*0.0*	*0.1*	*-2.5*	*4.5*	*5.1*	*11.7*
G5	*9.5%*	*0.0%*	*8.5%*	*143.3%*	*1.2%*	*30.5%*	*-0.2*	*0.1*	*-1.2*	*3.5*	*5.2*	*37.6*

Table 4.4 - Descriptive statistics for the five segments detected for gasoline prices.

*Spot gasoline price S in $ and the retail gasoline price G in £.

Finally, table 4.5 exhibit the four final segments. Whilst the breakdate methodology is explained in the previous sections, the rationale behind the use of four final segments is further explained in subsection 4.4.2.

S1	W	S	X	P (£)	G (£)
Mean	*34.5*	*32.0*	*1.5*	*33.5*	*31.5*
Std. Dev.	*5.0*	*3.6*	*0.1*	*2.2*	*3.1*
Skewness	*0.9*	*0.2*	*0.6*	*0.5*	*0.3*
Kurtosis	*2.5*	*2.6*	*2.2*	*2.6*	*2.2*
S1	ΔW	ΔS	ΔX	ΔP (£)	ΔG (£)
Mean	*-0.1%*	*0.6%*	*-0.1%*	*0.8%*	*0.5%*
Std. Dev.	*80.9%*	*68.1%*	*0.8%*	*43.5%*	*35.2%*
Skewness	*-0.2*	*-0.2*	*0.4*	*3.1*	*0.0*
Kurtosis	*3.9*	*5.1*	*4.0*	*52.4*	*18.7*
S2	W	S	X	P (£)	G (£)
Mean	*58.3*	*51.5*	*1.7*	*42.8*	*39.2*
Std. Dev.	*28.5*	*22.9*	*0.2*	*12.7*	*11.6*
Skewness	*0.8*	*0.5*	*-0.3*	*0.7*	*0.5*
Kurtosis	*3.1*	*2.3*	*1.9*	*2.8*	*2.2*
S2	ΔW	ΔS	ΔX	ΔP (£)	ΔG (£)
Mean	*7.2%*	*4.9%*	*0.0%*	*2.9%*	*2.3%*
Std. Dev.	*128.9%*	*123.3%*	*0.9%*	*22.6%*	*22.7%*
Skewness	*0.1*	*0.3*	*-0.2*	*-2.2*	*0.3*
Kurtosis	*6.2*	*7.3*	*3.9*	*39.8*	*30.1*
S3	W	S	X	P (£)	G (£)
Mean	*123.9*	*90.3*	*1.8*	*82.5*	*65.1*
Std. Dev.	*39.6*	*34.5*	*0.2*	*15.0*	*15.3*
Skewness	*-0.3*	*-0.5*	*-0.4*	*-0.7*	*-0.8*
Kurtosis	*1.7*	*1.6*	*1.7*	*2.2*	*2.1*
S3	ΔW	ΔS	ΔX	ΔP (£)	ΔG (£)
Mean	*-59.3%*	*-45.5%*	*-0.3%*	*-21.9%*	*-23.3%*
Std. Dev.	*318.7%*	*255.0%*	*1.8%*	*70.7%*	*62.0%*
Skewness	*0.8*	*0.0*	*0.1*	*-1.9*	*-2.5*
Kurtosis	*5.5*	*4.5*	*5.1*	*9.5*	*11.7*
S4	W	S	X	P (£)	G (£)
Mean	*81.1*	*73.1*	*1.6*	*62.9*	*58.6*
Median	*83.9*	*76.6*	*1.6*	*60.7*	*59.5*
Skewness	*-0.6*	*-1.0*	*-0.4*	*0.2*	*-0.5*
Kurtosis	*2.6*	*3.3*	*2.2*	*1.5*	*2.3*
S4	ΔW	ΔS	ΔX	ΔP (£)	ΔG (£)
Mean	*6.5%*	*9.5%*	*0.0%*	*6.2%*	*8.5%*
Median	*10.1%*	*16.8%*	*0.0%*	*8.1%*	*8.1%*
Skewness	*0.0*	*-0.2*	*0.1*	*-1.9*	*-1.2*
Kurtosis	*3.0*	*3.5*	*5.2*	*34.2*	*37.6*

Table 4.5 - Descriptive statistics for the 4 final segments

In the next section, I present the results of the comparison between the weekly and the daily models for the full sample (2000-2010). Then I segment the sample using the breakdates and compare APT across segments.

4.4 Results

All the detailed results are in Appendix B.

4.4.1 Comparison between weekly and daily models 2000-2010

Figures 4.1 to 4.4 show the CRFs of retail prices (in GBP for figures 4.1 and 4.3 and in US$ for figures 4.2 and 4.4) to a one-unit (positive and negative) change in the corresponding wholesale price for both weekly and daily models and both fuels. Asymmetries are defined as the faster response of retail prices in the case of a cost increase than in the case of a decrease.

Reading on the graphs, significant asymmetries are represented by the white area between the 95% confidence band of the response to an “increase” and the 95% confidence band to a “decrease” impulse. If the response to an increase is faster to the response to a decrease, the COIRF “increase” will be above the COIRF “decrease”, however the difference is only significant where the two confidence bands are separated by a white “empty” area (Figures 4.3 and 4.4).

As far as the weekly response in GBP is concerned, asymmetric price transmission is observed for both fuels in figure 4.1 but the phenomenon is not significant at the chosen confidence interval. On the other hand figure 4.2 exhibits no evidence of asymmetric response in US$, or at least in commonly accepted definition of asymmetries. The response to a decrease is faster than the response to a similar increase although in definitive the phenomenon is not significant.

4.4.2 Segmented daily model

	IT	*ASC_1*	*ASC_2^{BT}*	*ASC_2^{QS}*	*ASC_2^{VH}*	*KL_{BT}*	*KL_{QS}*	*KL_{VH}*	*LMT*	*Adopted*
ΔP	3/14/2001	3/14/2001	3/14/2001	3/14/2001	9/30/2007	9/30/2007	3/14/2001	9/30/2007	3/14/2001	3/14/2001
	1/10/2007	1/10/2007	1/10/2007	1/10/2007	-	6/1/2009	1/10/2007	-	1/10/2007	1/10/2007
	6/1/2009	6/1/2009	6/1/2009	6/1/2009	-	-	6/1/2009	-	6/1/2009	6/1/2009
	7/4/2010	-	-	-	-	-	-	-	-	-
ΔG	9/4/2001	12/5/2008	12/5/2008	12/5/2008	-	12/5/2008	12/5/2008	-	12/5/2008	12/5/2008
	5/13/2008	5/1/2009	5/1/2009	5/1/2009	-	5/1/2009	5/1/2009	-	5/1/2009	5/1/2009
	5/1/2009	-	-	-	-	-	-	-	-	-
	11/1/2010	-	-	-	-	-	-	-	-	-
ΔW	8/26/2004	8/26/2004	8/26/2004	8/26/2004	8/26/2004	8/26/2004	8/26/2004	8/26/2004	8/26/2004	8/26/2004
	11/13/2007	11/13/2007	11/13/2007	11/13/2007	11/13/2007	11/13/2007	11/13/2007	11/13/2007	11/13/2007	11/13/2007
	3/2/2009	3/2/2009	3/2/2009	3/2/2009	3/2/2009	3/2/2009	3/2/2009	3/2/2009	3/2/2009	3/2/2009
	4/7/2010	4/7/2010	4/7/2010	4/7/2010	4/7/2010	4/7/2010	4/7/2010	4/7/2010	4/7/2010	4/7/2010
ΔS	3/16/2003	3/16/2003	3/16/2003	3/16/2003	3/16/2003	3/16/2003	3/16/2003	3/16/2003	3/16/2003	3/16/2003
	8/24/2005	8/24/2005	8/24/2005	8/24/2005	8/24/2005	8/24/2005	8/24/2005	8/24/2005	8/24/2005	8/24/2005
	2/9/2009	2/9/2009	-	2/9/2009	-	-	2/9/2009	-	2/9/2009	2/9/2009

Table 4.6 - Structural break detection - Nominating and awarding breakdates.

Table 4.6 above shows that the break tests awarded up to 3 breakdates for the retail diesel price and 2 for the gasoline retail price. As far as the NWE wholesale spot prices are concerned 4 dates were awarded for the diesel market and 3 dates for the gasoline market.

Table 4.7 below details the probable causes and the characteristics of the data after the breakdate. Causes for changes in ΔP are to be found at the UK level whilst any global political or economic event could cause a break in ΔW as W is published in US dollars by default and closely follows the trend of crude oil prices.

	Break points	Probable causes	Aftermath characteristics
ΔP	14/03/2001	Change in UK duty one-3p	Steady increase and less volatile
	01/10/2007	Change in UK duty +2 p	More volatility and important falls
	06/01/2009	Cold weather/snow (UK) /exit of recession	Less volatility clustering and higher rises
ΔW	26/08/2004	World oil demand rise /Iraq /Venezuela	Increasing volatility
	13/11/2007	Pessimistic predictions for oil industry	brutal rises and falls / extreme volatility
	03/02/2009	Iraq elections/economic recovery	No change from previous period
	04/07/2010	Gaza Strip events	No change from previous period
ΔG	12/05/2008	China earthquake and US tornados	Down period with uniquely high volatility
	05/01/2009	Cold weather (UK)/ economic recovery	Up period with less volatility
ΔS	16/03/2003	Iraq invasion	Increasing volatility
	24/08/2005	Hurricane Katrina	Brutal increase and then higher volatility
	02/09/2009	Indonesia earthquake	No change from previous period

Table 4.7 - Probable causes of the breakdates and characteristics of the series afterwards

Tables 4.8 and 4.9 below present the final selection process based on the plausibility of the event and the size of the contiguous segments.

	Break points	Probable causes	Aftermath characteristics	Decision
ΔP	14/03/2001	UK duty -3p/ growth recovery	Up period and less volatile	Y
ΔW	26/08/2004	World oil demand rise / Iraq	Up and down with increased volatility	Y
ΔP	01/10/2007	UK duty +2 p/	Down period and higher volatility	Y
ΔW	13/11/2007	Negative forecasts in oil demand	No real change from previous	N
ΔP	06/01/2009	Cold weather (UK)/ recovery	Up period / High rises	Y
ΔW	03/02/2009	Iraq elections/ exit of recession	No real change from previous	N
ΔW	04/07/2010	Gaza strip events	No real change from previous	N

Table 4.8 - Diesel market: final selection of breakdates

	Break points	Probable causes	Aftermath characteristics	Decision
ΔS	3/16/2003	Iraq invasion	Increased volatility	Y
ΔS	8/24/2005	Hurricane Katrina	Brutal increase and increased volatility	Y
ΔG	5/12/2008	China earthquake, US tornados	Down period with sky-high volatility	Y
ΔG	1/5/2009	Weather (UK)/ recovery	Up period with less volatility	Y
ΔS	9/2/2009	Indonesia earthquake	No real change from previous	N

Table 4.9 - Gasoline market: final selection of breakdates

Note for tables 4.8 and 4.9: the final selection process is based on the comparison of the series before and after the awarded breakdate. If a significant change is observed in the data characteristics and the segment lasts at least 6 months, I decide to keep the breakdate (Y). Otherwise, the breakdate is dropped (N). This approach is coupled to the plausibility of the segment's length. E.g. the break in ΔP (retail) is observed on the 1st October 2007, and on the 13th November 2007 for ΔW (spot), either date could be selected as the breakdate.

The detected structural breaks are used to split the sample for each fuel into five segments. The resulting five segments are presented in table 4.10 below:

	Diesel	Gasoline
Segment 1	4/1/2000 to 14/03/2001 (D1)	4/1/2000 to 16/3/2003 (G1)
Segment 2	14/3/2001 to 26/8/2004 (D2)	16/3/2003 to 24/8/2005 (G2)
Segment 3	26/8/2004 to 1/10/2007 (D3)	24/8/2005 to 12/5/2008 (G3)
Segment 4	1/10/2007 to 06/1/2009 (D4)	12/5/2008 to 5/1/2009 (G4)
Segment 5	6/1/2009 to 31/12/2010 (D5)	5/1/2009 to 31/12/2010 (G5)

Table 4.10 - The five segments for the diesel and gasoline markets.

The methodology used for the full sample is then replicated for the 5 segments of each market. Figure 4.5 presents the COIRFS of retail diesel price response in GBP based of the VECM applied to each segment whilst figure 4.6 exhibits the results for gasoline prices. The graphs show that asymmetries are predominant in the period 2000-2010 although the degree of asymmetries is marginal compared to what was found in other European countries. The two segments showing no asymmetries at all (D1 and G4) correspond to two periods of recession characterised by an important fall in oil price and demand. I find that although asymmetries are only significant in two of the 10 segments studies (G3 and G5), 8 segments do exhibit some degree of asymmetric price transmission. The fact that they are not significant might be due to the fact that the segment's sample size is too small.

In order to average out the impact of breaks, I merged segments with similar data characteristics as well as similar price transmission. As well as increasing substantially the samples' size, merging those segment enables us to compare diesel and gasoline price transmissions. The resulting merged segments are presented as presented in table 4.11 below:

	Harmonised segments
S1	4/1/2000 to 14/03/2001
S2	14/3/2001 to 12/5/2008
S3	12/5/2008 to 5/1/2009
S4	5/1/2009 to 31/12/2010

Table 4.11 - The final four segments

Figure 4.5 shows the comparison between diesel and gasoline price response in GBP for S1, S2 and S3. The segment S4 is shown in figure 5 for the diesel market (D5) and figure 6 for the gasoline market (G5).

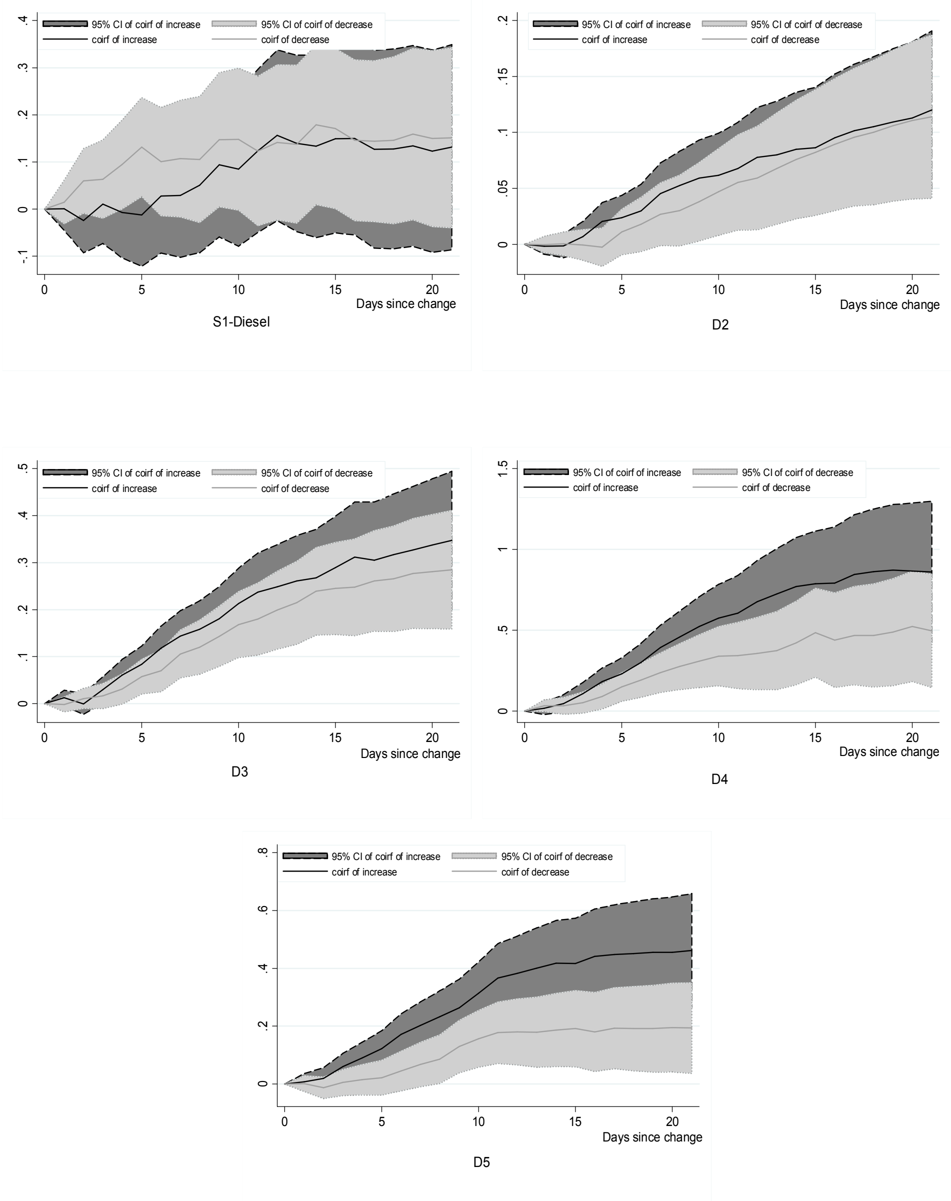

Figure 4.1 - Diesel COIRFS based on the VECM applied on each segment.

Note: The horizontal axis represents the number of days since a wholesale price change, the vertical axis represents the cumulative orthogonalised impulse response of the retail price in USD in response to a one standard deviation change in wholesale price (US$). Changes in wholesale prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI. The underlying daily VECM with 17 (diesel) or 15 (gasoline) lags implies that robust conclusions can only be drawn from the graphs from day 1 to day 18 or 16 since the change.

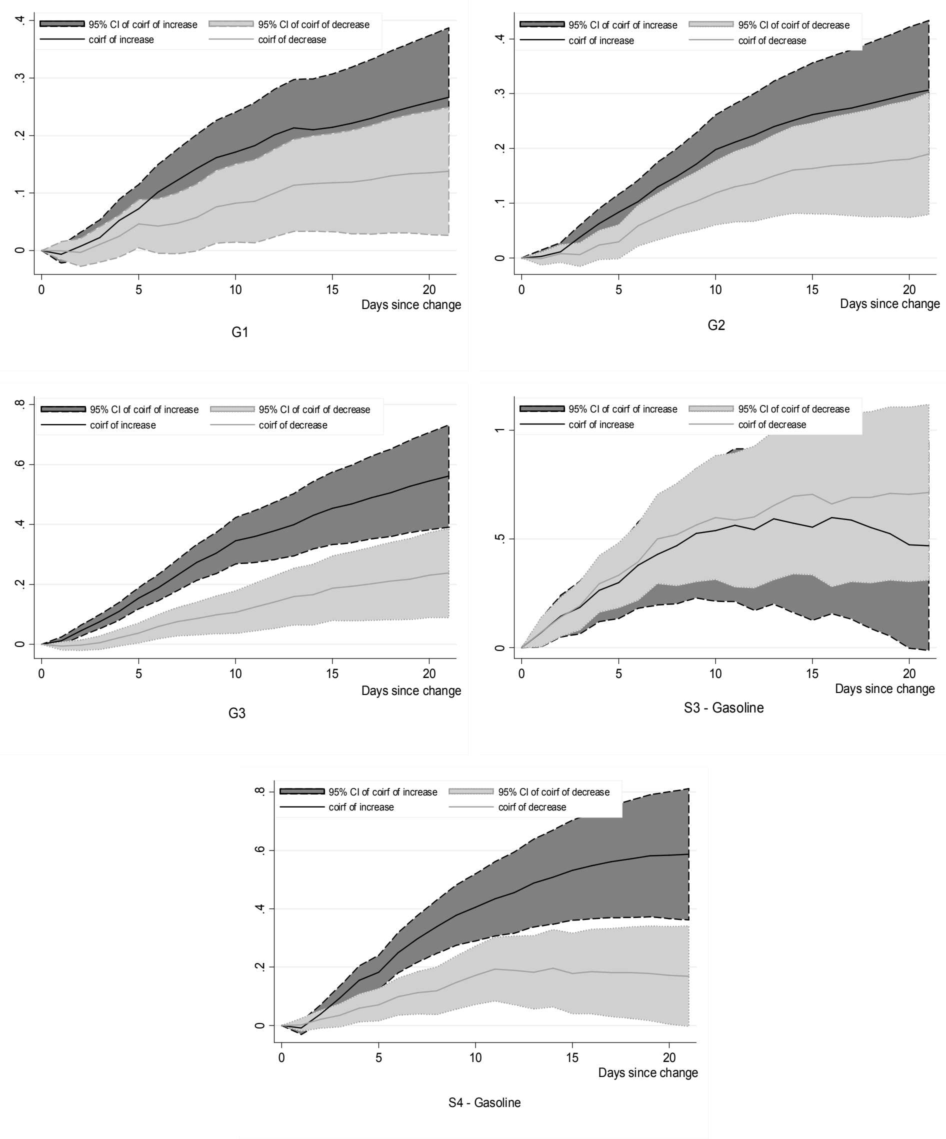

Figure 4.2 - Gasoline COIRFS based on the VECM applied on each segment.

Note: The horizontal axis represents the number of days since a wholesale price change, the vertical axis represents the cumulative orthogonalised impulse response of the retail price in USD in response to a one standard deviation change in wholesale price (US$). Changes in wholesale prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI. The underlying daily VECM with 17 (diesel) or 15 (gasoline) lags implies that robust conclusions can only be drawn from the graphs from day 1 to day 18 or 16 since the change.

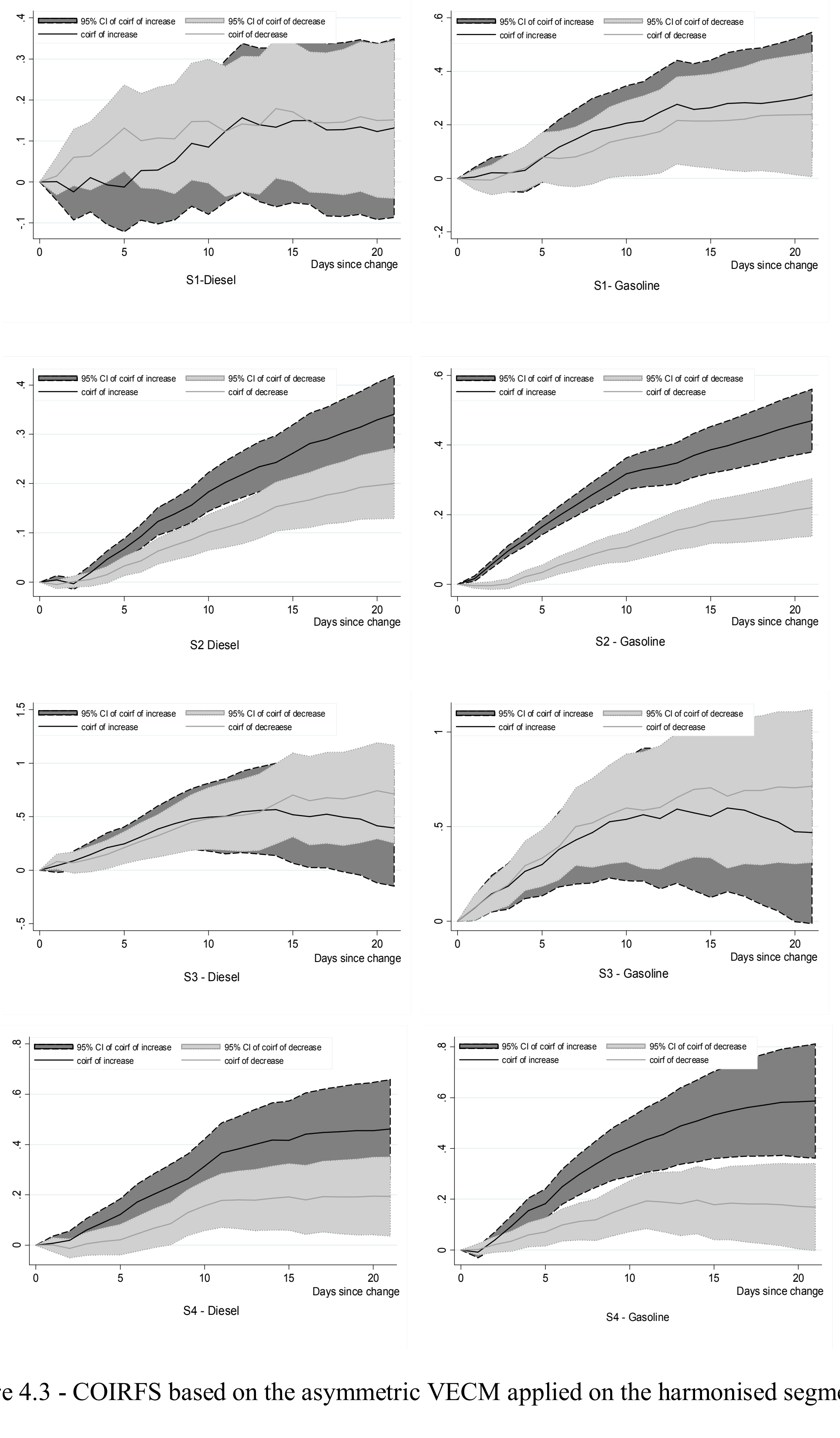

Figure 4.3 - COIRFS based on the asymmetric VECM applied on the harmonised segments.

Note: The horizontal axis represents the number of days since a wholesale price change, the vertical axis represents the cumulative orthogonalised impulse response of the retail price in USD in response to a one standard deviation change in wholesale price (US$). Changes in wholesale prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI. The underlying daily VECM with 17 (diesel) or 15 (gasoline) lags implies that robust conclusions can only be drawn from the graphs from day 1 to day 18 or 16 since the change.

Figure 4.7 above shows that the long period from 2001 to 2008 (S2) is where significant asymmetric price transmission is observed. In this period whilst the retail gasoline price increase 15 days after the $1 spot price increase is £0.5/barrel the retail gasoline price decrease 15 days after a $1 spot price decrease is only £0.25/barrel. In turn in a period of high volatility, a $10/barrel increase in spot gasoline price would generate a retail positive response of £5/barrel whilst a similar decrease would decrease the retail gasoline price by only £2.5/barrel. In such conditions of high volatility, the welfare transfer of £2.5/barrel would correspond to a mere 1.6 pence per litre. For an average driver using 100 litres of gasoline per month, the cost of asymmetries would be £1.6. In the diesel market the cost of asymmetric pricing is much lower at £0.11 /barrel or 0.7 pence per litre.

This confirms the results of Johnson (2002) who stated that the greater asymmetries in the gasoline US daily price response were probably due to the fact that drivers of diesel cars have lower search costs than drivers owning gasoline cars. Table 4.12 below shows the welfare transfer generated by APT for the segment 2001-2008. Even in a case of extreme oil volatility ($10 change in spot price), the welfare transfer could be considered negligible for the average driver utilising 100 litres of diesel (70 pence) or gasoline (£1.6) every month.

Standard deviation in Spot Price	COIRF 15-17 days after a standard impulse (£/brl)	Standard welfare gain for the retailer in £/brl	Welfare gain for the retailer in £/brl: $10 change	Welfare gain for the retailer in pence/litre: $10 change
$\Delta S+ = 0.79$	0.39	+0.21	+2.5	+1.6
$\Delta S- = 0.72$	0.18			
$\Delta W+ = 0.82$	0.29	+0.11	+1.1	+0.7
$\Delta W- = 0.76$	0.18			
	Total welfare gain for both fuels	+0.32	+3.6	+2.3

Table 4.12 - Estimated welfare transfer from the end user to the retailer based on the VECM.

Table 4.13 below shows that although the welfare transfer could be considered marginal for the end user, it is generated important additional profits for the main fuel retailers. In one year of rising price such as the year 2005, my model predicts that British Petroleum (BP) have gained £11.8M from APT; in other words by responding to price increases faster than to price decreases. For the following three fuel retailing companies in terms of volume delivered (Tesco, Esso and Shell), the gains are similar and range between £8.5M and £8.7M. Table 4.12 and table 4.13 demonstrate that APT are also the result of the consequent difference in size between the average driver and the Big Oil companies that also benefits from being vertically-integrated (BP, Shell and Esso which is the retail brand of the giant Exxon-Mobil). Whilst the retail price data considered in this study only accounts for fuel delivered in 'normal' petrol stations, it would be an interesting extension to consider contract prices in the commercial sector (Heavy Goods Vehicle) in which the size of the consumer (transports companies) is considerably more important.

2005 data	Volume delivered in kl*	Estimated welfare gains from APT	
BP	5,877,872	£	11,829,679
Tesco	4,347,640	£	8,749,967
Esso	4,255,992	£	8,565,518
Shell	4,252,424	£	8,558,338

Table 4.13 - Estimated profit generated from APT for the top 4 fuel retailers in the UK in 2005.

*kilolitres: volume data obtained from Experian Catalist reports.

4.5 Discussion

In this chapter, the results confirm the importance of the choice of data frequency. Whilst the weekly model does not uncover any evidence of asymmetric pricing, the daily model provides evidence of significant asymmetries in both diesel and gasoline markets. Furthermore, the tests conducted on the daily price data unveiled the presence of four structural breaks for the pair of diesel prices and four other breaks for the gasoline prices. The sample (for diesel and gasoline series) is then split into five segments and the model (VECM) is replicated for each segment. In order to draw comparisons between diesel and gasoline prices, four final harmonised segments are chosen based on the plausibleness of the break dates. This fastidious testing procedure is a key contribution as it enables us to separate four periods with alternating pricing regimes: January 2000 to March 2001 is a period of recession and/or declining price, March 2001 to May 2008 a period of constantly rising price; thereafter May 2008 to January 2009 prices are declining rapidly and finally price increase rapidly until the end of 2010.

There are significant asymmetries in long periods of rising demand (2001-2008 and 2009-2010) whilst periods of recession (2000 and 2008) do not exhibit any significant asymmetries. I find that asymmetries are compatible with periods of high volatility (2005-2007 and 2009-2010) and moderate volatility (2001-2004). The results somewhat contradict the findings of Peltzman (2000) and Radchenko (2005), who stated that asymmetries are reduced in periods of high volatility in the United States; they attributed it to coordination failure in periods of higher price volatility. The descriptive statistics for 2008 show at the same time very high volatility and plummeting oil price whilst the recession of 2000 exhibited less volatility and a marginal fall in oil price. Meanwhile both periods did not reveal any presence of APT in retail price response; the common factor for the two periods is rather the presence of a recession.

Whilst the actual effect of asymmetries on the average driver's budget can seem marginal, the combination of these asymmetries with high taxation and regularly rising price may explain the mounting controversy over this particular topic. In fact, I provide evidence that the welfare gains for the major fuel retailers are not negligible. Whilst the previous studies on the UK fuel markets frequently rejected the hypothesis of asymmetric price transmission, why should the present study's results be more trusted? The response mainly lies in the unique daily dataset and the rigorous methodology.

First as far as the pass-through of EU spot prices to UK retail prices is concerned, I find that the spot prices are endogenous and in turn a VEC model should be used rather than the classical

ECM. This finding confirms the proposition of Geweke (2004) who stated that endogeneity and feedback were often neglected in the literature.

Second, I confirm the importance of utilising datasets where the sample frequency at least matches that of price adjustments. When comparing the weekly and the daily model, it is obvious that the daily dataset is more appropriate to capture the recent volatility of fuel prices. This issue was raised and confirmed in the study of Asplund et al (2000) for the Swedish gasoline market and the most recent North American studies utilised daily or even twice-daily data.

Third, the availability of daily data allows addressing the issue of aggregation over time for long sample periods. Structural break detection tests are performed on diesel and gasoline spot and retail prices, uncovering different pricing regimes depending on the period studied. The tests resulted in splitting the sample into five segments for each fuel's sample (diesel and gasoline). Whilst most of the segments exhibited some degree of asymmetric price transmission, the smaller samples resulted in loss of statistical significance, obvious in the confidence intervals of the COIRFs.

Nevertheless, the results suggested that asymmetries generally arise in periods of rising price, regardless of the level of volatility. In turn, by isolating the segments of recession and harmonising the segments for both fuels; the results for the period 2001-2008 were statistically more significant and provided a clearer picture on the level of asymmetries.

Why are asymmetries more significant in periods of rising oil price? Whilst the pass-through of spot prices into UK retail prices is only partial, the response to a spot increase is generally twice as important as in the case of a spot decrease. In turn asymmetries can be presented as a mechanism of welfare transfer from the small end user to the bigger fuel retailer.

The literature often states than it is the result of collusion between retailers and my results corroborate this hypothesis. In periods of rising oil price, fuel retailers are well-aware that demand for oil is increasing worldwide and that spot price is rising in the long-run. Although the retail chains also respond to spot decreases by decreasing their retail prices, they do so with less eagerness as they consider the decrease as a short-term adjustment and anticipate the next period of rising price. This is evident in the first 10 days after a spot change in segment 2 (Figure 4.7) as the response to an increase is twice as important as that to a decrease. In periods of recession, the picture is different as the response to both positive and negative impulses is almost symmetric with variations across segments.

Haltiwanger and Harrington (1991) showed that deviation from collusion (they call cheating) is easier when future demand is falling, given that the value of the forgone collusive profits is smaller as compared to when demand is on the rise. Though, Fabra (2006) showed that the incentive to cheat is linked to the value of firms' capacities. When capacity constrains are tight enough, collusive firms find it harder to collude during booms whereas they find it easier with large capacities. In the context of the present study Borenstein and Shepard (1996) note that the petroleum industry is characterised by cyclical cost movements rather than tight capacity constraints. Throughout the literature review, there was no evidence that retail petroleum markets can be characterised by tight capacity constraints. Consequently, it can be confidently stated that the present results support the model of Haltiwanger and Harrington (1991) without contradicting the important theoretical contribution of Fabra (2006).

Although Peltzman (2000) and Radchenko (2005b) associated volatility to a lesser degree of price asymmetry; it is rather due to the fact that volatility in oil price is often coupled with recession due to increased speculation in crude markets. Kohl (2002) argued that although OPEC is often accused of causing volatility by not adjusting to changing demand in oil, the oil futures market is playing an even greater role in oil price volatility through the actions of speculators, hedge funds and commercial traders. By being more active when prices fall, speculators actively increase the level of volatility in spot prices as observed recently in 2008. As explained in detail in the first two chapter of this thesis, such reduction (or disappearance) in the degree of asymmetry would support the oligopolistic coordination theory. My results do not clearly support the arguments of Peltzman and Radchenko (2005). Nonetheless, further evidence from other countries is needed in order to check whether volatility appears mainly in periods of recession and reduces the degree of asymmetry.

As far as the comparison between diesel and gasoline markets is concerned, Johnson (2002) is the unique study known to have discussed this particular topic. He found greater asymmetries in the gasoline markets and he argued that this result is consistent with a search costs explanation. The diesel users drive cars that are more fuel-efficient and the cost of searching for cheaper price is lower. Diesel drivers are assumed to search more for the cheapest pump prices while drivers of petrol cars are more likely to buy smaller volumes of fuel. Finally the choice of a diesel car is often based on economy rather than performance, a choice that suggests a more economical behaviour. Our results also provide support for this explanation, especially when the segment 2001-2008 is isolated. The difference between the costs of asymmetry between the two fuels is quite substantial and supports the findings of Johnson (2002).

5. Price Stickiness in a Competitive Petroleum Retail Market

5.1 Introduction

The final empirical investigation focuses on a local market: the data includes all the daily diesel and gasoline prices of petrol stations with 'B' postcodes, in other words all the stations in the Birmingham (UK) area for the year 2008. In the APT literature, studies using regional data were limited to North American markets and this represents the first opportunity to study a local market within a European country. Although the petroleum markets are international by nature, station level data are necessary in order to understand the pricing mechanisms behind APT.

While I know from the previous chapter that in 2008 there is no evidence of APT at the national UK level, the Birmingham data allow us to test the robustness of the result at a more local level. Apart from the presence or not of APT, I am interested in the pricing mechanisms at the local level: do retailers with market power adjust prices more slowly than competitive firms? What are the characteristics of retail petroleum pricing in the Birmingham area? Can these characteristics be associated to the level of competitiveness in this area?

Out of the existing 222 stations in the B postcode area, the Experian Catalist data covers a satisfying number of observations for 191 outlets. Whilst the spot gasoline and diesel prices fluctuate on a daily basis from Monday to Friday, they are not published for Saturdays and Sundays.

At the level station, I observe that retail prices are held constant in the short run as in figure 5.1. In the short run and at the station level, the price remains constant for several days despite the frequent fluctuations in spot price.

To explain this point, I take the following example; I randomly chose two stations in Northern Birmingham. One is a supermarket service station (ASDA) and one belonging to a major oil company (BP). The pricing pattern is similar for both stations with long periods of price stability and upward price adjustment triggered by a one penny per litre increase in cost. Smaller changes in cost do not appear to trigger any price adjustment. In all previous chapters, I have observed a clear pattern of APT. Looking at station-level data uncovers one characteristic which has been impossible to study at the aggregated national level: price stickiness for both upwards and downwards cost changes. In contrast, the aggregated data uncovered downward price stickiness although not for this particular period of study.

Price stickiness is the topic of a well-developed literature, slightly distinct from but linked to the topic of APT. Here I only succinctly list some references in order to understand the theoretical background. In fact the sticky prices literature is often linked to the menu cost explanation.

Rotenberg (1982) presented robust evidence suggesting that US prices are in fact sticky. He presented a formal model explaining price stickiness by the fact that firms fearing to upset their customers attribute a cost to price changes. The model developed is tested empirically with US post-war data and the results strongly support this theory.

Ball and Romer (1991) argue that sticky prices are the result of coordination failure rather than menu costs adjustments. Borsenstein and Shepard (2002) develop a model of price adjustments where futures prices of gasoline adjust incompletely to crude oil price shocks that occur close to the expiration date of the futures contract. They examine wholesale price responses in 188 gasoline markets and find that firms with market power adjust prices more slowly than do competitive firms, consistent with the model.

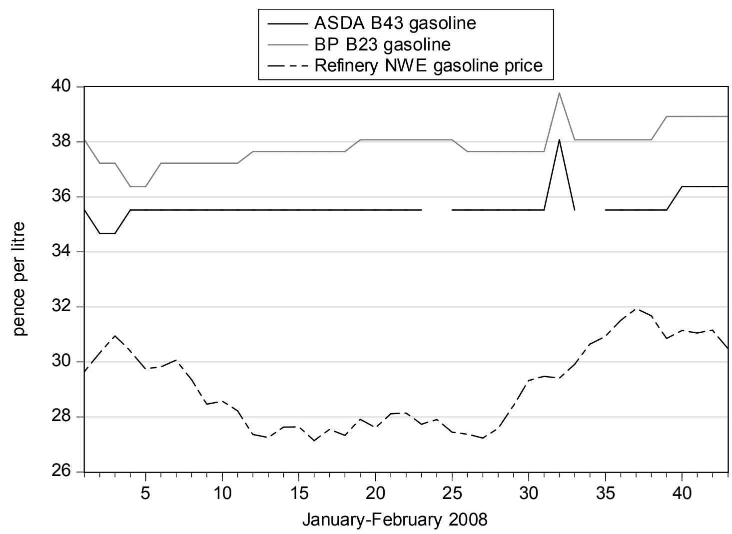

Figure 5.1. Spot and retail gasoline prices for 2 stations in the Northern suburbs of Birmingham.

According to Davis and Hamilton (2004), the menu-cost interpretation of sticky prices implies that the probability of a price change should depend on the past history of prices only through the gap between the current price and the frictionless price. They find that this prediction is broadly consistent with the behaviour of 9 Philadelphia gasoline wholesalers. They nevertheless reject the menu-cost model as a literal description of these firms' behaviour, arguing instead that price stickiness arises from strategic considerations of how customers and competitors will react to price changes.

As far as the EU is concerned, Alvarez et al. (2006) observe that prices in the Euro area are in general stickier than in the US. Furthermore, some asymmetries are observed: downward price rigidity is only slightly more marked than upward price rigidity. The relevance of theories that explain price stickiness, such as implicit or explicit contracts, marginal costs, and coordination failure, is confirmed, whereas menu costs, pricing thresholds, and costly information explanations are judged less relevant by firms.

Why have sticky prices raised less interest than APT in the EU petroleum markets? The main reason is the higher cost of stations-level data and the fact that aggregated data do not uncover the existence of price stickiness. When average retail diesel and gasoline prices are considered for the 191 stations in the Birmingham area, they seem to closely follow spot prices movements. Figure 5.2 and figure 5.3 below clearly show this pattern. Although the year 2008 is market with extremely high volatility in upstream prices, Birmingham retail prices seem to closely follow the pattern of spot prices.

In this study, I observe a high level of price stickiness in the Birmingham area which is a highly competitive area. I investigate the price transmission mechanism and do not find evidence of asymmetries. Whilst price stickiness has often been associated to market power and coordination failures, I observe at the same time symmetric price transmission and only partial pass-through in a rather competitive environment.

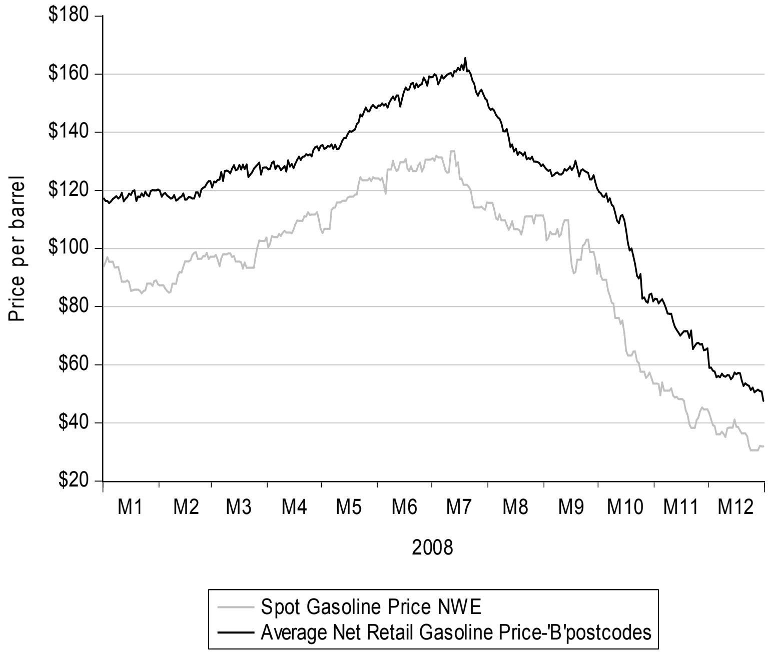

Figure 5.2 - Spot and average retail gasoline price for all 191 petrol stations

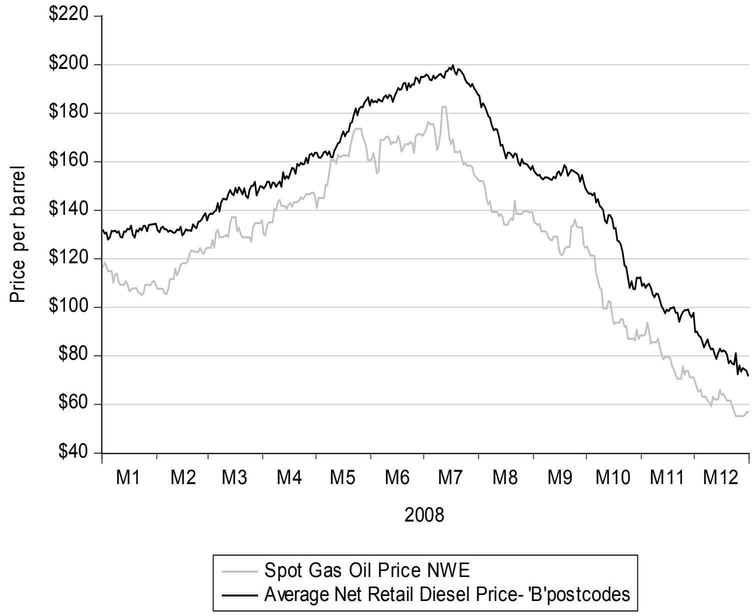

Figure 5.3 - Spot gas oil price and average diesel price for all 191 petrol stations

5.2 Market and data description

5.2.1 Further details on the UK petroleum retail market

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Table 5.1 - Volume share (VS) and Market share in number of sites (MS) in the UK (2008).

Note for table 5.1: Effectiveness is a measure of the total volume delivered in comparison with the total number of sites: VS divided by MS.

Source: Experian Catalist UK V4 2008.

The data for 2008 show that the UK retail petroleum market is the least concentrated in the EU with a fierce competition between the “Big Five” major oil companies (BP, Shell, Esso, Total and Texaco) sharing around 56% of the number of sites and the volume delivered and four highly-effective supermarkets (Tesco, Morrison’s, Sainsbury’s and Asda) using a very aggressive pricing strategy. The supermarkets represent 35% of the volume of fuel delivered in the UK whilst their site share does not exceed 12.5%. However table 5.2 below provides further evidence on the real type of ownership. In fact out of 9264 petrol stations in the UK 2180 only are managed directly by British and international oil companies whilst 5869 are dealer-owned although they are branded by the "majors".

These 'Dealer' outlets are independent from the management of the major oil companies although they benefit from their marketing. The term "company" as provided by Experian Catalist covers all types of oil companies present in the UK petroleum retail market (majors, International oil companies and smaller British oil companies). The data show that supermarkets with only 13% share of the total sites deliver 36% of the total volume of fuel sold to the end users. This exceeds the 35% share of the dealers and 28.8% of the other oil companies.

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Table 5.2 - The UK retail petroleum markets by type of ownership.

Source: Experian Catalist UK V4 2008.

One could argue that dealer-owned and company-owned stations could have different pricing strategies at the local level. Nevertheless, the data treats petrol stations according to brand rather than ownership. An overview of the data suggests that the brand and the location rather than the type of ownership causes prices to be more or less competitive. In fact, it is obvious from the data that independent petrol stations follow the pricing strategy of the company which brands them.

5.2.2 The Birmingham petroleum retail market

The data comes from Experian Catalist and covers all the 222 stations with "B" or "Birmingham" postcodes for the year 2008. The Birmingham map (figure 5.4) shows the full area covered by this chapter. Whilst the richness of the data is unique, there are an important number of missing observations, especially for Saturdays and Sundays. I therefore exclude 31 stations with little or no observations at all. For the purpose of this study, I divide the studied area into 6 areas:

- Northern Towns: Sutton Coldfield (B72 to B76) and Tamworth (B77 to B79).
- North Birmingham suburbs: including Aston, Erdington and Kingstanding: B6, B7, B20, B21, B23, B24, B35, B42, B43 and B44.
- East Birmingham: B8, B9, B10, B25, B26, B33, B34, B36, B37, B40 and B46.
- West Birmingham: Edgbaston and Harborne (B15, B16, B17 and B32), and the Western towns from Halesowen to West Bromwich (B62 to B71).
- South Birmingham: Sparkhill to Kings Heath (B11 to B14), Acocks Green B27 to B31, B38, B45, B47 and B48.

  .Southern Towns: Alcester, Bromsgrove, Henley-in-Arden, Redditch and Solihull

The NWE spot prices used are reference prices similar to that used in the major EU refinery hub: the ARA (Amsterdam-Rotterdam-Antwerp). As far as the diesel market is concerned I use the 'Gas Oil-European Economic Community Cost, Insurance and Freight Cargos NEW' in U$/MT. For the gasoline market I use the 'Unleaded Regular Cost Insurance and Freight NWE' in U$/MT. They are converted in US$/barrel using the conventional formulas in the industry.

As far as the retail prices are concerned, the data provided by Experian Catalist represent the pump prices in pence per litre including duty and VAT. I convert the retail prices into net of duty and net of VAT prices. Subsequently I convert the net prices in pence per litre into US$/barrel price using the sterling pounds into US$ WMR&DS exchange rate.

The resulting data is represented below in table 5.3 for gasoline prices and table 5.4 for diesel prices.

Aston University

Illustration removed for copyright restrictions

Figure 5.4 - Map of Birmingham "B" postcodes.

Source: Wikipedia (n.d)

	G	S	ΔG	ΔG>0	ΔG<0	ΔG=0	ΔS	ΔS>0	ΔS<0
Mean	40.2	31.2	-0.1	0.1	-0.2	0.0	-0.1	0.2	-0.3
Std. Dev.	7.5	7.6	0.5	0.3	0.4	0.0	0.7	0.4	0.5
Skewness	-0.8	-0.7	-0.6	3.2	-2.9	0.0	-0.4	2.2	-2.5
Kurtosis	3.0	2.5	7.3	15.8	13.9	0.0	5.3	9.1	13.0
Observations	254	254	253	96	109	48	253	121	132

Table 5.3 - Descriptive statistics for the gasoline market in the Birmingham area.

Note: *G for average retail gasoline price. **S for spot gasoline oil price.

	P*	W**	ΔP	ΔP>0	ΔP<0	ΔP=0	ΔW	ΔW>0	ΔW<0
Mean	49.5	41.7	0.0	0.1	-0.1	0.0	0.0	0.3	-0.4
Std. Dev.	8.1	8.5	0.4	0.2	0.3	0.0	0.9	0.6	0.5
Skewness	-0.1	-0.2	-1.7	3.1	-3.7	0.0	0.4	2.7	-1.6
Kurtosis	2.1	2.1	10.6	16.6	19.8	0.0	4.5	12.3	5.6
Observations	254	254	253	126	120	7	253	126	127

Table 5.4 - Descriptive statistics for the diesel market in the Birmingham area.

Note: *P for average retail diesel price. **W for spot gas oil price.

Table 5.3 shows that the average retail margins for gasoline amounts to $26 per barrel whilst the mean retail gasoline price is $120 per barrel. Conversely, table 4 shows that whilst the net-of-taxes average retail diesel price is higher at $146 per barrel, the average retail margins does not exceed $21 per barrel. The gross retail margins are consequently higher in the Birmingham gasoline market (22%) than in the Birmingham diesel market (14%). The margins are also higher than reported in chapter 3 for the UK for the period 1994-2013.

The average retail gasoline margins were at $18 and the average retail diesel margins were at $17.40. In addition, the difference between gasoline and diesel margins was reported to be $0.60 in 1994-2013 whilst it reaches $5 in 2008 in Birmingham. The UK petroleum sector benefited from relatively high margins in 2008 thanks to the sharp decrease after the peak in the summer.

Table 5.5 below shows that Texaco is the market leader in the Birmingham retail market with market share of 24.1%. The domination of the major oil companies is confirmed as Texaco, Total and BP control nearly 58% of the retail sector. Esso and Shell only control less than 10% of the retail stations in the Birmingham area. Although they control only 22 stations out of 191 in the Birmingham area, supermarkets deliver up to 3 times more volume of fuel than most company-owned stations as reported in table 5.1 above. Table 5.5 also shows that IOCs only control 21 stations out of 191 in the Birmingham area although their market share is slightly above the national average.

BRAND	COUNT	MS
TEX	46	24.1%
TOT	32	16.8%
BP	32	16.8%
ESS	19	9.9%
SHE	16	8.4%
JET	11	5.8%
MUR	8	4.2%
MOR	6	3.1%
SAI	6	3.1%
TES	6	3.1%
ASD	4	2.1%
UNB	2	1.0%
GUL	2	1.0%
POW	1	0.5%
All	191	100%

Table 5.5 - All petrol stations with B postcodes

In Birmingham the market concentration is higher than the national average: the Herfindhal-Hirschmann index in number of sites for the Birmingham area is 1150 whilst it is only 853 at the UK level in 2008. Indeed, three of the five major oil companies have much more market share in the Birmingham area than at the national level. Texaco controls 24.1% of the petrol stations in the Birmingham area instead of 12.5% at the UK level; Total 16.8% instead of 10.6% and BP 16.8% instead of 13%. As far as Esso is concerned, the market share is 9.4% instead of 9.9% at the national level. Only Shell loses with a market share of 8.4% instead of 10.8% at the national level.

The following tables (table 5.6 to table 5.11) summarise the retail market shares by area. There are no major differences in market structure across areas although I note that Texaco and BP have a relatively weaker presence in the North Birmingham suburbs whilst Total has a leader position in this area only.

BRAND	COUNT	MS
TEX	7	31.8%
BP	4	18.2%
SHE	3	13.6%
MUR	2	9.1%
TOT	2	9.1%
ASD	1	4.5%
JET	1	4.5%
MOR	1	4.5%
POW	1	4.5%
All	22	100.0%

Table 5.6 - East Birmingham

BRAND	COUNT	PERCENT
TOT	11	34.4%
MUR	4	12.5%
TEX	4	12.5%
BP	3	9.4%
SHE	3	9.4%
ESS	2	6.3%
ASD	1	3.1%
JET	1	3.1%
MOR	1	3.1%
SAI	1	3.1%
UNB	1	3.1%
All	32	100.0%

Table 5.7 - North Birmingham

BRAND	COUNT	MS
TEX	7	31.8%
BP	4	18.2%
SHE	3	13.6%
MUR	2	9.1%
TOT	2	9.1%
ASD	1	4.5%
JET	1	4.5%
MOR	1	4.5%
POW	1	4.5%
All	22	100.0%

Table 5.8 - Northern Towns

BRAND	COUNT	MS
TEX	12	36.4%
BP	5	15.2%
ESS	4	12.1%
TOT	4	12.1%
SHE	3	9.1%
MUR	2	6.1%
JET	1	3.0%
MOR	1	3.0%
UNB	1	3.0%
All	33	100.0%

Table 5.9 - South Birmingham

BRAND	COUNT	MS
BP	8	22.9%
ESS	6	17.1%
TEX	5	14.3%
TOT	5	14.3%
JET	2	5.7%
MOR	2	5.7%
SAI	2	5.7%
SHE	2	5.7%
TES	2	5.7%
GUL	1	2.9%
All	35	100.0%

Table 5.10 - Southern Towns

BRAND	COUNT	MS
TEX	14	33.3%
BP	8	19.0%
TOT	6	14.3%
JET	4	9.5%
SHE	3	7.1%
TES	3	7.1%
SAI	2	4.8%
ESS	2	4.8%
All	42	100.0%

Table 5.11 West Birmingham

Table 5.12 and table 5.13 provide price comparison across areas and types of petrol stations. Supermarkets' petrol stations charge lower gasoline prices than major oil companies and IOCs. However the average diesel price of major oil companies is lower than supermarkets' average diesel price. Price dispersion between different types of stations is greater in the gasoline market than in the diesel market; it seems that retail stations anticipate the fact that diesel users face smaller search costs due to the greater fuel efficiency of the cars they drive.

As far as the geographical patterns are concerned, I note that petrol stations in the Northern towns and Northern suburbs of Birmingham charge the lower prices of all. In contradiction with the findings according to the category of fuel station, price dispersion across suburbs and towns is greater in the diesel market than in the gasoline market. Diesel is almost $7 per barrel cheaper in Northern Birmingham suburbs than it is in Easters Birmingham suburbs. It seems likely that this corresponds to a deliberate strategy by the dominant actor in this area: Total. The French major company is indeed most likely to reduce the price of diesel as it benefits form the greatest number of refineries across the EU; this also seems to reduce the prices of diesel in the northern towns of Sutton Coldfield and Tamworth.

	SouthB	SouthT	EastB	WestB	NorthT	NorthB	MAJ	IOC	SUP
Mean	120.84	121.84	121.17	120.01	118.03	119.82	120.81	123.09	116.81
Std. Dev.	29.68	29.63	29.79	29.93	29.28	29.43	29.85	29.97	29.14
Skewness	-0.91	-0.92	-0.90	-0.89	-0.89	-0.90	-0.90	-0.87	-0.87
Kurtosis	3.02	3.17	3.01	2.97	3.02	3.01	3.00	3.03	3.02
Observations	364	337	356	366	364	363	365	361	356

Table 5.12 - Descriptive statistics for retail gasoline prices by area and type of station

	SouthB	SouthT	EastB	WestB	NorthT	NorthB	MAJ	IOC	SUP
Mean	147.2	147.8	148.9	146.1	144.3	142.3	145.4	149.7	147.0
Std. Dev.	32.9	32.4	33.0	32.8	32.4	32.3	40.0	32.9	32.3
Skewness	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-2.6	-0.4	-0.4
Kurtosis	2.4	2.5	2.5	2.5	2.5	2.5	19.6	2.5	2.5
Observations	361	328	341	365	363	356	365	347	363

Table 5.13 Descriptive statistics for retail diesel prices by area and type of station

Notes for tables 5.12 and 5.13: B stands for the city of Birmingham whilst T stands for the towns within the "B" area as defined in the previous subsection.
MAJ= major oil companies; IOC= International Oil Companies, SUP= Supermarkets

5.3 Price Transmission in the Birmingham area

The detailed results are in Appendix C.

5.3.1 Methodology

I consider the price transmission from spot prices as defined above to the average retail price for all 191 petrol stations with B postcodes. The preliminary regressions did not reveal any major difference across the towns and suburbs studied. Similar to the previous chapters, the standard Johansen procedure is used.

However the results of the cointegration test are mixed and the pattern of price stickiness observed with the raw data is lost with the VECM. In contrast the VAR without the error-correction term best captures the price stickiness as observed in Borenstein and Shepard (2002). As a result I use a bivariate VAR in first differences with q lags:

$$\Delta \mathbf{Y}_t = \mathbf{\Phi}_1 \, \Delta \mathbf{Y}_{t-1} + \mathbf{\Phi}_2 \Delta \mathbf{Y}_{t-2} + \ldots + \mathbf{\Phi}_q \, \Delta \mathbf{Y}_{t-q} + \nu_t \qquad (5.1)$$

Where Y_t is x×1 vector of the retail and wholesale variables of interest: respectively G_t and S_t for the gasoline market; and P_t and W_t for the diesel market. ν_t is x×1 vector of errors terms, $\mathbf{\Phi}_1,\ldots,\mathbf{\Phi}_q$ are n×n coefficient matrices.

In order to include asymmetric price transmission into the model, I modify (5.1) and split the vector into positive and negative prices changes:

$$\Delta\mathbf{Y}_t = \mathbf{\Phi}_1^+\Delta^+\mathbf{Y}_{t-1} + \mathbf{\Phi}_1^-\Delta^-\mathbf{Y}_{t-1} + \ldots + \mathbf{\Phi}_q^+\Delta^+\mathbf{Y}_{t-q} + \mathbf{\Phi}_q^-\Delta^-\mathbf{Y}_{t-q} + \nu_t \qquad (5.2)$$

I use lag tests and preliminary regressions and find that 7 lags are sufficient to capture the dynamics of price transmission for both diesel and gasoline markets. Although the Schwarz criterion (SBIC) is the most used in the literature with single-equation models, my tests with different lag orders and different versions of the models show that the SBIC advocated the use of a single lag in the model. This finding demonstrates the exaggerated penalty often imposed by this criterion with volatile daily data. I use the Akaike and Hannan-Quinn criteria to overcome this problem, and 7 lags are sufficient for both fuels.

Based on model (5.2) with 7 lags, I consequently use the cumulative orthogonalised impulse response functions (COIRFs) of the VAR as defined in Hamilton (1994). Here the recursive ordering of the variables is straightforward as I am primarily interested in the pass-through of the wholesale to the retail price; although I take into consideration the feedback in the underlying model.

5.3.2 Overall results

Figure 5.5 and figure 5.6 below show the COIRFs resulting from the model respectively for the gasoline and the diesel markets.

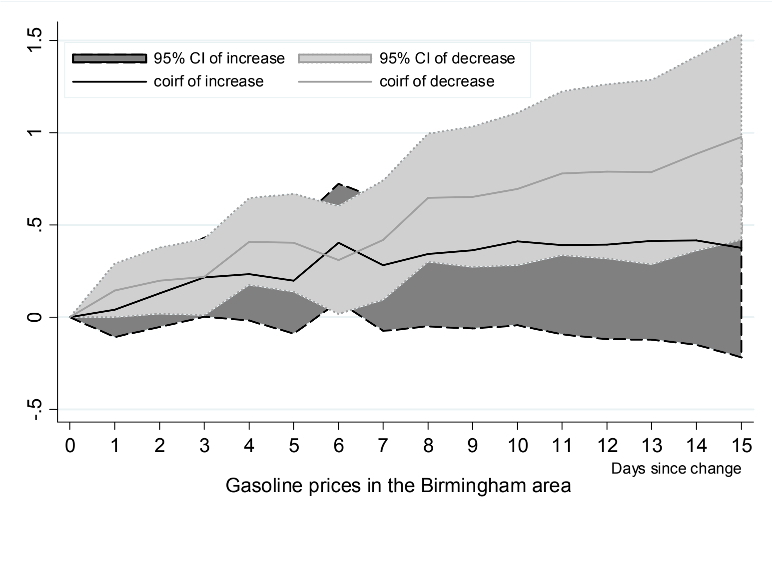


Figure 5.5 - COIRF of gasoline prices in the Birmingham area

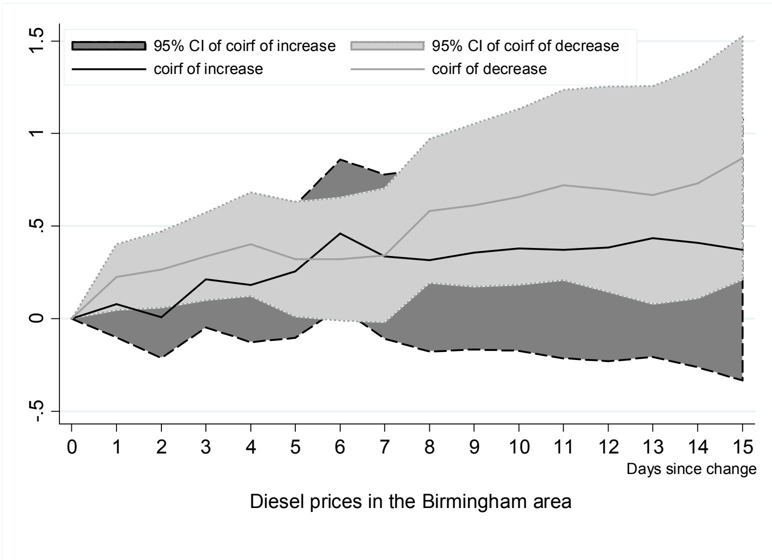


Figure 5.6 - COIRF of diesel price in the Birmingham area

Note: The horizontal axis represents the time in weeks since a spot price change, the vertical axis represents the cumulative orthogonalized impulse response of the retail price in US$ in response to a one US$ change in spot price. Changes in spot prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI. The underlying VECM with 7 lags implies that robust conclusions can only be drawn from the graphs from day 1 to day 8 since the change.

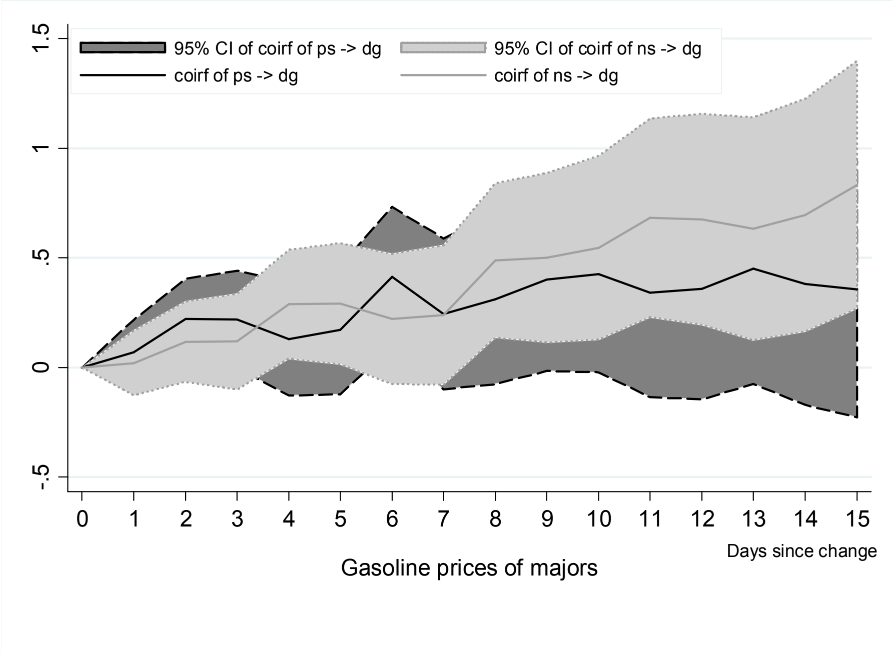
Although both figures above indicate no evidence of significant APT, I can draw several conclusions on the nature of petroleum pricing in the Birmingham market. Firstly, 7 days after the impulse the pass-through is symmetric for both fuels. Secondly, the price transmission is far from complete. As far as gasoline price transmission is concerned, 37% ($0.37 out of $1.09) of the standard deviation increase is passed through and nearly 31% ($0.37 out of $1.30) of the standard deviation decrease is passed through. As far as diesel price transmission is concerned, 22% 1) of the standard deviation is passed through for both increases ($0.35 of $1.61) and decreases ($0.25 of $1.56). These findings confirm the sticky prices hypothesis.

5.3.3 Results by type of petrol station

I use the same model and analyse the behaviour of petroleum retailers by type of ownership: majors, IOCs and supermarkets. Price stickiness is confirmed for all types of companies although IOCs respond to cost decreases more quickly than to increases.

Overall, I observe that retailers try not to upset customers by passing cost increases too quickly with some exceptions. Firstly, supermarkets increase their diesel prices in reaction to cost increases more quickly than they do for decreases. As supermarkets are committed to having the lowest prices in the UK, they seem to compensate with little response to cost decreases. Secondly, IOCs pass-through prices more fully than majors and supermarkets, especially in the case of cost decreases. This suggests that retailers with market power adjust their prices more slowly than competitive firms. Thirdly, supermarkets adjust their prices downwards and upwards more consistently than majors and IOCs with a clear stability of decision throughout the days. This is consistent with the fact that supermarkets act as leaders in the petroleum markets with high volumes delivered and lower prices. Supermarkets follow a clear pricing strategy whilst majors and IOCs seem to alternate increases and decreases in pursue of market share and margins.

Finally, I do not show the COIRFs by area of interest as the behaviour is similar for all six areas. There is no evidence of significant APT and the price stickiness is only more pronounced in the East Birmingham area.



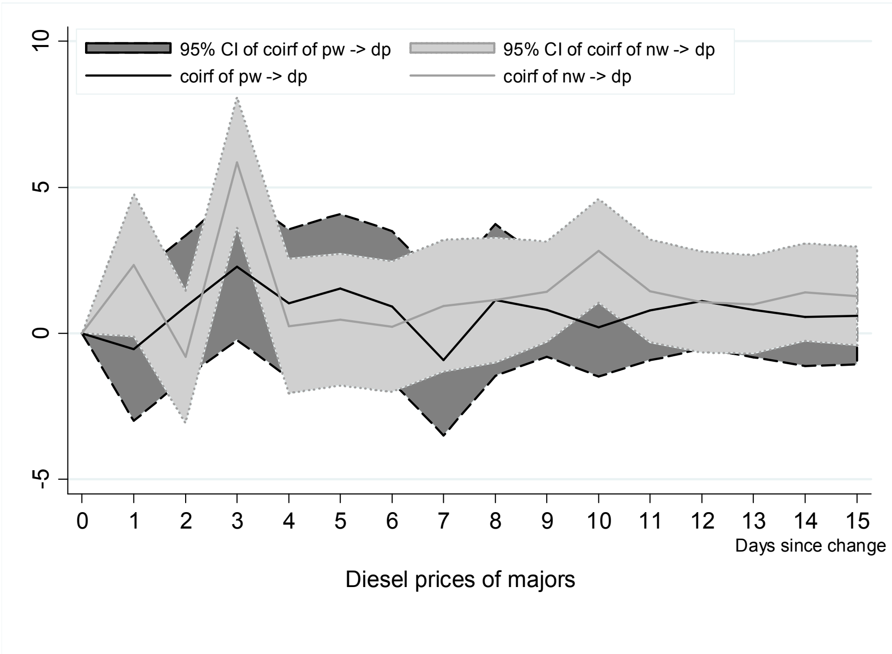
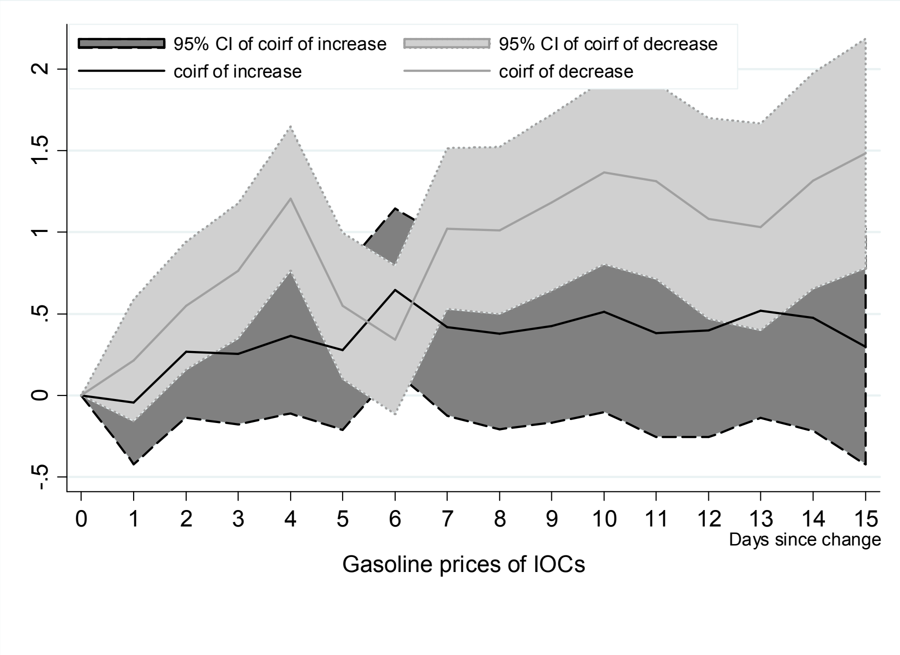


Figure 5.7 - Major oil companies



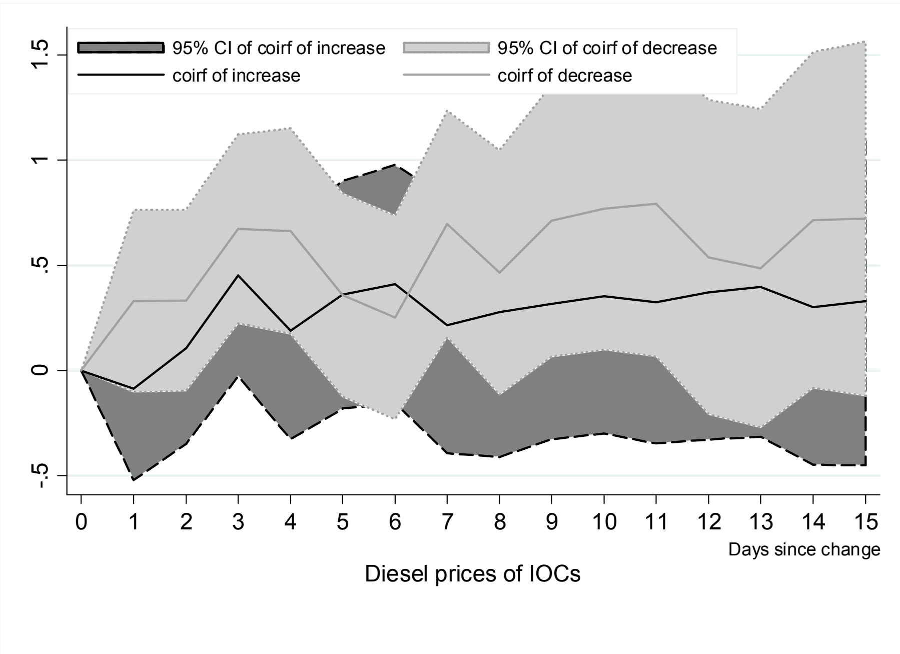
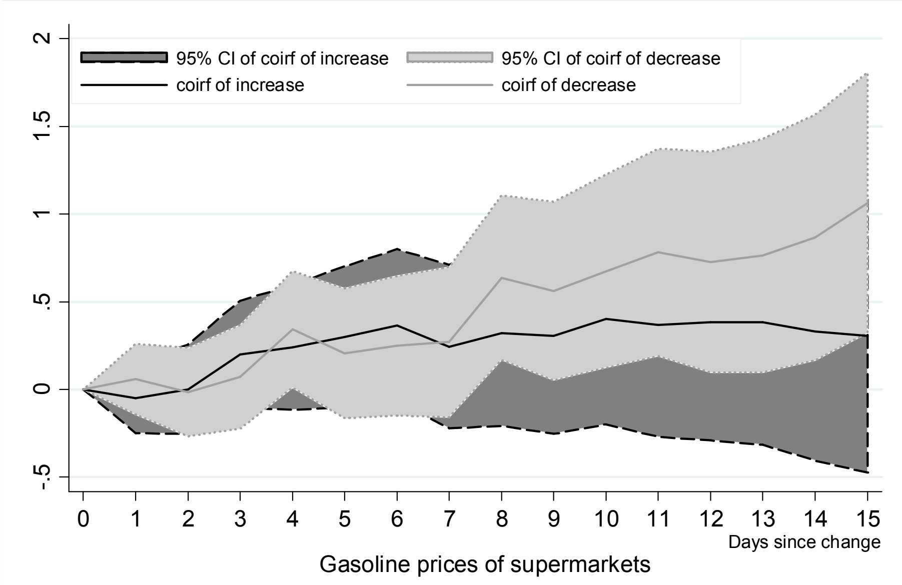


Figure 5.8 - IOCs



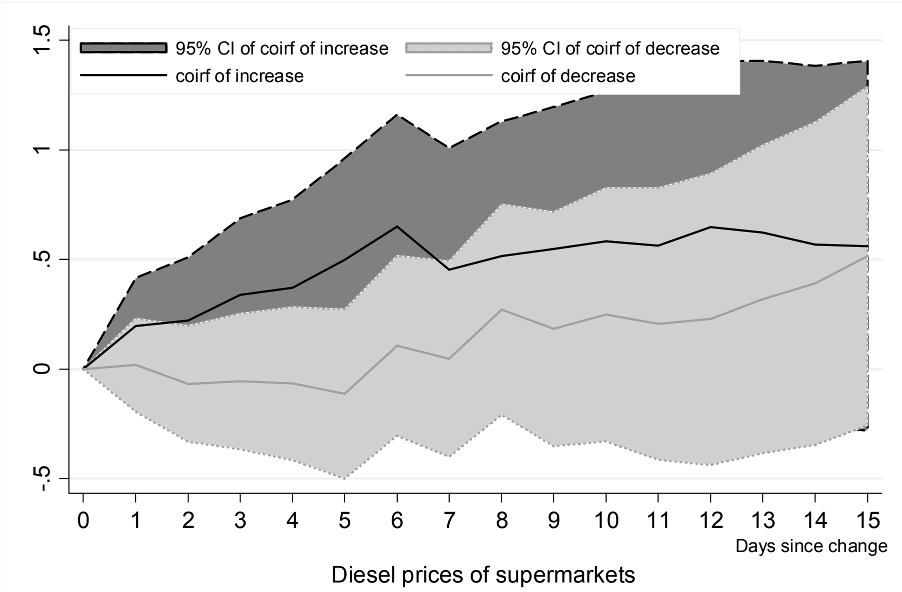


Figure 5.9 - Supermarkets

Note for figures 5.7, 5.8 and 5.9: The horizontal axis represents the time in weeks since a spot price change, the vertical axis represents the cumulative orthogonalized impulse response of the retail price in US$ in response to a one US$ change in spot price. Changes in spot prices are split into two impulses: increase (black) and decrease (grey) and the corresponding responses are also shown with their 95% CI. The underlying VECM with 7 lags implies that robust conclusions can only be drawn from the graphs from day 1 to day 8 since the change.

5.4 Discussion

I investigate the characteristics of retail petroleum pricing in the Birmingham area, using a unique panel of daily diesel and gasoline prices for 191 stations. Although the data dates back to 2008, I can draw several conclusions. The Birmingham data suggests a strong pattern of price stickiness although the hypothesis of symmetric price transmission cannot be rejected. This result also confirms the findings of chapter 4 regarding the absence of APT in the UK in the recession period of 2008.

There have been several contradicting explanations on the relationship between market power and price stickiness. First, my results are consistent with the model of Rotenberg (1982) which describes the sticky prices phenomenon as the willingness of retailers to try to avoid upsetting their customers. Often less than 30% of cost increases are passed-through with a clear-cut period of 'wait and see' of 2 to 4 days. Notwithstanding, petroleum retailers react similarly to cost decreases. This pattern of price stickiness for both upwards and downwards changes provide supports to the main assumption of the model: firms attribute a cost to price changes. The cost in the petroleum retailing case is the fear to lose customers over 1 or 2 pence per litre.

Secondly, the behaviour of petroleum retailers in the Birmingham area provides support to the findings of Borenstein & Shepard (2002). Although their results were limited to the wholesale market, I also find that firms with market power adjust prices more slowly than competitive firms. The actors with the greatest market power in the UK petroleum industry are the supermarkets and the majors. Whilst the former have a competitive advantage due to the huge scale of their mainstream retailing activities, the latter benefit from their vertical integration and their strong implantation in the refining business. On the other hand, IOCs and independents suffer from their absence in the refining activities and from their small scale. IOCs are therefore the competitive agents in the model of Borenstein & Shepard (2002); although their analysis included future prices. Our results seem to indicate that spot prices only partly explain retail prices and the use of future prices may have been useful in my analysis.

Moreover, British petroleum prices are stickier than in the US as argued in Alvarez et al (2006); and even stickier than in other EU countries. However, in contradiction with Alvarez et al (2006) I do not observe positive APT in the usual sense. Rather, the observed greater upward rigidity backs the model of Rotenberg (1982) and rejects the idea of APT in the Birmingham area in the year 2008.

Some APT authors argued that APT might be generated by the costs of the actual pricing process. If changing retail petroleum prices involves incurring substantial costs, retailers are more likely to do so when midstream prices rise, rather than when they decline. My results do not support this version as no asymmetry is observed. As Eckert (2002) and Noel (2007b) argues, in recent years we can assume the actual pricing process costs very little.

Rather, this investigation seems to provide support to the menu costs explanation in the wider sense; fuel retailers avoid upsetting their customers by avoiding changing their prices too often. As Slade (1998) points out, the costs related to small price changes might actually involve costs of losing the reputation gained by keeping the prices stable. This translates into upwards and downwards stickiness as observed in this analysis rather than APT as observed in the previous chapters.

Finally, the main limitation of this investigation is that it is limited to one year of data. In this respect, I do not present sufficient evidence on the presence or not of APT in the Birmingham area throughout the recent years. There is certainly evidence of market power and menu costs behaviour in the Birmingham area, as the analysis revealed. Nevertheless, the previous chapter revealed that price coordination may fail in periods of decreasing oil prices and high volatility; one of the characteristics of the data in 2008. Consequently the lack of data has limited the analysis to sticky pricing rather than APT.

6. Conclusions

In this chapter I first summarise the contributions and the limitations attached to the present thesis. Second, I discuss the potential impact of the link between asymmetries and market power for policy-makers in the EU.

6.1 Contributions and limitations

6.1.1 Empirical evidence on the presence of APT in EU markets

Although the key objective of this research was to advance further in linking APT to economic theory, the question of the presence or not of APT in the EU was only rarely answered. Throughout this thesis, I have used robust and consistent VEC methodology taking into account the endogeneity of wholesale prices. The EU retail prices are cointegrated with the causing upstream price which is generally the Rotterdam spot price. The results point at feedback from retail prices to Rotterdam spot prices even when the national data used is for tiny countries such as Luxembourg. The two EU studies with weekly data in chapter 3 and chapter 4 show that APT are found in all 12 countries studied except the United Kingdom; namely: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands (in the diesel market only), Portugal, Spain and Sweden. When using daily data for the UK, I nevertheless find significant APT for both diesel and gasoline markets.

I use COIRFS in the form of graphs to illustrate the adjustment of retail diesel and gasoline prices to cost changes. Overall, the degree of asymmetric pricing seems to have little effect on the consumers' welfare. For vertically-integrated oil companies such as the Big Five with weekly EU sales of millions of litres, the welfare gains from APT are far from negligible. Even for one station selling tens of thousands of litres each month, the welfare gains can be consequent.

One limitation from the empirical point of view is the non-availability of daily data for most EU countries. The fact that I found different results in the UK with daily and weekly data points at the necessity to use data with the highest frequency available. Nevertheless, the EU and UK studies all show that the pass-through of wholesale to retail prices takes 2 weeks on average. The results appear robust and the relationship with market concentration is a consistent pattern. The relatively slow pass-through in EU petroleum markets attenuates the possible problems caused by data aggregation over time. Furthermore, the need for daily data is mainly justified for the UK where the degree of asymmetric pricing is the lowest in my research. Indeed, significant APT was uncovered with weekly data in all cases but the UK. This could also be explained by the fact that the UK has the lowest rate of transmission from all the countries investigated. I find the pass-through rate depends on the geographical position as compared to the ARA (Rotterdam) hub whereas the literature generally assumes that the cost changes are fully passed-through. It seems that the ARA or NWE (North West Europe) references spot prices are close to pass-through in Belgium, France, Germany and the Netherlands; whereas retailers in Italy, Spain and Portugal rather use the MED reference price. Danish, Finnish and Swedish are caused by CEE and ARA references prices. Because the different references prices are strongly correlated, using MED or ARA for Mediterranean countries does not change the results but slightly affects their significance. It is likely that the UK exception comes from the non-availability of a more adequate reference price rather than from a data aggregation problem.

6.1.2 Explaining asymmetries: the link between empirics and theory

One key contribution of this research is the use of rich market structure data for 5 EU countries (Germany, Italy, the Netherlands, Spain and the UK) from Experian Catalist as well as market reports for 7 additional countries (Austria, Belgium, Denmark Finland, France, Portugal and Sweden) such as the CBRE market reports available online and based on the Datamonitor database. I compute consistent measures of asymmetries and I use the market share data to compute the well-known HHI to measure horizontal concentration. In order to measure vertical concentration I use the volume share of the retailing companies operating in upstream activities; in other words the companies retailing and refining in the same given country. Although the relationship between horizontal and vertical concentration and APT is appears clearly in the cross-country comparison, there is a lack of consistent market share data over time. For 3 of the 5 countries studied by Catalist reports, the data is only available from 2003 onwards. For the UK and the Netherlands it is available from 2000 onwards. For all other countries, market reports are only available from 2008 onwards. This clearly limits the analysis to a graphical overview of the relationship between APT and market concentration. This major data limitation is overcome by the fact that relative national market concentration is quite stable over time and across the countries studied. For instance, the data from 2000 onwards the UK is always by far the least concentrated market, followed by the Netherlands, which are then followed by the group composed Germany, Italy and France and finally Spain. The positions are stable as the rate of change in HHI hardly surpassed 1 or 2% per year. Nevertheless, the rockets and feathers literature still lacks a model to formalise this relation between APT and a measure of concentration such as the HHI. The main obstacle is that the APT data is weekly or daily whilst the HHI is only available on a yearly basis.

Moreover, I note that APT is more significant in diesel markets than in gasoline markets, with the exception of the UK. Apart from the UK market, in all the countries studied the retail diesel price is less taxed than the retail gasoline price and hence cheaper at the pump. The fact that Johnson (2002) found more APT in US gasoline than in diesel prices is consistent with what I found for the UK market and different from what I observed in the other 11 countries studied in this study. Our results do not support the search costs theory and if I except the UK case. Our results rather suggest that diesel users have less incentive to engage in time-consuming search given the significant savings they make from the more economical car they drive and the less-taxed fuel they purchase.

In conclusion, my cross-country comparisons suggest that horizontal and vertical market concentration are the main causes of asymmetry and that asymmetry are more important in periods of rising oil prices than in periods of recession. Deltas (2008) and Verlinda (2008) have also shown that local market power as measured by retail margins is strongly correlated with the degree of APT. Our limited graphical cross-country analysis could not formally support this (US) finding. The use of station-level data has been extensively used in recent years to uncover the presence of Edgeworth price cycles principally located in Canada and Midwestern states in the US. In the absence of sufficient panel data and a formal model encompassing APT and market concentration, this study has not provided a formal framework for explaining asymmetries. Consequently, the rockets and feathers literature is expected to continue to suffer from the lack of link between theory and empirics as long as no formal model is developed. Our view is that even the increasing availability of station-level data will not resolve this gap in economic theory. Important resources in terms of economists, econometricians and funds should be allocated by leading universities in the world in order to close this gap. This research has confirmed the necessity of daily panel data and rich market structure data as well as rigorous econometrics such as testing for causality and structural breaks.

6.2 Implications for policy-makers

One of the main findings of this research is that asymmetries are quite marginal from the end users' point of view but quite significant at the scale of the vertically-integrated oil companies. The 'majors' (BP, Chevron, ExxonMobil, Royal Dutch Shell and Total) and NOCs (Repsol in Spain for instance) compete in both the refining and the retailing tiers of the petroleum industry. I have provided evidence that the welfare transfer from the small end user to the 'big oil' company is quite substantial even though consumers are aware of this phenomenon. Indeed, numerous press articles have reported complaints from motorists' organisations such as the FIA in 2011. The Fédération Internationale de l'Automobile (FIA) which represents 35 million European drivers has sent a letter to call an investigation by the European Union (BBC website, 2011). The FIA stated: "the price of fuel in the UK reached record levels in April as the cost of Brent crude rose above \$125 a barrel. Although the price of crude has fallen \$10 since then, motoring groups say the wholesale price of petrol has not fallen as fast" (BBC website, 2011). To my knowledge and to date, no subsequent was taken by the European Competition Commission (ECC). Any EU citizen can observe that the ECC is mainly concerned with scrutiny over mergers and acquisition and the ECC website does not exhibit any concern with price transmission mechanisms.

On the other hand, the (British) Office of Fair Trading (OFT, 2013) delivered a thorough report on the petroleum sector in the UK. Using weekly data from 2000 to 2012 they found no statistical evidence of asymmetries in neither the petrol nor the diesel markets. The OFT then further updated the report with local daily data and found no evidence of APT in the UK. The ECM methodology used does not take into account the two-way causality I observe in my UK data. Even though the asymmetries in the UK are the least significant, I did observe some evidence of APT with daily data. To my knowledge the only EU comparison is the recent work of Meyler (2009) who found only little evidence of statistically significant asymmetries. Although he found some bi-directional causality he used a single-equation ECM which does not take into account the feedback from retail prices to wholesale prices. He also observed that in the countries where he found significant asymmetries, they were generally not economically significant. I made the same observation about the relatively small impact of APT on the single end user; nevertheless a policy-maker might be interested in the possible hundreds of million euros of welfare transferred from of EU drivers to vertically-integrated oil majors and NOCs.

Furthermore, chapter 4 of this thesis has shown that whilst gasoline retail margins are generally far more significant in the gasoline than in the diesel markets, asymmetries are in general more significant in the diesel markets. This might be due to the fact that the diesel market is more competitive with regards to the high number of large transport companies at the downstream level. On the other hand the relatively higher asymmetries in the diesel markets might be due to a compensation effect. As EU diesel users benefit from this more economical (due to lower duties) fuel coupled with more efficient cars, they are likely to be less concerned with the phenomenon of APT than gasoline users. Additionally, the retail diesel data does not take into consideration the price difference between the diesel fuel sold to the general public (in the normal forecourts) and the diesel sold in Heavy Good Vehicles (HGVs) stations. Due to the non-availability of data, I was unable to conduct two different studies. However it is likely that the story might have been different and could have different policy implications for the transport industry.

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APPENDICES A: Chapter 3. The relationship between market concentration and APT

NOMENCLATURE FOR APPENDICES A:

DP= RETAIL DIESEL PRICE

DDP= FIRST DIFFERENCE OF DP

DGP= FIRST DIFFERENCE OF RETAIL GP

DSP= FIRST DIFFERENCE OF SP

DWP= FIRST DIFFERENCE OF WP

GP= RETAIL GASOLINE PRICE

NSP= NEGATIVE CHANGE IN SP

NWP= NEGATIVE CHANGE IN WP

PSP= POSITIVE CHANGE IN SP

NSP= NEGATIVE CHANGE IN WP

RD= ERROR-CORRECTION TERM FOR DIESEL VECM (-1 FOR 1^{ST} LAG)

RG= ERROR-CORRECTION TERM FOR GASOLINE VECM (-1 FOR 1^{ST} LAG)

SP= WHOLESALE GASOLINE PRICE (one unique used for all countries)

WP= WHOLESALE DIESEL PRICE (one unique used for all countries)

Note: To simplify the estimation process, the same denominations of variables are used for every country. E.g. DP for the UK is in fact different from DP in Spain.

A1: WHOLESALE PRICE

A1-1 WHOLESALE DIESEL UNIT ROOT TESTS

Null Hypothesis: WP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.805238	0.8167
Test critical values:	1% level	-3.437508	
	5% level	-2.864589	
	10% level	-2.568447	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WP)
Method: Least Squares

Sample (adjusted): 2 887
Included observations: 886 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WP(-1)	-0.002276	0.002827	-0.805238	0.4209
C	0.207167	0.165835	1.249234	0.2119

R-squared	0.000733	Mean dependent var	0.096493
Adjusted R-squared	-0.000397	S.D. dependent var	2.761548
S.E. of regression	2.762096	Akaike info criterion	4.872112
Sum squared resid	6744.192	Schwarz criterion	4.882917
Log likelihood	-2156.346	Hannan-Quinn criter.	4.876243
F-statistic	0.648408	Durbin-Watson stat	1.927680
Prob(F-statistic)	0.420899		

Null Hypothesis: D(WP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-28.70234	0.0000
Test critical values:	1% level	-3.437516	
	5% level	-2.864593	
	10% level	-2.568449	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WP,2)
Method: Least Squares

Sample (adjusted): 3 887
Included observations: 885 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WP(-1))	-0.965332	0.033633	-28.70234	0.0000
C	0.093036	0.092934	1.001098	0.3171

R-squared	0.482665	Mean dependent var	0.000114
Adjusted R-squared	0.482079	S.D. dependent var	3.839287
S.E. of regression	2.763009	Akaike info criterion	4.872775
Sum squared resid	6741.016	Schwarz criterion	4.883590
Log likelihood	-2154.203	Hannan-Quinn criter.	4.876910
F-statistic	823.8245	Durbin-Watson stat	2.001352
Prob(F-statistic)	0.000000		

A1-2 WHOLESALE SPOT GASOLINE UNIT ROOT TESTS

Null Hypothesis: SP has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.571196	0.4969
Test critical values:	1% level	-3.437533	
	5% level	-2.864600	
	10% level	-2.568453	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SP)
Method: Least Squares

Sample (adjusted): 5 887
Included observations: 883 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SP(-1)	-0.005166	0.003288	-1.571196	0.1165
D(SP(-1))	0.022843	0.033560	0.680656	0.4963
D(SP(-2))	0.119818	0.033356	3.592059	0.0003
D(SP(-3))	0.109417	0.033618	3.254706	0.0012
C	0.286803	0.165041	1.737771	0.0826

R-squared	0.029499	Mean dependent var	0.087477
Adjusted R-squared	0.025078	S.D. dependent var	2.610080
S.E. of regression	2.577144	Akaike info criterion	4.736887
Sum squared resid	5831.389	Schwarz criterion	4.763973
Log likelihood	-2086.336	Hannan-Quinn criter.	4.747244
F-statistic	6.671894	Durbin-Watson stat	2.001806
Prob(F-statistic)	0.000027		

Null Hypothesis: D(SP) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.96652	0.0000
Test critical values:	1% level	-3.437533	
	5% level	-2.864600	
	10% level	-2.568453	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SP,2)
Method: Least Squares

Sample (adjusted): 5 887
Included observations: 883 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SP(-1))	-0.757621	0.054246	-13.96652	0.0000
D(SP(-1),2)	-0.222289	0.046496	-4.780799	0.0000
D(SP(-2),2)	-0.105689	0.033562	-3.149054	0.0017
C	0.066307	0.086929	0.762767	0.4458

R-squared	0.494542	Mean dependent var	0.000381
Adjusted R-squared	0.492817	S.D. dependent var	3.621752
S.E. of regression	2.579296	Akaike info criterion	4.737430
Sum squared resid	5847.785	Schwarz criterion	4.759099
Log likelihood	-2087.575	Hannan-Quinn criter.	4.745715
F-statistic	286.6719	Durbin-Watson stat	2.000962
Prob(F-statistic)	0.000000		

A2 FRANCE DIESEL

A2-1 UNIT ROOT TEST

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.930018	0.7788
Test critical values:	1% level	-3.437516	
	5% level	-2.864593	
	10% level	-2.568449	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 3 887
Included observations: 885 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.001887	0.002029	-0.930018	0.3526
D(DP(-1))	0.312311	0.032026	9.751781	0.0000
C	0.191440	0.148843	1.286191	0.1987

R-squared	0.097514	Mean dependent var	0.103125
Adjusted R-squared	0.095467	S.D. dependent var	2.304073
S.E. of regression	2.191333	Akaike info criterion	4.410281
Sum squared resid	4235.311	Schwarz criterion	4.426503
Log likelihood	-1948.549	Hannan-Quinn criter.	4.416483
F-statistic	47.65012	Durbin-Watson stat	2.008584
Prob(F-statistic)	0.000000		

A2-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.052542	49.66839	20.26184	0.0000
At most 1	0.002338	2.064894	9.164546	0.7648

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.052542	47.60349	15.89210	0.0000
At most 1	0.002338	2.064894	9.164546	0.7648

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.423836	0.471624	4.113244
0.032307	-0.011146	-2.110921

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.226389	-0.059560
D(WP)	-0.316668	-0.114331

1 Cointegrating Equation(s): Log likelihood -3709.964

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.112751	-9.704792
	(0.01041)	(0.60824)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.095952
	(0.02241)
D(WP)	0.134215
	(0.03902)

A2-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 882

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	265.9126	4	0.0000
All	265.9126	4	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	13.17215	4	0.0105
All	13.17215	4	0.0105

Pairwise Granger Causality Tests

Sample: 1 887
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
WP does not Granger Cause DP	883	207.276	5E-125
DP does not Granger Cause WP		3.26234	0.0114

A2-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP DWP
Exogenous variables: RD(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3855.708	NA	22.46002	8.787491	8.798374	8.791653
1	-3761.317	188.1378	18.28048	8.581588	8.614237	8.594075
2	-3723.020	76.15742	16.90668	8.503463	8.557878	8.524275
3	**-3703.743**	**38.24629**	**16.32847**	**8.468664**	**8.544845***	**8.497800***
4	-3697.345	12.66523	16.23953	8.463201	8.561148	8.500662
5	-3692.859	8.860577	16.22156	8.462093	8.581806	8.507878
6	-3685.673	14.15781*	16.10431*	8.454837*	8.596316	8.508947
7	-3682.578	6.084488	16.13758	8.456898	8.620143	8.519333
8	-3678.330	8.332069	16.12850	8.456333	8.641344	8.527092

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5383.372	NA	42.77733	12.26964	12.28596	12.27588
1	-4969.120	824.7298	16.99438	11.34651	11.41181	11.37149
2	-4834.507	267.0794	12.76554	11.06038	11.17465	11.10408
3	-4789.767	88.46110	11.76747	10.97897	11.14221	11.04140
4	-4764.583	49.62232	11.34159	10.94210	11.15432	11.02327
5	**-4724.226**	**79.24150**	**10.55982**	**10.87068**	**11.13187***	**10.97057**
6	-4705.890	35.87861	10.33770	10.84941	11.15957	10.96803
7	-4691.391	28.27116	10.20913	10.83688	11.19602	10.97424
8	-4664.698	51.86726*	9.805985*	10.79658*	11.20469	10.95266*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A2-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.176442	-0.039714	-0.100886
	(0.03889)	(0.04141)	(0.03781)
	[-4.53691]	[-0.95907]	[-2.66797]
DDP(-2)	-0.175121	-0.078837	-0.124132
	(0.03765)	(0.04008)	(0.03660)
	[-4.65165]	[-1.96677]	[-3.39115]
DDP(-3)	-0.047129	0.005380	-0.048490
	(0.03386)	(0.03605)	(0.03292)
	[-1.39201]	[0.14923]	[-1.47299]
DDP(-4)	0.028187	0.048847	0.047578
	(0.02494)	(0.02655)	(0.02425)
	[1.13018]	[1.83949]	[1.96200]
PWP(-1)	0.487274	0.126933	-0.109391
	(0.04120)	(0.04386)	(0.04006)
	[11.8279]	[2.89375]	[-2.73091]
PWP(-2)	0.311868	0.176443	-0.059525
	(0.04499)	(0.04790)	(0.04374)
	[6.93238]	[3.68356]	[-1.36082]
PWP(-3)	0.243783	0.212001	0.069113
	(0.04473)	(0.04763)	(0.04350)
	[5.44953]	[4.45088]	[1.58895]
PWP(-4)	0.079106	0.195774	0.012332
	(0.04328)	(0.04608)	(0.04208)
	[1.82783]	[4.24847]	[0.29305]
NWP(-1)	0.444453	0.038554	0.270518
	(0.04545)	(0.04840)	(0.04419)
	[9.77828]	[0.79663]	[6.12102]
NWP(-2)	0.390225	-0.053229	0.292999
	(0.04771)	(0.05080)	(0.04639)
	[8.17844]	[-1.04775]	[6.31557]
NWP(-3)	0.182989	0.000409	0.203214
	(0.04790)	(0.05101)	(0.04658)
	[3.81996]	[0.00801]	[4.36293]
NWP(-4)	0.071175	-0.114825	0.103313
	(0.04326)	(0.04606)	(0.04206)
	[1.64519]	[-2.49276]	[2.45605]
RD(-1)	-0.099699	0.069093	0.060417
	(0.02262)	(0.02408)	(0.02199)
	[-4.40796]	[2.86903]	[2.74729]

R-squared	0.543032	0.079006	0.227330
Adj. R-squared	0.536721	0.066288	0.216660
Sum sq. resids	2144.508	2431.204	2027.421
S.E. equation	1.570919	1.672633	1.527433
F-statistic	86.05531	6.212118	21.30597
Log likelihood	-1643.321	-1698.656	-1618.560
Akaike AIC	3.755829	3.881305	3.699683
Schwarz SC	3.826315	3.951791	3.770169
Mean dependent	0.103416	0.967238	-0.870308
S.D. dependent	2.307984	1.730989	1.725786

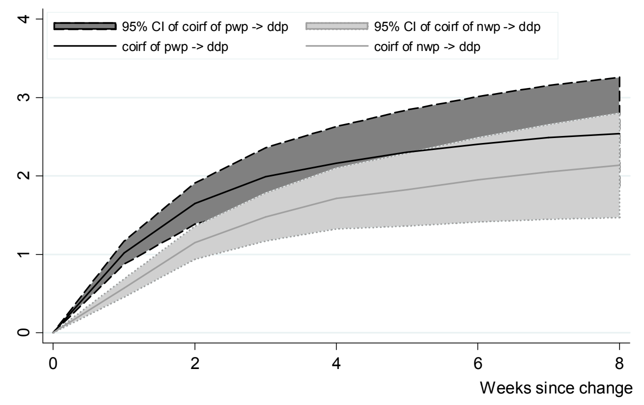
Determinant resid covariance (dof adj.)	10.71450
Determinant resid covariance	10.24768
Log likelihood	-4780.741
Akaike information criterion	10.92912
Schwarz criterion	11.14058

A2-6 COIRFS TABLE AND GRAPH

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.02019	.872775	1.16761	.569216	.452893	.68554
2	1.64603	1.38324	1.90882	1.14659	.936063	1.35712
3	1.9893	1.61807	2.36053	1.47583	1.16922	1.78244
4	2.16301	1.69716	2.62886	1.71287	1.32269	2.10305
5	2.30153	1.7612	2.84186	1.82614	1.36011	2.29216
6	2.40562	1.79972	3.01151	1.9505	1.4129	2.4881
7	2.48812	1.82239	3.15386	2.05131	1.44641	2.65621
8	2.53864	1.8188	3.25848	2.13648	1.46896	2.804

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



1.a. France diesel

A3: FRANCE GASOLINE ESTIMATIONS:

A3-1 UNIT ROOT TESTS

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.959144	0.7691
Test critical values:	1% level	-3.437516	
	5% level	-2.864593	
	10% level	-2.568449	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 3 887
Included observations: 885 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.002261	0.002357	-0.959144	0.3377
D(GP(-1))	0.268244	0.032489	8.256351	0.0000
C	0.211471	0.160700	1.315939	0.1885
R-squared	0.071976	Mean dependent var		0.101562
Adjusted R-squared	0.069872	S.D. dependent var		2.277374
S.E. of regression	2.196372	Akaike info criterion		4.414875
Sum squared resid	4254.811	Schwarz criterion		4.431097
Log likelihood	-1950.582	Hannan-Quinn criter.		4.421077
F-statistic	34.20340	Durbin-Watson stat		2.036921
Prob(F-statistic)	0.000000			

A3-2 COINTEGRATION TEST

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.040430	38.55709	20.26184	0.0001
At most 1	0.002393	2.115636	9.164546	0.7546

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.040430	36.44146	15.89210	0.0000
At most 1	0.002393	2.115636	9.164546	0.7546

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.294573	0.354956	2.698448
0.047910	-0.027596	-2.355694

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.194473	-0.059773
D(SP)	-0.306780	-0.101414

1 Cointegrating Equation(s): Log likelihood -3682.388

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.204983	-9.160543
	(0.02126)	(1.06475)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.057286
	(0.01539)
D(SP)	0.090369
	(0.02544)

A3-3 GRANGER CAUSALITY/BLOCK EXOGENEITY TEST

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 885

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	232.6697	1	0.0000
All	232.6697	1	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	10.69792	1	0.0011
All	10.69792	1	0.0011

Pairwise Granger Causality Tests

Sample: 1 887
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause GP	884	266.221	8E-123
GP does not Granger Cause SP		3.99205	0.0077

A3-4 LAG LENGTH TESTS

VAR Lag Order Selection Criteria
Endogenous variables: DGP DSP
Exogenous variables: RG(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3873.904	NA	23.41049	8.828938	8.839821	8.833101
1	-3744.743	257.4397	17.60317	8.543833	8.576482	8.556320
2	-3690.069	108.7256	15.68411	8.428402	8.482817	8.449214
3	**-3667.241**	**45.29203**	**15.02567**	**8.385514**	**8.461695***	**8.414650**
4	-3658.387	17.52618	14.86047	8.374457	8.472404	8.411918*
5	-3653.955	8.752132	14.84588	8.373474	8.493187	8.419260
6	-3649.531	8.718090	14.83156	8.372507	8.513986	8.426617
7	-3644.407	10.07153*	14.79369*	8.369948*	8.533194	8.432383
8	-3643.844	1.104331	14.91001	8.377777	8.562789	8.448537

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A3-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.202575	0.002171	-0.059105
	(0.03484)	(0.03547)	(0.03420)
	[-5.81473]	[0.06119]	[-1.72797]
DGP(-2)	-0.150178	-0.007447	-0.016416
	(0.03190)	(0.03248)	(0.03132)
	[-4.70751]	[-0.22927]	[-0.52411]
DGP(-3)	0.015837	0.014087	0.007512
	(0.02409)	(0.02453)	(0.02365)
	[0.65735]	[0.57430]	[0.31759]
PSP(-1)	0.550601	0.126403	-0.127469
	(0.03887)	(0.03958)	(0.03817)
	[14.1640]	[3.19369]	[-3.33982]

PSP(-2)	0.315223	0.308561	-0.097743
	(0.04119)	(0.04194)	(0.04044)
	[7.65225]	[7.35696]	[-2.41673]
PSP(-3)	0.236322	0.157554	0.007636
	(0.04185)	(0.04261)	(0.04109)
	[5.64650]	[3.69737]	[0.18583]
NSP(-1)	0.472262	-0.003502	0.217450
	(0.04048)	(0.04121)	(0.03974)
	[11.6677]	[-0.08498]	[5.47183]
NSP(-2)	0.448057	-0.176125	0.331174
	(0.04122)	(0.04197)	(0.04047)
	[10.8694]	[-4.19645]	[8.18275]
NSP(-3)	0.158111	-0.021575	0.131824
	(0.04217)	(0.04293)	(0.04140)
	[3.74964]	[-0.50254]	[3.18414]
RG(-1)	-0.059329	0.042968	0.041107
	(0.01567)	(0.01596)	(0.01539)
	[-3.78597]	[2.69303]	[2.67176]
R-squared	0.543708	0.043683	0.165343
Adj. R-squared	0.539004	0.033824	0.156738
Sum sq. resids	2091.602	2168.230	2016.226
S.E. equation	1.547862	1.575961	1.519716
F-statistic	115.5832	4.430761	19.21534
Log likelihood	-1633.655	-1649.540	-1617.450
Akaike AIC	3.722887	3.758868	3.686184
Schwarz SC	3.777059	3.813040	3.740356
Mean dependent	0.102767	0.911271	-0.823794
S.D. dependent	2.279732	1.603309	1.654936

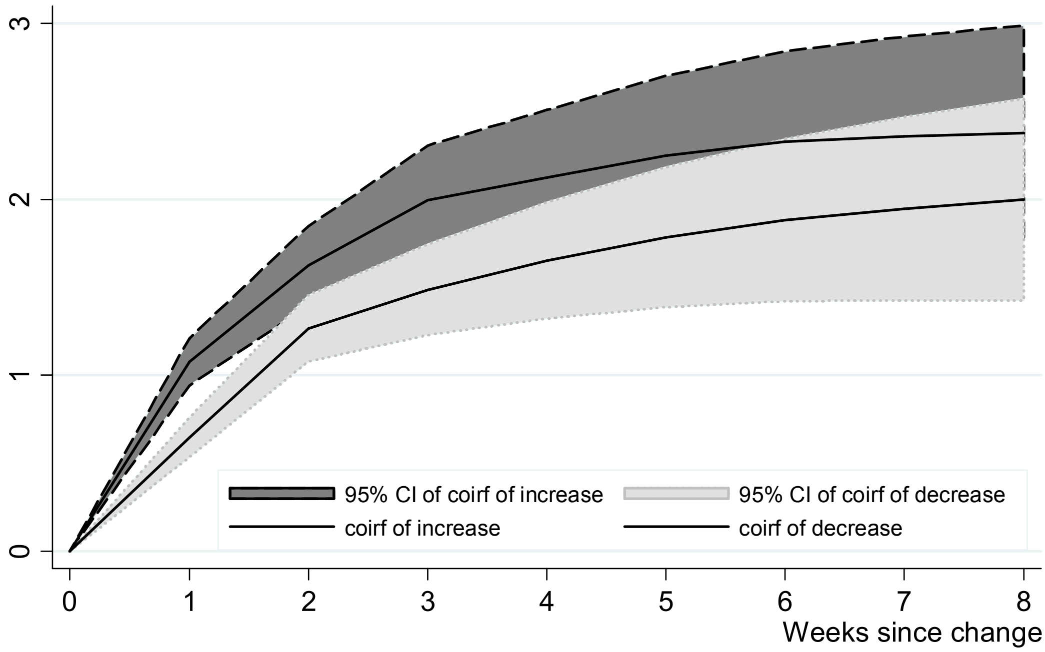
Determinant resid covariance (dof adj.)	10.80568
Determinant resid covariance	10.44269
Log likelihood	-4794.484
Akaike information criterion	10.92748
Schwarz criterion	11.09000

A3-6 COIRFS TABLE AND CORRESPONDING GRAPH

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.07569	.941296	1.21008	.646828	.534657	.758999
2	1.62459	1.39937	1.84981	1.26748	1.07837	1.4566
3	1.9954	1.68484	2.30595	1.48718	1.2289	1.74545
4	2.12277	1.7367	2.50883	1.65297	1.32273	1.9832
5	2.24877	1.79508	2.70246	1.78561	1.38727	2.18394
6	2.32902	1.81477	2.84328	1.88309	1.42118	2.34501
7	2.35981	1.79358	2.92603	1.9482	1.42682	2.46958
8	2.37897	1.76896	2.98899	1.99834	1.42392	2.57276

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



1.b. France gasoline

A4: GERMANY DIESEL

A4-1 UNIT ROOT TESTS FOR DP

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.854166	0.8025
Test critical values:	1% level	-3.437508	
	5% level	-2.864589	
	10% level	-2.568447	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 2 887
Included observations: 886 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.002572	0.003011	-0.854166	0.3932
C	0.281412	0.228262	1.232849	0.2180

R-squared	0.000825	Mean dependent var	0.109393
Adjusted R-squared	-0.000306	S.D. dependent var	3.197925
S.E. of regression	3.198414	Akaike info criterion	5.165442
Sum squared resid	9043.190	Schwarz criterion	5.176247
Log likelihood	-2286.291	Hannan-Quinn criter.	5.169573
F-statistic	0.729600	Durbin-Watson stat	2.012867
Prob(F-statistic)	0.393244		

A4-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.037281	35.50788	20.26184	0.0002
At most 1	0.002262	1.997239	9.164546	0.7783

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.037281	33.51064	15.89210	0.0000
At most 1	0.002262	1.997239	9.164546	0.7783

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.286357	0.312030	3.986928
0.018016	0.004051	-2.038976

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.385183	-0.077841
D(WP)	-0.186254	-0.122075

1 Cointegrating Equation(s): Log likelihood -4163.823

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.089655	-13.92294
	(0.01842)	(1.07700)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.110300
	(0.02473)
D(WP)	0.053335
	(0.02651)

A4-3 GRANGER CAUSALITY/BLOCK EXOGENEITY TESTS

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 880

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	227.6202	6	0.0000
All	227.6202	6	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	18.92007	6	0.0043
All	18.92007	6	0.0043

A4-4 LAG LENGTH TESTS

VAR Lag Order Selection Criteria
Endogenous variables: DDP DWP
Exogenous variables: RD(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4257.787	NA	56.12793	9.703388	9.714271	9.707550
1	-4208.684	97.87017	50.64769	9.600648	9.633297	9.613135
2	-4174.253	68.46995	47.25577	9.531329	9.585744	9.552140
3	**-4159.604**	**29.06559**	**46.12322**	**9.507070**	**9.583251***	**9.536206**
4	-4148.831	21.32505	45.41712	9.491642	9.589589	9.529103
5	-4143.446	10.63425	45.27416	9.488488	9.608201	9.534273
6	-4133.500	19.59823*	44.66512*	9.474943*	9.616422	9.529053*
7	-4132.484	1.997085	44.96987	9.481740	9.644985	9.544175
8	-4128.763	7.297851	44.99859	9.482376	9.667387	9.553135

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A4-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.300717	-0.000114	-0.007396

	(0.03794)	(0.02502)	(0.02265)
	[-7.92622]	[-0.00454]	[-0.32648]
DDP(-2)	-0.175625	-0.032962	-0.020909
	(0.03561)	(0.02349)	(0.02126)
	[-4.93156]	[-1.40339]	[-0.98335]
DDP(-3)	-0.040067	0.000536	-0.029544
	(0.02943)	(0.01941)	(0.01757)
	[-1.36124]	[0.02762]	[-1.68110]
PWP(-1)	0.522972	0.123618	-0.163402
	(0.06087)	(0.04014)	(0.03634)
	[8.59209]	[3.07938]	[-4.49632]
PWP(-2)	0.283945	0.192663	-0.150713
	(0.06239)	(0.04115)	(0.03725)
	[4.55093]	[4.68195]	[-4.04571]
PWP(-3)	0.333686	0.209239	-0.023008
	(0.06257)	(0.04127)	(0.03736)
	[5.33313]	[5.07049]	[-0.61590]
NWP(-1)	0.494365	-0.039470	0.227846
	(0.06699)	(0.04418)	(0.04000)
	[7.38003]	[-0.89340]	[5.69682]
NWP(-2)	0.523967	-0.162798	0.224626
	(0.06634)	(0.04375)	(0.03961)
	[7.89848]	[-3.72093]	[5.67126]
NWP(-3)	0.090015	-0.085555	0.143817
	(0.06655)	(0.04389)	(0.03973)
	[1.35265]	[-1.94931]	[3.61961]
RD(-1)	-0.128315	0.022246	0.022011
	(0.02440)	(0.01609)	(0.01457)
	[-5.25883]	[1.38237]	[1.51087]
R-squared	0.357324	0.042011	0.210240
Adj. R-squared	0.350698	0.032135	0.202099
Sum sq. resids	5814.730	2529.327	2072.860
S.E. equation	2.580820	1.702140	1.540912
F-statistic	53.93140	4.253745	25.82220
Log likelihood	-2085.073	-1717.550	-1629.681
Akaike AIC	4.745352	3.912910	3.713886
Schwarz SC	4.799523	3.967082	3.768058
Mean dependent	0.110051	0.966448	-0.869322
S.D. dependent	3.202834	1.730166	1.725056

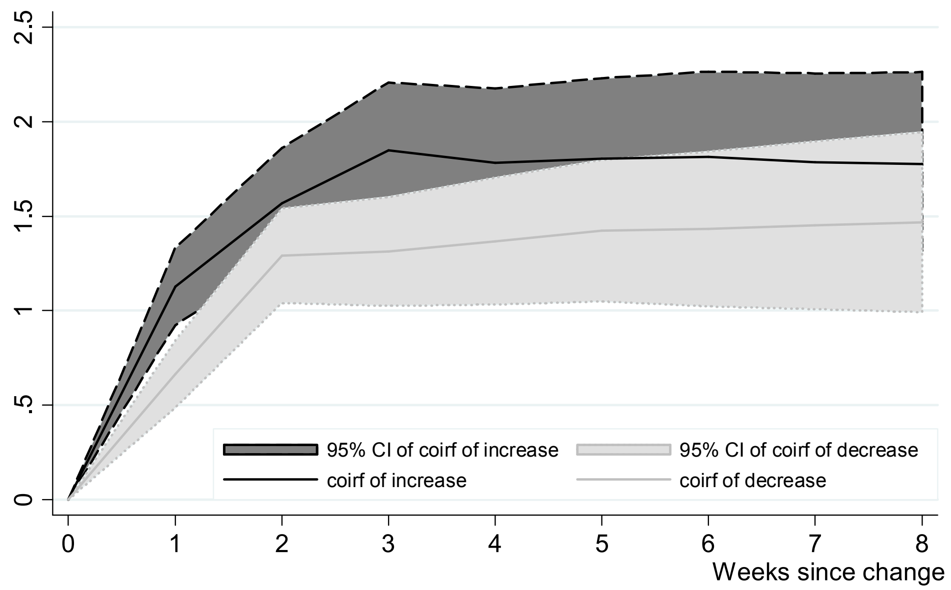
Determinant resid covariance (dof adj.)	32.54857
Determinant resid covariance	31.45521
Log likelihood	-5281.309
Akaike information criterion	12.03015
Schwarz criterion	12.19266

A4-6 COIRFS TABLES WITH 95% CI AND CORRESPONDING GRAPH:

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.1279	.923842	1.33195	.663809	.485805	.841813
2	1.56935	1.27711	1.8616	1.29128	1.04096	1.5416
3	1.84775	1.48721	2.20828	1.31345	1.02518	1.60173
4	1.78201	1.38755	2.17647	1.36861	1.03281	1.70441
5	1.80434	1.37765	2.23103	1.4238	1.04886	1.79875
6	1.81448	1.363	2.26596	1.43274	1.02303	1.84246
7	1.78681	1.31729	2.25633	1.45264	1.0083	1.89699
8	1.77582	1.28832	2.26333	1.46882	.992345	1.94529

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



1.c. Germany diesel

A5: GERMANY GASOLINE

A5-1 UNIT ROOT TESTS FOR GP

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.306398	0.6284
Test critical values:	1% level	-3.437508	
	5% level	-2.864589	
	10% level	-2.568447	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 2 887
Included observations: 886 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.005034	0.003853	-1.306398	0.1918
C	0.418275	0.268652	1.556942	0.1198

R-squared	0.001927	Mean dependent var	0.100753
Adjusted R-squared	0.000798	S.D. dependent var	3.408158
S.E. of regression	3.406798	Akaike info criterion	5.291677
Sum squared resid	10259.94	Schwarz criterion	5.302483
Log likelihood	-2342.213	Hannan-Quinn criter.	5.295808
F-statistic	1.706676	Durbin-Watson stat	2.066100
Prob(F-statistic)	0.191757		

A5-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.038348	37.24224	20.26184	0.0001
At most 1	0.003117	2.753367	9.164546	0.6277

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.038348	34.48887	15.89210	0.0000
At most 1	0.003117	2.753367	9.164546	0.6277

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.284669	0.319357	4.312122
0.022912	0.007551	-2.258743

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.443730	-0.082135
D(SP)	-0.152635	-0.136846

1 Cointegrating Equation(s): Log likelihood -4163.535

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.121853	-15.14784
	(0.02265)	(1.13540)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.126316
	(0.02568)
D(SP)	0.043450
	(0.02474)

A5-3 GRANGER CAUSALITY/BLOCK EXOGENEITY TESTS:

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 885

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	103.9801	1	0.0000
All	103.9801	1	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	4.066856	1	0.0437
All	4.066856	1	0.0437

A5-4 LAG LENGTH TEST

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5742.944	NA	97.03580	13.08871	13.10504	13.09495
1	-5458.625	566.0482	51.82791	12.46156	12.52686	12.48653
2	**-5288.026**	**338.4774**	**35.86719**	**12.09345**	**12.20772***	**12.13716**
3	-5261.327	52.78941	34.44999	12.05314	12.21638	12.11557
4	-5238.041	45.88372	33.34703	12.02059	12.23281	12.10176
5	-5207.011	60.92762	31.71513	11.97041	12.23161	12.07031
6	-5182.758	47.45640	30.63236	11.93567	12.24583	12.05429
7	-5164.827	34.96394*	30.01579*	11.91532*	12.27446	12.05268*
8	-5159.662	10.03574	30.27960	11.92406	12.33217	12.08015

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A5-5 ASYMMETRIC VECM ESTIMATION

Vector Autoregression Estimates

Sample (adjusted): 4 887
Included observations: 884 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.248566	0.009982	0.003484
	(0.03479)	(0.02040)	(0.01955)
	[-7.14404]	[0.48938]	[0.17827]
DGP(-2)	-0.085942	0.019358	0.028711
	(0.02895)	(0.01697)	(0.01627)
	[-2.96813]	[1.14043]	[1.76516]
PSP(-1)	0.601358	0.139008	-0.197798
	(0.06145)	(0.03603)	(0.03452)
	[9.78553]	[3.85857]	[-5.72963]
PSP(-2)	0.323007	0.313977	-0.167112
	(0.06438)	(0.03774)	(0.03617)
	[5.01694]	[8.31882]	[-4.62050]
NSP(-1)	0.477331	-0.074352	0.209456
	(0.06464)	(0.03790)	(0.03631)
	[7.38389]	[-1.96197]	[5.76782]
NSP(-2)	0.442015	-0.241416	0.292622
	(0.06254)	(0.03666)	(0.03513)
	[7.06816]	[-6.58524]	[8.32971]
RG(-1)	-0.172839	0.005318	0.007536
	(0.02471)	(0.01449)	(0.01388)
	[-6.99412]	[0.36706]	[0.54284]
R-squared	0.369096	0.017461	0.153251
Adj. R-squared	0.364779	0.010739	0.147458
Sum sq. resids	6483.583	2228.145	2046.008
S.E. equation	2.718991	1.593940	1.527404
F-statistic	85.51141	2.597585	26.45437
Log likelihood	-2135.058	-1662.956	-1625.263
Akaike AIC	4.846286	3.778182	3.692903
Schwarz SC	4.884172	3.816068	3.730789
Mean dependent	0.099870	0.910494	-0.822862
S.D. dependent	3.411501	1.602568	1.654230
Determinant resid covariance (dof adj.)		34.33803	
Determinant resid covariance		33.52875	
Log likelihood		-5315.507	
Akaike information criterion		12.07355	
Schwarz criterion		12.18720	

A5-6 COIRFS TABLES WITH 95% INDEX AND CORRESPONDING GRAPH:

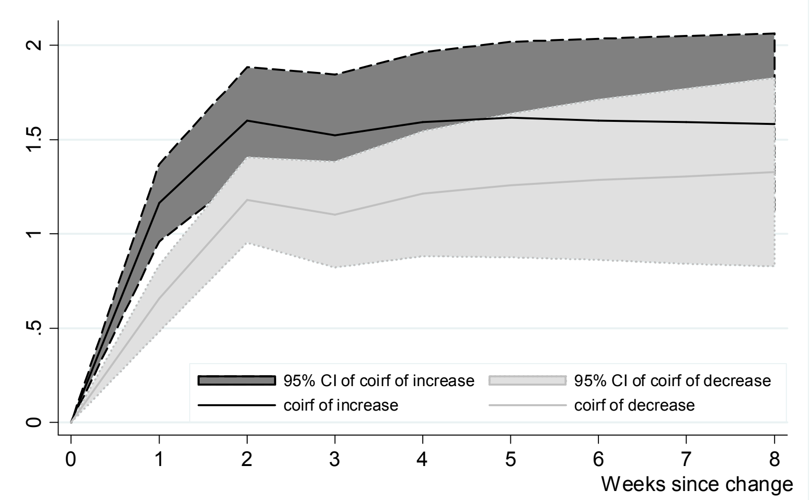
```
. irf ctable (ger_g psp dgp coirf, ci) (ger_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper
0	0	0	0
1	1.16482	.958988	1.37066
2	1.60099	1.31746	1.88451
3	1.52192	1.19925	1.84458
4	1.594	1.22459	1.9634
5	1.61572	1.2124	2.01905
6	1.60163	1.16786	2.03539
7	1.59234	1.13476	2.04993
8	1.5829	1.10343	2.06237

step	(2) coirf	(2) Lower	(2) Upper
0	0	0	0
1	.657586	.481048	.834123
2	1.1792	.953057	1.40535
3	1.10201	.821628	1.3824
4	1.2131	.881514	1.54468
5	1.25647	.87509	1.63785
6	1.28706	.861888	1.71223
7	1.30521	.84075	1.76966
8	1.32727	.827486	1.82705

```
95% lower and upper bounds reported
(1) irfname = ger_g, impulse = psp, and response = dgp
(2) irfname = ger_g, impulse = nsp, and response = dgp

.
```



1.d. Germany gasoline

A6: ITALY DIESEL

A6-1 UNIT ROOT TESTS

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.802304	0.8175
Test critical values:	1% level	-3.437516	
	5% level	-2.864593	
	10% level	-2.568449	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 3 887
Included observations: 885 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.001389	0.001731	-0.802304	0.4226
D(DP(-1))	0.327939	0.031840	10.29942	0.0000
C	0.180144	0.144369	1.247802	0.2124

R-squared	0.107473	Mean dependent var	0.116159
Adjusted R-squared	0.105449	S.D. dependent var	2.156425
S.E. of regression	2.039561	Akaike info criterion	4.266731
Sum squared resid	3668.953	Schwarz criterion	4.282953
Log likelihood	-1885.028	Hannan-Quinn criter.	4.272933
F-statistic	53.10278	Durbin-Watson stat	2.039004
Prob(F-statistic)	0.000000		

A6-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.044189	42.05297	20.26184	0.0000
At most 1	0.002481	2.190872	9.164546	0.7395

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.044189	39.86209	15.89210	0.0000
At most 1	0.002481	2.190872	9.164546	0.7395

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.256697	0.312379	3.652249
0.025078	-0.006968	-2.148405

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.121073	-0.081252
D(WP)	-0.428465	-0.091474

1 Cointegrating Equation(s): Log likelihood -3786.385

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.216914	-14.22784
	(0.01882)	(1.09980)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.031079
	(0.01499)
D(WP)	0.109986
	(0.02354)

A6-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 884

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	170.5205	2	0.0000
All	170.5205	2	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	4.611584	2	0.0997
All	4.611584	2	0.0997

A6-4 LAG LENGTH TEST

VAR Lag Order Selection Criteria
Endogenous variables: DDP DWP
Exogenous variables: RD(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3915.416	NA	25.73223	8.923499	8.934382	8.927661
1	-3827.296	175.6381	21.24511	8.731881	8.764530	8.744368
2	**-3788.402**	**77.34533**	**19.62180**	**8.652395**	**8.706810***	**8.673207**
3	-3780.333	16.00815	19.44081	8.643128	8.719309	8.672264*
4	-3773.268	13.98447	19.30558	8.636147	8.734094	8.673608
5	-3769.490	7.462225	19.31535	8.636652	8.756365	8.682437
6	-3762.912	12.96092	19.20229	8.630779	8.772259	8.684890
7	-3756.009	13.57118*	19.07575*	8.624165*	8.787411	8.686600
8	-3752.933	6.032072	19.11602	8.626271	8.811283	8.697031

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A6-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 4 887
Included observations: 884 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.040257	0.038404	0.022601
	(0.03469)	(0.03381)	(0.03036)
	[1.16032]	[1.13596]	[0.74445]
DDP(-2)	0.013134	0.038539	0.030769
	(0.02989)	(0.02912)	(0.02615)
	[0.43946]	[1.32335]	[1.17655]
PWP(-1)	0.331503	0.193483	-0.188686
	(0.03772)	(0.03675)	(0.03300)
	[8.78911]	[5.26440]	[-5.71699]
PWP(-2)	0.188424	0.219618	-0.189959
	(0.03975)	(0.03874)	(0.03479)
	[4.73981]	[5.66943]	[-5.46077]
NWP(-1)	0.290779	-0.105587	0.272270
	(0.04236)	(0.04128)	(0.03707)
	[6.86404]	[-2.55784]	[7.34491]
NWP(-2)	0.238589	-0.250597	0.249699
	(0.04086)	(0.03982)	(0.03576)
	[5.83874]	[-6.29351]	[6.98323]
RD(-1)	-0.051971	0.044111	0.043740
	(0.01443)	(0.01406)	(0.01262)
	[-3.60231]	[3.13777]	[3.46474]
R-squared	0.341011	0.026235	0.209831
Adj. R-squared	0.336502	0.019573	0.204425
Sum sq. resids	2708.609	2571.887	2073.988
S.E. equation	1.757411	1.712483	1.537812
F-statistic	75.63769	3.937983	38.81493
Log likelihood	-1749.264	-1726.370	-1631.267
Akaike AIC	3.973448	3.921652	3.706486
Schwarz SC	4.011334	3.959538	3.744372
Mean dependent	0.115359	0.965355	-0.869026
S.D. dependent	2.157514	1.729492	1.724102

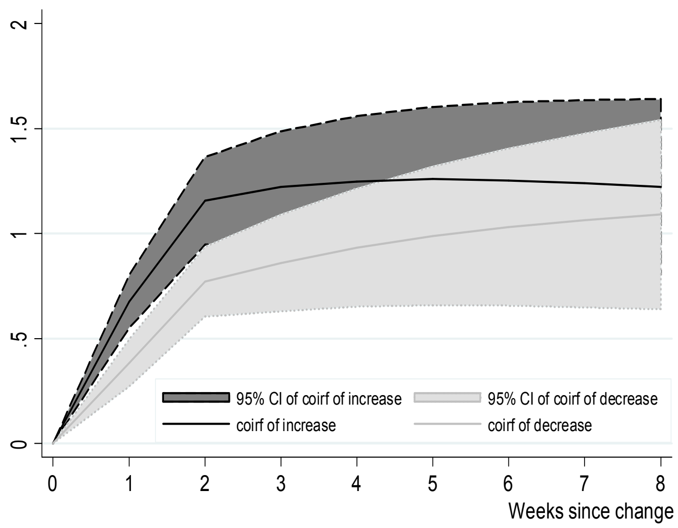
Determinant resid covariance (dof adj.)	14.60666
Determinant resid covariance	14.26241
Log likelihood	-4937.696
Akaike information criterion	11.21877
Schwarz criterion	11.33243

A6- COIRFS TABLE AND GRAPH

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.674493	.548736	.800251	.382547	.270486	.494607
2	1.15579	.946443	1.36513	.770467	.603885	.937049
3	1.22184	.956271	1.4874	.859669	.628941	1.0904
4	1.24866	.938389	1.55892	.933447	.651524	1.21537
5	1.26043	.917042	1.60382	.988577	.658024	1.31913
6	1.25319	.880606	1.62578	1.03114	.656408	1.40586
7	1.23858	.841443	1.63572	1.06269	.647671	1.47772
8	1.22258	.803922	1.64124	1.09001	.638795	1.54122

95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp



1.e. Italy diesel

A7: ITALY GASOLINE

A7-1 UNIT ROOT TESTS ON GP

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.195001	0.6785
Test critical values:	1% level	-3.437524	
	5% level	-2.864596	
	10% level	-2.568451	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 4 887
Included observations: 884 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.002452	0.002052	-1.195001	0.2324
D(GP(-1))	0.303551	0.033533	9.052297	0.0000
D(GP(-2))	0.100420	0.033617	2.987152	0.0029
C	0.237513	0.162071	1.465494	0.1431

R-squared	0.122423	Mean dependent var	0.103168
Adjusted R-squared	0.119431	S.D. dependent var	2.117033
S.E. of regression	1.986595	Akaike info criterion	4.215236
Sum squared resid	3472.972	Schwarz criterion	4.236885
Log likelihood	-1859.134	Hannan-Quinn criter.	4.223513
F-statistic	40.92022	Durbin-Watson stat	2.008672
Prob(F-statistic)	0.000000		

A7-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.047003	44.83487	20.26184	0.0000
At most 1	0.002686	2.372101	9.164546	0.7031

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.047003	42.46277	15.89210	0.0000
At most 1	0.002686	2.372101	9.164546	0.7031

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.259592	0.324701	4.840717
0.034011	-0.011214	-2.554795

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.206498	-0.069871
D(SP)	-0.348199	-0.103623

1 Cointegrating Equation(s): Log likelihood -3719.736

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.250815	-18.64742
	(0.02239)	(1.12035)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.053605
	(0.01439)
D(SP)	0.090389
	(0.02232)

A7-3 GRANGER CAUSALITY/BLOCK EXOGENEITY TESTS

Pairwise Granger Causality Tests

Sample: 1 887
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause GP	885	162.759	7.E-61
GP does not Granger Cause SP		15.6909	2.E-07

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 884

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	166.6011	2	0.0000
All	166.6011	2	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	13.11863	2	0.0014
All	13.11863	2	0.0014

A7-4 LAG LENGTH TESTS

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5322.613	NA	37.24824	12.13124	12.14756	12.13748
1	-4998.834	644.6075	18.18449	11.41420	11.47950	11.43917
2	**-4842.419**	**310.3355**	**12.99770**	**11.07840**	**11.19267***	**11.12211**
3	-4817.135	49.99210	12.52443	11.04131	11.20455	11.10374
4	-4799.659	34.43511	12.28497	11.02200	11.23422	11.10317
5	-4773.086	52.17664	11.80300	10.98197	11.24317	11.08187
6	-4755.398	34.61118	11.57179	10.96218	11.27235	11.08081
7	-4733.767	42.17734	11.24373	10.93341	11.29255	11.07077*
8	-4723.878	19.21410*	11.22115*	10.93139*	11.33950	11.08747

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Exclusion Wald Tests

Sample: 1 887
Included observations: 882

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DGP	PSP	NSP	Joint
Lag 1	196.2966	11.45736	34.18509	250.4207
	[0.000000]	[0.009493]	[1.81e-07]	[0.000000]
Lag 2	73.99398	38.63978	56.91584	204.9258
	[5.55e-16]	[2.07e-08]	[2.68e-12]	[0.000000]
Lag 3	30.40626	8.060038	10.32153	47.19605
	[1.13e-06]	[0.044787]	[0.016022]	[3.61e-07]
Lag 4	5.580230	20.69997	2.988236	35.12864
	[0.133918]	[0.000122]	[0.393443]	[5.65e-05]
df	3	3	3	9

A7-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 4 887
Included observations: 884 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	0.069747	0.083839	0.049706
	(0.03327)	(0.03147)	(0.03044)
	[2.09632]	[2.66409]	[1.63278]
DGP(-2)	0.017318	0.060161	0.019162
	(0.02853)	(0.02698)	(0.02610)
	[0.60710]	[2.22965]	[0.73415]
PSP(-1)	0.348862	0.149169	-0.184131
	(0.03673)	(0.03474)	(0.03360)
	[9.49890]	[4.29404]	[-5.47941]
PSP(-2)	0.141269	0.292402	-0.171761
	(0.03863)	(0.03653)	(0.03534)
	[3.65737]	[8.00336]	[-4.85998]
NSP(-1)	0.291411	-0.065710	0.219740
	(0.03940)	(0.03727)	(0.03605)
	[7.39583]	[-1.76312]	[6.09506]
NSP(-2)	0.221508	-0.254513	0.298873
	(0.03858)	(0.03649)	(0.03530)
	[5.74223]	[-6.97542]	[8.46771]
RG(-1)	-0.078005	0.038868	0.031023
	(0.01386)	(0.01311)	(0.01268)
	[-5.63001]	[2.96588]	[2.44712]
R-squared	0.387158	0.043175	0.159699
Adj. R-squared	0.382965	0.036629	0.153950
Sum sq. resids	2425.294	2169.832	2030.428
S.E. equation	1.662962	1.572944	1.521577
F-statistic	92.33964	6.595544	27.77890
Log likelihood	-1700.431	-1651.235	-1621.885
Akaike AIC	3.862965	3.751662	3.685259
Schwarz SC	3.900851	3.789548	3.723145
Mean dependent	0.103168	0.910494	-0.822862
S.D. dependent	2.117033	1.602568	1.654230

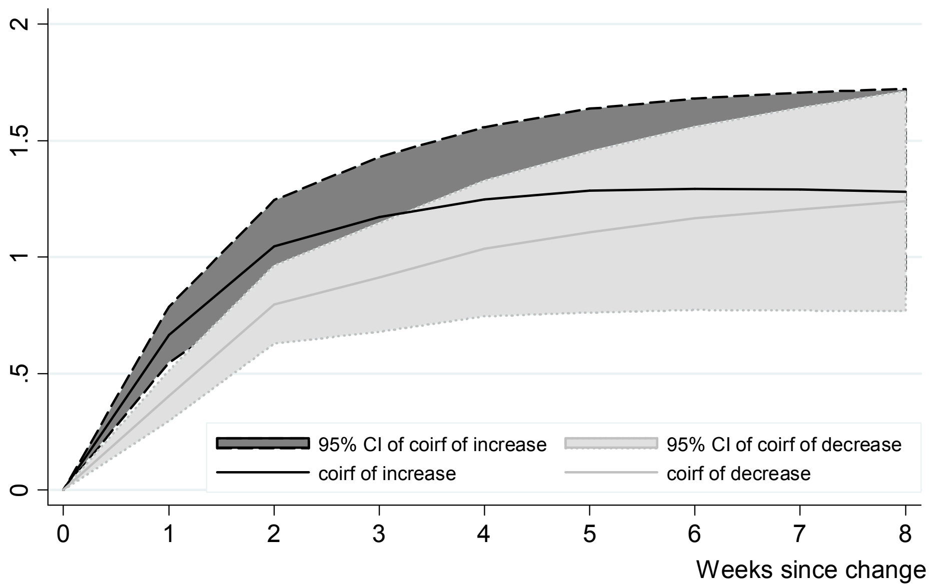
Determinant resid covariance (dof adj.)	12.45266
Determinant resid covariance	12.15918
Log likelihood	-4867.178
Akaike information criterion	11.05923
Schwarz criterion	11.17288

A7-6 COIRFS TABLE AND GRAPH

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.660156	.534502	.78581	.476507	.362175	.590838
2	1.05997	.847405	1.27254	.984611	.796059	1.17316
3	1.44141	1.14997	1.73284	1.17379	.925925	1.42166
4	1.57294	1.21614	1.92974	1.35441	1.03853	1.6703
5	1.67827	1.26055	2.09598	1.45235	1.07378	1.83093
6	1.7414	1.2712	2.2116	1.52765	1.09158	1.96373
7	1.76992	1.25698	2.28286	1.57794	1.09021	2.06567
8	1.78417	1.23488	2.33346	1.61284	1.07937	2.14632

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



1.f. Italy gasoline

A8: THE NETHERLANDS DIESEL

A8-1 UNIT ROOT TESTS ON DP

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.968535	0.7659
Test critical values:	1% level	-3.437516	
	5% level	-2.864593	
	10% level	-2.568449	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 3 887
Included observations: 885 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.002462	0.002542	-0.968535	0.3330
D(DP(-1))	0.181441	0.033156	5.472413	0.0000
C	0.268566	0.205855	1.304638	0.1924

R-squared	0.033315	Mean dependent var	0.111007
Adjusted R-squared	0.031123	S.D. dependent var	2.831529
S.E. of regression	2.787117	Akaike info criterion	4.891277
Sum squared resid	6851.394	Schwarz criterion	4.907499
Log likelihood	-2161.390	Hannan-Quinn criter.	4.897479
F-statistic	15.19847	Durbin-Watson stat	2.012398
Prob(F-statistic)	0.000000		

A8-2 COINTEGRATION TEST

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: DP WP
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.038097	41.20332	25.87211	0.0003
At most 1	0.007791	6.906005	12.51798	0.3544

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.038097	34.29731	19.38704	0.0002
At most 1	0.007791	6.906005	12.51798	0.3544

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	@TREND(2)
0.284193	-0.345019	0.003803
0.050013	-0.006164	-0.005861

Unrestricted Adjustment Coefficients (alpha):

D(DP)	-0.267584	-0.181208
D(WP)	0.177746	-0.228671

1 Cointegrating Equation(s): Log likelihood -3981.268

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	@TREND(2)
1.000000	-1.214030	0.013381
	(0.03268)	(0.00419)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.076045
	(0.02358)
D(WP)	0.050514
	(0.02633)

A8-3 CAUSALITY

Pairwise Granger Causality Tests

Sample: 1 887
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Prob.
WP does not Granger Cause DP	884	81.2144	2.E-46
DP does not Granger Cause WP		2.56569	0.0534

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 884

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	128.8540	2	0.0000
All	128.8540	2	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	6.564028	2	0.0376
All	6.564028	2	0.0376

A8-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP DWP
Exogenous variables: RD(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4086.103	NA	37.96077	9.312307	9.323190	9.316470
1	-4006.286	159.0882	31.93970	9.139604	9.172253	9.152091
2	**-3974.565**	**63.08105**	**29.98520**	**9.076458**	**9.130873***	**9.097269***
3	-3967.570	13.87902	29.78132	9.069635	9.145816	9.098771
4	-3960.966	13.07299	29.60520	9.063703	9.161650	9.101164
5	-3954.480	12.80822	29.43810	9.058041	9.177755	9.103827
6	-3951.603	5.669313	29.51354	9.060599	9.202078	9.114709
7	-3938.260	26.23059	28.89210	9.039316	9.202561	9.101751
8	-3931.434	13.38654*	28.70684*	9.032880*	9.217891	9.103639

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Exclusion Wald Tests

Sample: 1 887
Included observations: 882

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DDP	PWP	NWP	Joint
Lag 1	159.2566	7.045845	35.06856	314.7759
	[0.000000]	[0.070451]	[1.18e-07]	[0.000000]
Lag 2	50.32903	15.84296	27.23188	155.3246
	[6.80e-11]	[0.001221]	[5.26e-06]	[0.000000]
Lag 3	18.06147	11.20835	7.535959	46.38543
	[0.000427]	[0.010651]	[0.056642]	[5.11e-07]
Lag 4	12.64126	22.12409	5.257992	54.17927
	[0.005480]	[6.15e-05]	[0.153852]	[1.75e-08]
df	3	3	3	9

A8-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 4 887
Included observations: 884 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.146897	0.055843	0.000550
	(0.04176)	(0.02896)	(0.02622)
	[-3.51724]	[1.92844]	[0.02099]
DDP(-2)	-0.050861	0.075105	0.016383
	(0.03555)	(0.02465)	(0.02231)
	[-1.43082]	[3.04726]	[0.73416]
PWP(-1)	0.468697	0.141314	-0.221588
	(0.05473)	(0.03795)	(0.03436)
	[8.56354]	[3.72387]	[-6.44935]
PWP(-2)	0.190569	0.167868	-0.196016
	(0.05836)	(0.04046)	(0.03663)
	[3.26552]	[4.14874]	[-5.35056]
NWP(-1)	0.445712	-0.148965	0.251699
	(0.06438)	(0.04464)	(0.04041)
	[6.92330]	[-3.33725]	[6.22799]
NWP(-2)	0.262904	-0.312995	0.233196
	(0.06127)	(0.04248)	(0.03846)
	[4.29094]	[-7.36781]	[6.06295]
RD(-1)	-0.097060	0.011399	-0.000978
	(0.02193)	(0.01520)	(0.01377)
	[-4.42602]	[0.74971]	[-0.07107]
R-squared	0.244468	0.025349	0.196035
Adj. R-squared	0.239300	0.018681	0.190534
Sum sq. resids	5354.764	2574.227	2110.200
S.E. equation	2.470986	1.713261	1.551179
F-statistic	47.29537	3.801562	35.64051
Log likelihood	-2050.510	-1726.772	-1638.918
Akaike AIC	4.654999	3.922562	3.723795
Schwarz SC	4.692885	3.960448	3.761681
Mean dependent	0.111374	0.965355	-0.869026
S.D. dependent	2.833111	1.729492	1.724102

Determinant resid covariance (dof adj.)	22.03461
Determinant resid covariance	21.51530
Log likelihood	-5119.419
Akaike information criterion	11.62991
Schwarz criterion	11.74356

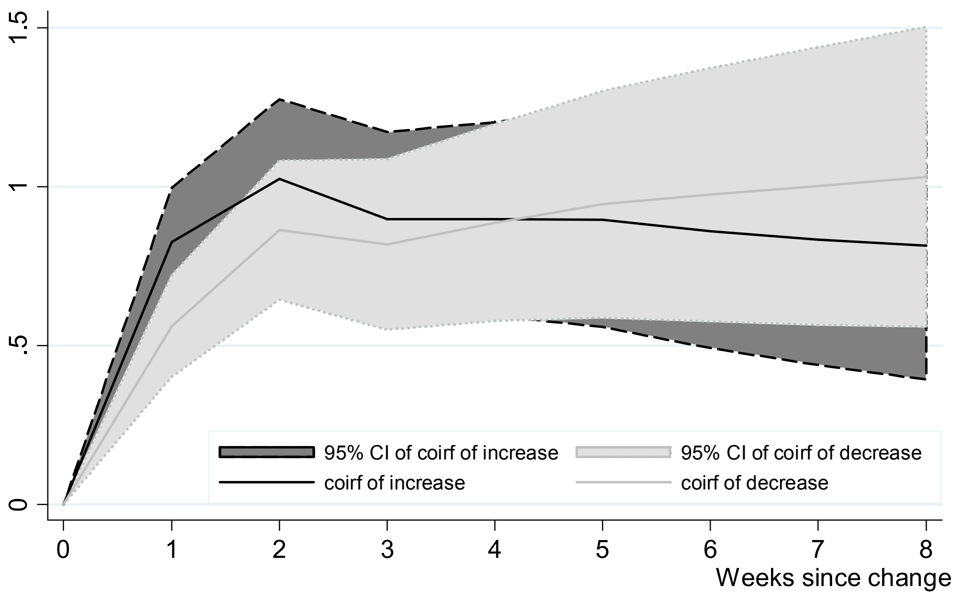
A8-6 COIRFS TABLES WITH 95% CI AND CORRESPONDING GRAPH

```
. irf ctable (ned_d pwp ddp coirf, ci) (ned_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper
0	0	0	0
1	.825114	.653883	.996345
2	1.02497	.77518	1.27477
3	.897495	.623171	1.17182
4	.897987	.593076	1.2029
5	.895568	.558229	1.23291
6	.859305	.491382	1.22723
7	.833611	.438408	1.22881
8	.813366	.392519	1.23421

step	(2) coirf	(2) Lower	(2) Upper
0	0	0	0
1	.560932	.400618	.721247
2	.862719	.643815	1.08162
3	.817932	.549347	1.08652
4	.886819	.577016	1.19662
5	.943853	.587193	1.30051
6	.974042	.575312	1.37277
7	1.00171	.564715	1.43871
8	1.03063	.558901	1.50237

95% lower and upper bounds reported
(1) irfname = ned_d, impulse = pwp, and response = ddp
(2) irfname = ned_d, impulse = nwp, and response = ddp



1.g. The Netherlands diesel

A9: THE NETHERLANDS GASOLINE

A9-1 UNIT ROOT TESTS

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.536181	0.5149
Test critical values:	1% level	-3.437524	
	5% level	-2.864596	
	10% level	-2.568451	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 4 887
Included observations: 884 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.004644	0.003023	-1.536181	0.1249
D(GP(-1))	0.051952	0.033255	1.562229	0.1186
D(GP(-2))	0.165927	0.033280	4.985766	0.0000
C	0.417685	0.243597	1.714654	0.0868

R-squared	0.032552	Mean dependent var	0.098155
Adjusted R-squared	0.029253	S.D. dependent var	3.034688
S.E. of regression	2.989971	Akaike info criterion	5.032919
Sum squared resid	7867.137	Schwarz criterion	5.054568
Log likelihood	-2220.550	Hannan-Quinn criter.	5.041197
F-statistic	9.869718	Durbin-Watson stat	2.013353
Prob(F-statistic)	0.000002		

A9-2 COINTEGRATION TEST

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: GP SP
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.032164	36.72501	25.87211	0.0015
At most 1	0.008859	7.857164	12.51798	0.2636

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.032164	28.86784	19.38704	0.0016
At most 1	0.008859	7.857164	12.51798	0.2636

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	@TREND(2)
0.194821	-0.303598	0.006486
0.132852	-0.119336	-0.003428

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.011747	-0.245436
D(SP)	0.380364	-0.133675

1 Cointegrating Equation(s): Log likelihood -3986.606

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	@TREND(2)
1.000000	-1.558345	0.033292
	(0.06899)	(0.00714)

Adjustment coefficients (standard error in parentheses)

D(GP)	0.002289
	(0.01718)
D(SP)	0.074103
	(0.01662)

A9-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 884

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	176.8929	2	0.0000
All	176.8929	2	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	15.95607	2	0.0003
All	15.95607	2	0.0003

A9-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5618.143	NA	73.02445	12.80443	12.82075	12.81067
1	-5291.134	651.0383	35.38898	12.08003	12.14533	12.10501
2	**-5116.856**	**345.7767**	**24.28635**	**11.70354**	**11.81782***	**11.74725**
3	-5088.431	56.20243	23.23519	11.65930	11.82254	11.72173
4	-5062.677	50.74596	22.36522	11.62113	11.83335	11.70230
5	-5025.878	72.25724	20.99299	11.55781	11.81900	11.65770
6	-5009.099	32.83153	20.62445	11.54009	11.85025	11.65871
7	-4985.139	46.71881	19.93370	11.50601	11.86515	11.64337*
8	-4971.434	26.62862*	19.72151*	11.49529*	11.90341	11.65138

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A9-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 4 887
Included observations: 884 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.297472	0.067202	0.052642
	(0.04055)	(0.02431)	(0.02341)
	[-7.33523]	[2.76425]	[2.24847]
DGP(-2)	-0.026395	0.061204	0.051178
	(0.03572)	(0.02141)	(0.02062)
	[-0.73897]	[2.85839]	[2.48185]
PSP(-1)	0.552750	0.106930	-0.227851
	(0.06047)	(0.03625)	(0.03491)
	[9.14083]	[2.94976]	[-6.52667]
PSP(-2)	0.300286	0.262766	-0.209735
	(0.06380)	(0.03825)	(0.03684)
	[4.70634]	[6.86986]	[-5.69382]
NSP(-1)	0.625165	-0.115066	0.170793
	(0.06543)	(0.03922)	(0.03777)
	[9.55473]	[-2.93361]	[4.52145]
NSP(-2)	0.343834	-0.292166	0.253036
	(0.06401)	(0.03837)	(0.03695)
	[5.37154]	[-7.61396]	[6.84724]
RG(-1)	-0.055059	0.015778	0.007672
	(0.01931)	(0.01158)	(0.01115)
	[-2.85076]	[1.36275]	[0.68810]
R-squared	0.250883	0.034652	0.159732
Adj. R-squared	0.245758	0.028048	0.153983
Sum sq. resids	6091.702	2189.159	2030.349
S.E. equation	2.635540	1.579934	1.521548
F-statistic	48.95188	5.246823	27.78567
Log likelihood	-2107.501	-1655.154	-1621.867
Akaike AIC	4.783940	3.760530	3.685220
Schwarz SC	4.821826	3.798416	3.723106
Mean dependent	0.098155	0.910494	-0.822862
S.D. dependent	3.034688	1.602568	1.654230

Determinant resid covariance (dof adj.)	23.24435
Determinant resid covariance	22.69653
Log likelihood	-5143.043
Akaike information criterion	11.68335
Schwarz criterion	11.79701

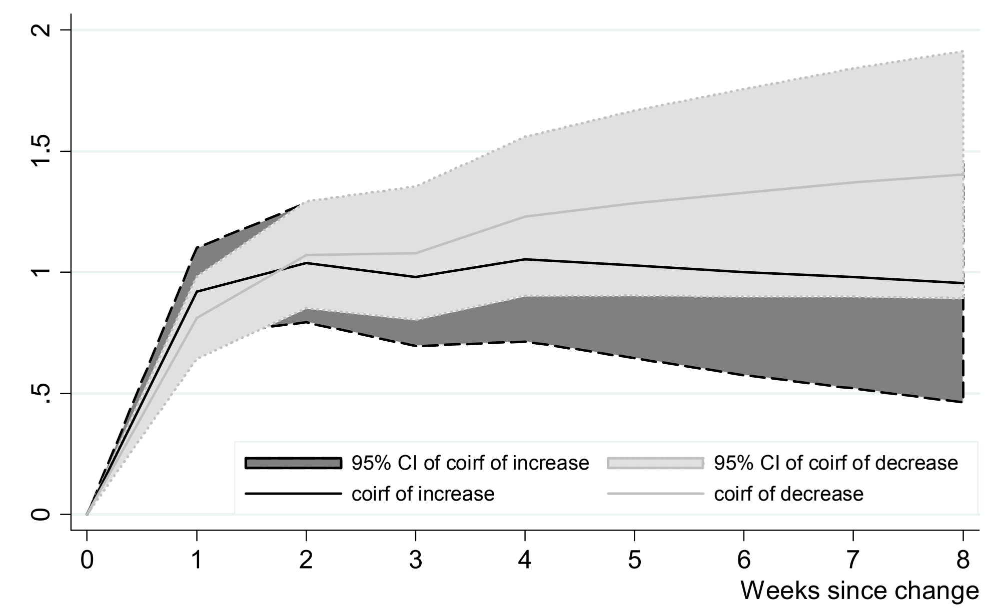
A9-6 COIRFS TABLE AND GRAPH

```
. irf ctable (ned_g psp dgp coirf, ci) (ned_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper
0	0	0	0
1	.91886	.736902	1.10082
2	1.03919	.793162	1.28522
3	.981208	.694532	1.26788
4	1.05378	.714001	1.39356
5	1.02903	.64507	1.41299
6	.999236	.574663	1.42381
7	.979253	.519599	1.43891
8	.953977	.46202	1.44593

step	(2) coirf	(2) Lower	(2) Upper
0	0	0	0
1	.811213	.64121	.981216
2	1.07208	.851666	1.29249
3	1.07898	.8036	1.35436
4	1.23087	.902767	1.55897
5	1.28575	.903389	1.66811
6	1.32739	.898428	1.75636
7	1.37022	.898472	1.84197
8	1.4028	.892769	1.91284

```
95% lower and upper bounds reported
(1) irfname = ned_g, impulse = psp, and response = dgp
(2) irfname = ned_g, impulse = nsp, and response = dgp
```



1.h. The Netherlands gasoline

A10: SPAIN DIESEL

A10-1 UNIT ROOT TESTS ON DP

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.747794	0.8324
Test critical values:	1% level	-3.437516	
	5% level	-2.864593	
	10% level	-2.568449	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 3 887
Included observations: 885 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.001352	0.001807	-0.747794	0.4548
D(DP(-1))	0.323008	0.031908	10.12317	0.0000
C	0.170065	0.143894	1.181877	0.2376

R-squared	0.104153	Mean dependent var	0.111622
Adjusted R-squared	0.102122	S.D. dependent var	2.169808
S.E. of regression	2.056033	Akaike info criterion	4.282818
Sum squared resid	3728.453	Schwarz criterion	4.299040
Log likelihood	-1892.147	Hannan-Quinn criter.	4.289020
F-statistic	51.27172	Durbin-Watson stat	2.051031
Prob(F-statistic)	0.000000		

A10-2 COINTEGRATION TEST

Sample (adjusted): 7 887
Included observations: 881 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.035519	33.67128	20.26184	0.0004
At most 1	0.002052	1.809754	9.164546	0.8152

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.035519	31.86153	15.89210	0.0001
At most 1	0.002052	1.809754	9.164546	0.8152

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.284885	0.336710	3.525682
0.038624	-0.023975	-2.252115

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.101556	-0.073406
D(WP)	-0.376606	-0.084975

1 Cointegrating Equation(s): Log likelihood -3758.746

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.181915	-12.37583
	(0.01908)	(1.11346)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.028932
	(0.01646)
D(WP)	0.107289
	(0.02622)

A10-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 883

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
PWP	157.9317	3	0.0000
NWP	136.7522	3	0.0000
All	199.8999	6	0.0000

Dependent variable: PWP

Excluded	Chi-sq	df	Prob.
DDP	7.584467	3	0.0554
NWP	26.02100	3	0.0000
All	46.26882	6	0.0000

Dependent variable: NWP

Excluded	Chi-sq	df	Prob.
DDP	7.208425	3	0.0655
PWP	34.42586	3	0.0000
All	82.56965	6	0.0000

A10-4 LAG LENGTH

VAR Lag Exclusion Wald Tests

Sample: 1 887
Included observations: 881

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DDP	PWP	NWP	Joint
Lag 1	189.5443 [0.000000]	6.268690 [0.099245]	28.66355 [2.64e-06]	256.0681 [0.000000]
Lag 2	117.5981 [0.000000]	10.94921 [0.012004]	34.65258 [1.44e-07]	188.8836 [0.000000]
Lag 3	43.71136 [1.74e-09]	14.65749 [0.002134]	12.33156 [0.006330]	56.98152 [5.09e-09]
Lag 4	**13.82947** **[0.003147]**	**16.50891** **[0.000892]**	**4.983457** **[0.173012]**	**37.71149** **[1.96e-05]**
Lag 5	**9.677311** **[0.021518]**	**4.185095** **[0.242158]**	**37.19785** **[4.18e-08]**	**83.86980** **[2.74e-14]**
df	3	3	3	9

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5426.006	NA	47.14016	12.36676	12.38308	12.37300
1	-5028.772	790.8497	19.46785	11.48240	11.54769	11.50737
2	-4883.475	288.2767	14.27192	11.17192	11.28620	11.21563
3	-4843.172	79.68727	13.28973	11.10062	11.26387	11.16305
4	-4818.727	48.16557	12.83035	11.06544	11.27766	11.14660
5	**-4777.629**	**80.69796**	**11.92579**	**10.99232**	**11.25351***	**11.09222**
6	-4761.814	30.94622	11.74217	10.97680	11.28696	11.09542
7	-4740.615	41.33582	11.42049	10.94901	11.30815	11.08637
8	-4712.043	55.51714*	10.92267*	10.90443*	11.31254	11.06051*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A10-5 ASYMMETRIC VECM ESTIMATION

Vector Autoregression Estimates

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.056519	0.018845	-0.000112
	(0.03780)	(0.03699)	(0.03361)
	[-1.49533]	[0.50944]	[-0.00332]
DDP(-2)	-0.084618	-0.016823	-0.082808
	(0.03475)	(0.03401)	(0.03090)
	[-2.43534]	[-0.49470]	[-2.68027]
DDP(-3)	0.024651	0.078476	0.013852
	(0.02974)	(0.02911)	(0.02644)
	[0.82894]	[2.69629]	[0.52385]
PWP(-1)	0.381796	0.134797	-0.145645
	(0.04042)	(0.03956)	(0.03594)
	[9.44576]	[3.40747]	[-4.05236]
PWP(-2)	0.213079	0.184686	-0.143585
	(0.04226)	(0.04136)	(0.03758)
	[5.04186]	[4.46508]	[-3.82092]
PWP(-3)	0.177188	0.185805	-0.003637
	(0.04279)	(0.04188)	(0.03805)
	[4.14112]	[4.43698]	[-0.09560]
NWP(-1)	0.299381	-0.022088	0.239247
	(0.04663)	(0.04564)	(0.04147)
	[6.41982]	[-0.48395]	[5.76968]
NWP(-2)	0.356467	-0.157815	0.262583
	(0.04543)	(0.04446)	(0.04039)
	[7.84670]	[-3.54945]	[6.50044]
NWP(-3)	0.100526	-0.123266	0.144441
	(0.04483)	(0.04387)	(0.03986)
	[2.24261]	[-2.80972]	[3.62388]
RD(-1)	-0.050764	0.049775	0.040959
	(0.01612)	(0.01577)	(0.01433)
	[-3.14953]	[3.15534]	[2.85789]
R-squared	0.376367	0.058707	0.218426
Adj. R-squared	0.369938	0.049003	0.210369
Sum sq. resids	2594.536	2485.245	2051.374
S.E. equation	1.723942	1.687242	1.532905
F-statistic	58.54020	6.049705	27.10859
Log likelihood	-1728.788	-1709.788	-1625.081
Akaike AIC	3.938365	3.895329	3.703467
Schwarz SC	3.992536	3.949500	3.757638
Mean dependent	0.110214	0.966448	-0.869322
S.D. dependent	2.171856	1.730166	1.725056

Determinant resid covariance (dof adj.)	12.64755
Determinant resid covariance	12.22270
Log likelihood	-4863.973
Akaike information criterion	11.08488
Schwarz criterion	11.24739

A10-6 COIRFS AND GRAPH

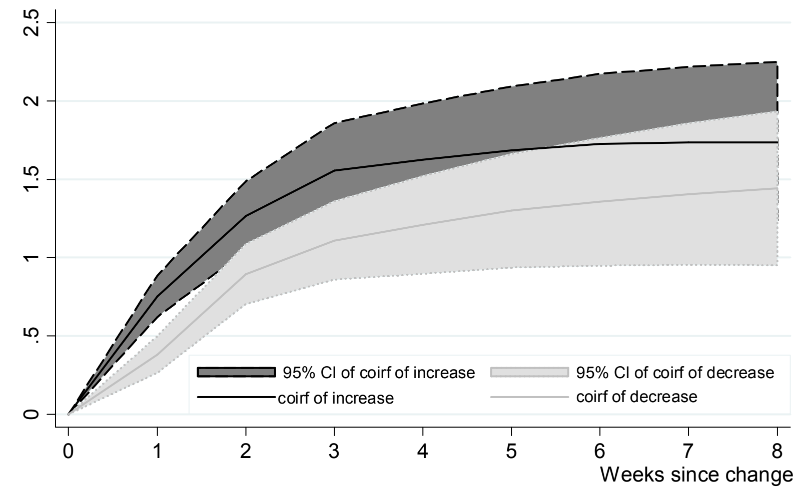
```
. irf ctable (spa_d pwp ddp coirf, ci) (spa_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper
0	0	0	0
1	.753665	.62158	.88575
2	1.26489	1.04229	1.4875
3	1.55734	1.25465	1.86002
4	1.62424	1.26464	1.98383
5	1.68528	1.27728	2.09327
6	1.72496	1.27639	2.17353
7	1.73496	1.25174	2.21818
8	1.73664	1.22219	2.25109

step	(2) coirf	(2) Lower	(2) Upper
0	0	0	0
1	.38175	.264505	.498996
2	.895295	.703412	1.08718
3	1.1101	.859907	1.36029
4	1.20896	.896879	1.52103
5	1.29961	.936961	1.66226
6	1.35708	.948784	1.76538
7	1.40635	.954669	1.85804
8	1.4431	.952046	1.93415

```
95% lower and upper bounds reported
(1) irfname = spa_d, impulse = pwp, and response = ddp
(2) irfname = spa_d, impulse = nwp, and response = ddp

.
```



1.i. Spain diesel

A11: SPAIN GASOLINE

A11-1 UNIT ROOT TEST

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.120408	0.7095
Test critical values:	1% level	-3.437524	
	5% level	-2.864596	
	10% level	-2.568451	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 4 887
Included observations: 884 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.002323	0.002073	-1.120408	0.2628
D(GP(-1))	0.273476	0.033419	8.183169	0.0000
D(GP(-2))	0.131627	0.033533	3.925270	0.0001
C	0.215813	0.155492	1.387933	0.1655

R-squared	0.114052	Mean dependent var	0.098700
Adjusted R-squared	0.111032	S.D. dependent var	2.079133
S.E. of regression	1.960312	Akaike info criterion	4.188599
Sum squared resid	3381.686	Schwarz criterion	4.210248
Log likelihood	-1847.361	Hannan-Quinn criter.	4.196877
F-statistic	37.76216	Durbin-Watson stat	2.014468
Prob(F-statistic)	0.000000		

A11-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.032993	31.45701	20.26184	0.0010
At most 1	0.002114	1.866123	9.164546	0.8042

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.032993	29.59088	15.89210	0.0002
At most 1	0.002114	1.866123	9.164546	0.8042

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.238978	0.295521	3.610453
0.051247	-0.032260	-2.717996

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.137062	-0.064978
D(SP)	-0.309169	-0.088631

1 Cointegrating Equation(s):	Log likelihood	-3679.601

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.236602	-15.10787
	(0.02927)	(1.46389)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.032755
	(0.01291)
D(SP)	0.073885
	(0.02065)

A11-3 GRANGER CAUSALITY/BLOCK EXOGENEITY TESTS

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 884

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	204.2335	2	0.0000
All	204.2335	2	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	6.535797	2	0.0381
All	6.535797	2	0.0381

A11-4 LAG LENGTH TESTS:

VAR Lag Order Selection Criteria
Endogenous variables: DGP DSP
Exogenous variables: RG(-1)

1.4.3

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3826.192	NA	20.99956	8.720255	8.731139	8.724418
1	-3732.717	186.3116	17.12750	8.516440	8.549089	8.528926
2	-3692.236	80.50092	15.76174	8.433339	8.487754	8.454151
3	**-3674.703**	**34.78679**	**15.28327**	**8.402512**	**8.478693***	**8.431648**
4	-3667.830	13.60508	15.18359	8.395968	8.493915	8.433429
5	-3659.877	15.70600	15.04751	8.386964	8.506677	8.432749
6	-3652.863	13.81965	14.94459	8.380099	8.521578	8.434209
7	-3641.840	21.67097*	14.70742*	8.364099*	8.527345	8.426534*
8	-3640.872	1.898633	14.80939	8.371006	8.556017	8.441765

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Exclusion Wald Tests

Sample: 1 887
Included observations: 882

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DGP	DSP	Joint
Lag 1	223.2831 [0.000000]	4.769412 [0.092116]	239.8419 [0.000000]
Lag 2	118.0941 [0.000000]	9.541858 [0.008473]	118.9877 [0.000000]
Lag 3	44.56438 [2.10e-10]	7.931334 [0.018955]	44.78654 [4.40e-09]
Lag 4	**13.03095** **[0.001480]**	**0.982045** **[0.612000]**	**13.83572** **[0.007838]**
df	2	2	4

A11-5 ASYMMETRIC VECM ESTIMATION:

Vector Autoregression Estimates

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.080257	0.042482	0.005178
	(0.03552)	(0.03487)	(0.03366)
	[-2.25919]	[1.21828]	[0.15384]
DGP(-2)	-0.073002	0.023801	-0.046245
	(0.03320)	(0.03258)	(0.03145)
	[-2.19909]	[0.73045]	[-1.47023]
DGP(-3)	0.022355	-0.001406	0.011109
	(0.02837)	(0.02785)	(0.02689)
	[0.78786]	[-0.05049]	[0.41321]
PSP(-1)	0.389454	0.105477	-0.144886
	(0.03932)	(0.03860)	(0.03726)
	[9.90355]	[2.73256]	[-3.88838]
PSP(-2)	0.187627	0.287119	-0.130408
	(0.03973)	(0.03900)	(0.03765)
	[4.72251]	[7.36237]	[-3.46410]
PSP(-3)	0.221626	0.142144	0.008751
	(0.04071)	(0.03996)	(0.03857)
	[5.44420]	[3.55729]	[0.22687]
NSP(-1)	0.328583	-0.024776	0.195431
	(0.04103)	(0.04027)	(0.03888)
	[8.00843]	[-0.61519]	[5.02695]
NSP(-2)	0.385689	-0.198671	0.312504
	(0.04020)	(0.03946)	(0.03810)
	[9.59313]	[-5.03425]	[8.20327]
NSP(-3)	0.088639	-0.040008	0.119236
	(0.04206)	(0.04128)	(0.03985)
	[2.10753]	[-0.96912]	[2.99202]
RG(-1)	-0.043863	0.032841	0.031796
	(0.01304)	(0.01280)	(0.01235)
	[-3.36468]	[2.56645]	[2.57408]
R-squared	0.411803	0.045917	0.165557
Adj. R-squared	0.405739	0.036081	0.156954
Sum sq. resids	2245.153	2163.164	2015.708
S.E. equation	1.603673	1.574119	1.519521
F-statistic	67.91065	4.668313	19.24516
Log likelihood	-1664.932	-1648.508	-1617.337
Akaike AIC	3.793731	3.756529	3.685928
Schwarz SC	3.847902	3.810700	3.740099
Mean dependent	0.098542	0.911271	-0.823794
S.D. dependent	2.080306	1.603309	1.654936

Determinant resid covariance (dof adj.)	10.91073
Determinant resid covariance	10.54422
Log likelihood	-4798.756
Akaike information criterion	10.93716
Schwarz criterion	11.09967

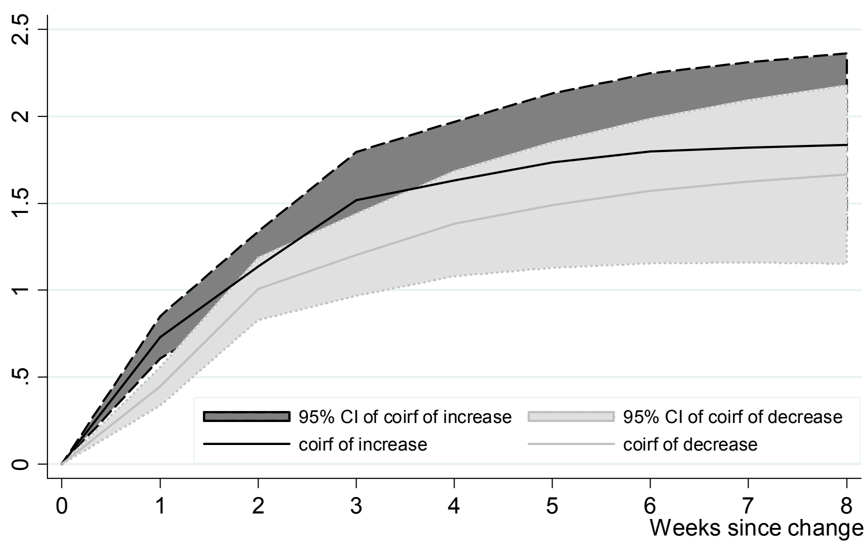
A11-6 COIRFS AND GRAPH

```
. irf ctable (spa_g psp dgp coirf, ci) (spa_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper
0	0	0	0
1	.72932	.607279	.851361
2	1.13714	.935635	1.33865
3	1.51969	1.24421	1.79517
4	1.63114	1.29215	1.97014
5	1.73524	1.33782	2.13265
6	1.79974	1.35167	2.24782
7	1.82151	1.33136	2.31166
8	1.83649	1.30942	2.36356

step	(2) coirf	(2) Lower	(2) Upper
0	0	0	0
1	.446298	.335716	.556881
2	1.00846	.82908	1.18784
3	1.20444	.96817	1.44072
4	1.38339	1.08107	1.68571
5	1.49062	1.12929	1.85194
6	1.57114	1.15475	1.98754
7	1.62662	1.15954	2.09369
8	1.66583	1.15308	2.17857

```
95% lower and upper bounds reported
(1) irfname = spa_g, impulse = psp, and response = dgp
(2) irfname = spa_g, impulse = nsp, and response = dgp
```



1.j. Spain gasoline

A12: UK DIESEL

A12-1 UNIT ROOT TESTS ON DP:

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.257551	0.6509
Test critical values:	1% level	-3.437524	
	5% level	-2.864596	
	10% level	-2.568451	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 4 887
Included observations: 884 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.002097	0.001668	-1.257551	0.2089
D(DP(-1))	0.363348	0.033194	10.94621	0.0000
D(DP(-2))	0.171870	0.033249	5.169135	0.0000
C	0.179912	0.123561	1.456062	0.1457

R-squared	0.215232	Mean dependent var	0.093074
Adjusted R-squared	0.212557	S.D. dependent var	1.942409
S.E. of regression	1.723655	Akaike info criterion	3.931286
Sum squared resid	2614.469	Schwarz criterion	3.952935
Log likelihood	-1733.628	Hannan-Quinn criter.	3.939563
F-statistic	80.45016	Durbin-Watson stat	2.017452
Prob(F-statistic)	0.000000		

12-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.056718	53.81143	20.26184	0.0000
At most 1	0.002618	2.311721	9.164546	0.7152

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.056718	51.49971	15.89210	0.0000
At most 1	0.002618	2.311721	9.164546	0.7152

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.274039	0.291320	3.808033
0.009800	0.015863	-1.930520

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.320426	-0.037653
D(WP)	-0.117468	-0.138106

1 Cointegrating Equation(s): Log likelihood -3698.840

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.063058	-13.89594
	(0.01549)	(0.90410)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.087809
	(0.01391)
D(WP)	0.032191
	(0.02543)

12-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 884

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	45.05930	2	0.0000
All	45.05930	2	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	5.421314	2	0.0665
All	5.421314	2	0.0665

12-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 887
Included observations: 876

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5331.619	NA	39.08992	12.17950	12.19585	12.18575
1	-4960.275	739.2970	17.09174	11.35223	11.41764	11.37725
2	-4820.909	276.5044	12.69181	11.05459	11.16907	11.09838
3	-4782.200	76.53453	11.85951	10.98676	11.15030*	11.04931
4	-4758.053	47.57720	11.45643	10.95218	11.16478	11.03350
5	-4726.448	62.05476	10.88024	10.90057	11.16223	11.00065
6	-4701.971	47.89223	10.50258	10.86523	11.17596	10.98408
7	-4684.660	33.75327	10.30528	10.84626	11.20604	10.98388
8	-4663.658	40.80627	10.02687	10.81885	11.22770	10.97524*
9	-4649.781	26.86555	9.916042	10.80772	11.26563	10.98287
10	-4636.845	24.95605*	9.827567*	10.79873*	11.30571	10.99265

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

12-5 ASYMMETRIC VECM ESTIMATION

Vector Autoregression Estimates

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.148675	0.045573	-0.039835
	(0.03398)	(0.03824)	(0.03472)
	[4.37518]	[1.19162]	[-1.14735]
DDP(-2)	0.074312	0.038125	0.002387
	(0.03224)	(0.03629)	(0.03294)
	[2.30482]	[1.05064]	[0.07247]
DDP(-3)	0.074476	0.015500	0.039494
	(0.03020)	(0.03399)	(0.03086)
	[2.46583]	[0.45598]	[1.27983]
PWP(-1)	0.080401	0.108158	-0.172486
	(0.03502)	(0.03941)	(0.03578)
	[2.29592]	[2.74422]	[-4.82080]
PWP(-2)	0.157254	0.178358	-0.154693
	(0.03414)	(0.03842)	(0.03488)
	[4.60632]	[4.64206]	[-4.43501]
PWP(-3)	0.107743	0.175980	-0.035325
	(0.03497)	(0.03936)	(0.03573)
	[3.08070]	[4.47087]	[-0.98858]
NWP(-1)	0.093521	-0.047231	0.226593
	(0.03902)	(0.04391)	(0.03986)
	[2.39688]	[-1.07555]	[5.68404]
NWP(-2)	0.192063	-0.188720	0.218575
	(0.03797)	(0.04273)	(0.03879)
	[5.05838]	[-4.41626]	[5.63434]
NWP(-3)	0.088779	-0.118360	0.123771
	(0.03816)	(0.04295)	(0.03899)
	[2.32618]	[-2.75554]	[3.17413]
RD(-1)	-0.092457	0.019752	0.008904
	(0.01344)	(0.01513)	(0.01373)
	[-6.87844]	[1.30567]	[0.64838]
R-squared	0.402744	0.045434	0.208656
Adj. R-squared	0.396587	0.035593	0.200498
Sum sq. resids	1989.696	2520.289	2077.019
S.E. equation	1.509685	1.699096	1.542457
F-statistic	65.40937	4.616847	25.57623
Log likelihood	-1611.603	-1715.969	-1630.566
Akaike AIC	3.672939	3.909331	3.715891
Schwarz SC	3.727110	3.963502	3.770062
Mean dependent	0.093472	0.966448	-0.869322
S.D. dependent	1.943474	1.730166	1.725056

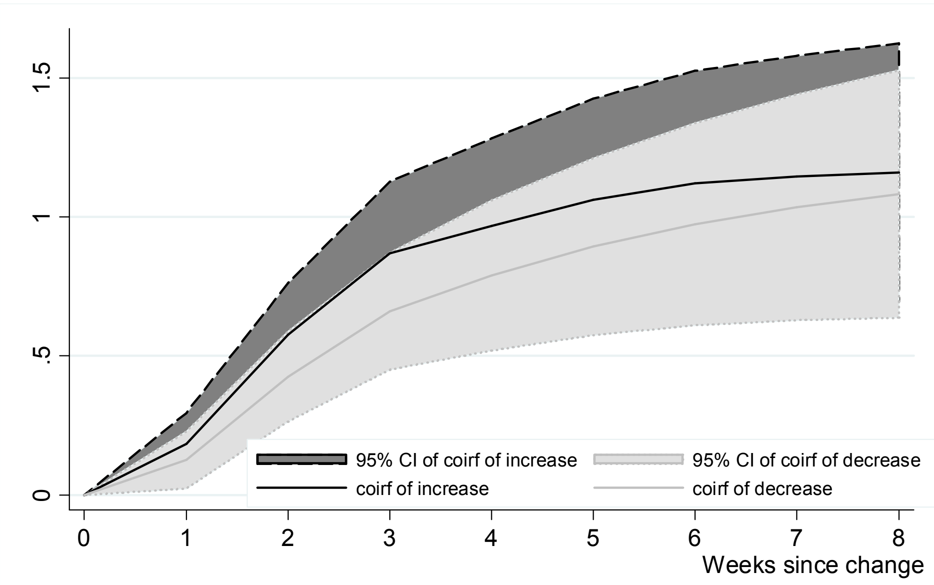
Determinant resid covariance (dof adj.)	11.21229
Determinant resid covariance	10.83565
Log likelihood	-4810.793
Akaike information criterion	10.96442
Schwarz criterion	11.12694

12-6 COIRFS and GRAPH

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.184682	.074535	.294828	.125775	.023343	.228207
2	.576437	.390833	.76204	.426169	.26399	.588349
3	.868404	.609823	1.12698	.660965	.450725	.871205
4	.967353	.653195	1.28151	.78948	.519279	1.05968
5	1.06177	.698745	1.42479	.89296	.57479	1.21113
6	1.12102	.717053	1.52498	.973704	.610196	1.33721
7	1.14436	.709081	1.57965	1.03464	.628605	1.44068
8	1.15946	.695836	1.62309	1.08234	.637435	1.52724

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



1.k. The Uk diesel

A13: THE UK GASOLINE

A13-1 UNIT ROOT TEST

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.499433	0.5337
Test critical values:	1% level	-3.437524	
	5% level	-2.864596	
	10% level	-2.568451	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 4 887
Included observations: 884 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.002747	0.001832	-1.499433	0.1341
D(GP(-1))	0.388483	0.033183	11.70726	0.0000
D(GP(-2))	0.172365	0.033257	5.182850	0.0000
C	0.202096	0.122862	1.644903	0.1003

R-squared	0.241964	Mean dependent var	0.086532
Adjusted R-squared	0.239380	S.D. dependent var	1.882619
S.E. of regression	1.641899	Akaike info criterion	3.834099
Sum squared resid	2372.332	Schwarz criterion	3.855748
Log likelihood	-1690.672	Hannan-Quinn criter.	3.842376
F-statistic	93.63159	Durbin-Watson stat	2.013719
Prob(F-statistic)	0.000000		

A13-2 COINTEGRATION TEST

Sample (adjusted): 6 887
Included observations: 882 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.060595	57.90848	20.26184	0.0000
At most 1	0.003142	2.775453	9.164546	0.6235

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.060595	55.13302	15.89210	0.0000
At most 1	0.003142	2.775453	9.164546	0.6235

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.292614	0.336695	3.174932
0.026069	0.004512	-2.194060

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.298001	-0.039503
D(SP)	-0.175135	-0.138644

1 Cointegrating Equation(s): Log likelihood -3579.317

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.150644	-10.85023
	(0.01743)	(0.87099)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.087199
	(0.01356)
D(SP)	0.051247
	(0.02543)

A13-3 GRANGER CAUSALITY/BLOCK EXOGENEITY TESTS

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 887
Included observations: 884

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
PSP	35.79876	2	0.0000
NSP	53.89314	2	0.0000
All	64.34137	4	0.0000

Dependent variable: PSP

Excluded	Chi-sq	df	Prob.
DGP	6.053127	2	0.0485
NSP	57.65532	2	0.0000
All	59.92264	4	0.0000

Dependent variable: NSP

Excluded	Chi-sq	df	Prob.
DGP	1.665000	2	0.4350
PSP	62.98043	2	0.0000
All	67.79878	4	0.0000

A13-4 LAG LENGTH TESTS

VAR Lag Exclusion Wald Tests

Sample: 1 887
Included observations: 882

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DGP	PSP	NSP	Joint
Lag 1	52.28595 [2.60e-11]	4.738778 [0.191955]	33.86395 [2.12e-07]	102.2153 [0.000000]
Lag 2	94.67238 [0.000000]	43.13567 [2.30e-09]	58.86129 [1.03e-12]	227.8097 [0.000000]
Lag 3	29.36901 [1.87e-06]	11.17377 [0.010822]	9.845545 [0.019926]	45.83146 [6.47e-07]
Lag 4	10.45596 [0.015063]	24.03323 [2.46e-05]	0.887012 [0.828561]	42.04138 [3.23e-06]
df	3	3	3	9

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 887
Included observations: 878

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5165.215	NA	26.02530	11.77270	11.78902	11.77894
1	-4880.350	567.1352	13.88313	11.14431	11.20960	11.16928
2	-4708.655	340.6519	9.583777	10.77370	10.88797*	10.81741
3	-4684.102	48.54697	9.250200	10.73827	10.90152	10.80071
4	-4663.189	41.20753	9.002579	10.71114	10.92335	10.79230
5	-4644.093	37.49446	8.797968	10.68814	10.94933	10.78804
6	-4624.758	37.83321	8.593334	10.66460	10.97476	10.78322
7	-4606.657	35.29542	8.417107*	10.64387*	11.00301	10.78122*
8	-4597.838	17.13632*	8.420696	10.64428	11.05239	10.80036

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A13-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 5 887
Included observations: 883 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	0.123265	0.001247	-0.038197
	(0.03306)	(0.03785)	(0.03651)
	[3.72800]	[0.03295]	[-1.04621]
DGP(-2)	0.076120	0.033116	0.032304
	(0.03097)	(0.03545)	(0.03420)
	[2.45767]	[0.93415]	[0.94457]
DGP(-3)	0.052539	0.013896	-0.026024
	(0.02854)	(0.03267)	(0.03152)
	[1.84073]	[0.42537]	[-0.82574]
PSP(-1)	0.098193	0.105441	-0.147991
	(0.03430)	(0.03926)	(0.03788)
	[2.86244]	[2.68549]	[-3.90701]
PSP(-2)	0.151736	0.308444	-0.127705
	(0.03244)	(0.03714)	(0.03583)
	[4.67677]	[8.30595]	[-3.56468]
PSP(-3)	0.136752	0.152042	-0.002148
	(0.03379)	(0.03868)	(0.03732)
	[4.04654]	[3.93069]	[-0.05756]
NSP(-1)	0.138962	-0.016622	0.193190
	(0.03545)	(0.04057)	(0.03914)
	[3.92038]	[-0.40970]	[4.93596]
NSP(-2)	0.236534	-0.186686	0.300289
	(0.03387)	(0.03877)	(0.03740)
	[6.98337]	[-4.81547]	[8.02905]
NSP(-3)	0.040964	-0.031994	0.119592
	(0.03538)	(0.04049)	(0.03906)
	[1.15794]	[-0.79014]	[3.06154]
RG(-1)	-0.096188	0.022590	0.018557
	(0.01302)	(0.01491)	(0.01438)
	[-7.38502]	[1.51534]	[1.29033]
R-squared	0.468757	0.039398	0.160891
Adj. R-squared	0.463280	0.029495	0.152240
Sum sq. resids	1662.486	2177.945	2026.979
S.E. equation	1.379977	1.579488	1.523763
F-statistic	85.59057	3.978338	18.59881
Log likelihood	-1532.279	-1651.514	-1619.799
Akaike AIC	3.493271	3.763339	3.691504
Schwarz SC	3.547442	3.817510	3.745675
Mean dependent	0.086974	0.911271	-0.823794
S.D. dependent	1.883640	1.603309	1.654936

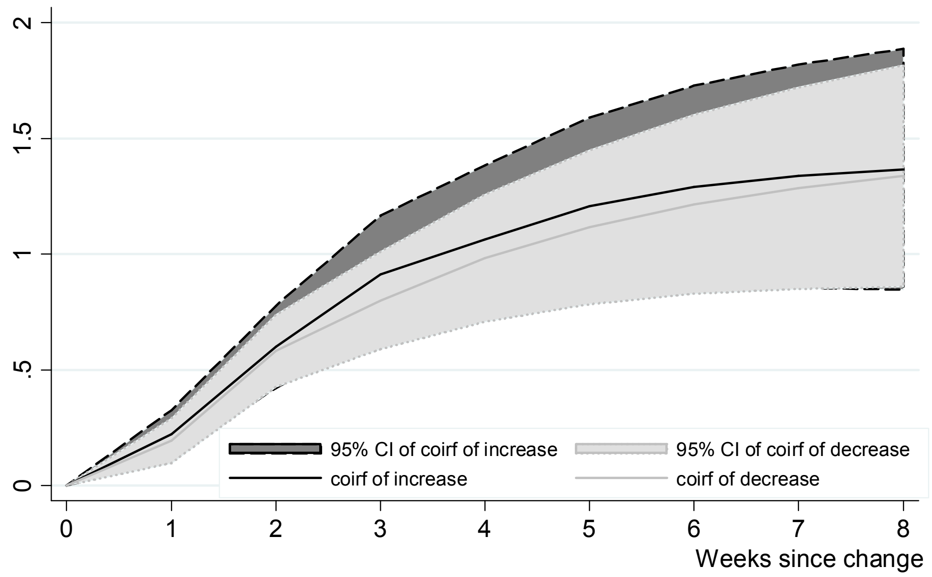
Determinant resid covariance (dof adj.)	8.807638
Determinant resid covariance	8.511774
Log likelihood	-4704.219
Akaike information criterion	10.72303
Schwarz criterion	10.88555

A13-6 COIRFS TABLES WITH 95% CI AND GRAPH

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.221415	.117825	.325004	.193417	.096847	.289988
2	.599418	.421963	.776872	.581579	.425175	.737983
3	.911256	.656911	1.1656	.799838	.588803	1.01087
4	1.06426	.744188	1.38433	.982789	.707143	1.25843
5	1.20653	.822857	1.59019	1.11587	.783244	1.44851
6	1.2899	.851997	1.7278	1.2156	.828354	1.60284
7	1.33697	.854682	1.81926	1.28515	.849444	1.72086
8	1.36658	.846116	1.88704	1.33749	.858285	1.81669

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



1.I. The UK gasoline

A14: AUSTRIA DIESEL

A14-1 UNIT ROOT TESTS ON DP

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.062524	0.7322
Test critical values:	1% level	-3.436984	
	5% level	-2.864357	
	10% level	-2.568323	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares
Date: 05/02/13 Time: 15:38
Sample (adjusted): 4 957
Included observations: 954 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.002273	0.002139	-1.062524	0.2883
D(DP(-1))	0.132673	0.032333	4.103300	0.0000
D(DP(-2))	0.090001	0.032429	2.775309	0.0056
C	0.260862	0.197693	1.319535	0.1873

R-squared	0.029575	Mean dependent var	0.091973
Adjusted R-squared	0.026511	S.D. dependent var	2.675029
S.E. of regression	2.639332	Akaike info criterion	4.783113
Sum squared resid	6617.772	Schwarz criterion	4.803493
Log likelihood	-2277.545	Hannan-Quinn criter.	4.790877
F-statistic	9.650971	Durbin-Watson stat	2.010488
Prob(F-statistic)	0.000003		

A14-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.028691	29.97213	20.26184	0.0017
At most 1	0.002370	2.259057	9.164546	0.7258

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.028691	27.71308	15.89210	0.0005
At most 1	0.002370	2.259057	9.164546	0.7258

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.221744	0.219864	5.218280
0.011257	0.009321	-2.071321

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.342386	-0.039221
D(WP)	-0.022761	-0.145448

1 Cointegrating Equation(s): Log likelihood -4416.640

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-0.991520	-23.53290
	(0.02132)	(1.54186)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.075922
	(0.01552)
D(WP)	0.005047
	(0.02159)

A14-3 GRANGER CAUSALITY/BLOCK EXOGENEITY TESTS

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 953

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	237.1085	3	0.0000
All	237.1085	3	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	2.460947	3	0.4824
All	2.460947	3	0.4824

A14-4 LAG LENGTH TESTS

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6269.169	NA	112.0329	13.23242	13.24779	13.23828
1	-5886.481	762.1453	50.92848	12.44405	12.50550	12.46747
2	-5771.157	228.9461	40.69517	12.21974	12.32727	12.26072
3	-5711.760	117.5405	36.59050	12.11342	12.26704	12.17195
4	-5680.401	61.85779	34.90468	12.06625	12.26595	12.14234
5	-5645.622	68.38377	33.05720	12.01186	12.25765*	12.10552
6	-5622.394	45.52514	32.07987	11.98184	12.27372	12.09306
7	-5602.793	38.29228	31.37065	11.95948	12.29744	12.08826
8	-5574.496	55.10177*	30.11951*	11.91877*	12.30281	12.06511*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A14-5 ASYMMETRIC VECM ESTIMATION

Vector Autoregression Estimates

Sample (adjusted): 7 957
Included observations: 951 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.200932	-0.008359	-0.021645
	(0.03575)	(0.02996)	(0.02844)
	[-5.61982]	[-0.27900]	[-0.76105]
DDP(-2)	-0.110878	0.003609	-0.003872
	(0.03606)	(0.03021)	(0.02868)
	[-3.07508]	[0.11944]	[-0.13501]
DDP(-3)	-0.014768	0.052838	-0.009576
	(0.03478)	(0.02914)	(0.02767)
	[-0.42459]	[1.81294]	[-0.34612]
DDP(-4)	-0.019015	0.007771	0.031838
	(0.03280)	(0.02749)	(0.02609)
	[-0.57970]	[0.28274]	[1.22022]
DDP(-5)	-0.031298	0.003703	4.98E-05
	(0.02819)	(0.02362)	(0.02242)
	[-1.11034]	[0.15675]	[0.00222]
PWP(-1)	0.436989	0.042633	-0.120213
	(0.04565)	(0.03825)	(0.03631)
	[9.57330]	[1.11457]	[-3.31072]
PWP(-2)	0.250093	0.121909	-0.055361
	(0.04867)	(0.04078)	(0.03872)
	[5.13851]	[2.98914]	[-1.42996]
PWP(-3)	0.252174	0.138832	0.009307
	(0.04933)	(0.04134)	(0.03924)
	[5.11164]	[3.35834]	[0.23717]
PWP(-4)	0.050100	0.101464	-0.082244
	(0.04895)	(0.04101)	(0.03893)
	[1.02358]	[2.47385]	[-2.11237]
PWP(-5)	0.096622	0.087301	-0.145232
	(0.04757)	(0.03986)	(0.03784)
	[2.03128]	[2.19021]	[-3.83826]
NWP(-1)	0.392448	-0.047468	0.173850
	(0.04850)	(0.04064)	(0.03858)
	[8.09146]	[-1.16795]	[4.50609]
NWP(-2)	0.320190	-0.126323	0.063293
	(0.04991)	(0.04183)	(0.03971)
	[6.41475]	[-3.02015]	[1.59407]
NWP(-3)	0.198399	-0.058857	0.065122
	(0.05114)	(0.04286)	(0.04068)
	[3.87933]	[-1.37338]	[1.60075]

NWP(-4)	0.107555	-0.094017	0.082126
	(0.05080)	(0.04257)	(0.04041)
	[2.11720]	[-2.20857]	[2.03232]
NWP(-5)	0.045319	-0.063651	0.177645
	(0.04916)	(0.04119)	(0.03910)
	[0.92186]	[-1.54514]	[4.54279]
RD(-1)	-0.070252	0.003561	0.000913
	(0.01576)	(0.01320)	(0.01253)
	[-4.45839]	[0.26972]	[0.07284]
R-squared	0.361328	0.048095	0.173867
Adj. R-squared	0.351082	0.032824	0.160613
Sum sq. resids	4354.851	3057.901	2755.579
S.E. equation	2.158146	1.808447	1.716725
F-statistic	35.26501	3.149403	13.11857
Log likelihood	-2072.899	-1904.780	-1855.280
Akaike AIC	4.393058	4.039496	3.935395
Schwarz SC	4.474782	4.121220	4.017119
Mean dependent	0.092281	1.089946	-0.989760
S.D. dependent	2.679081	1.838879	1.873784

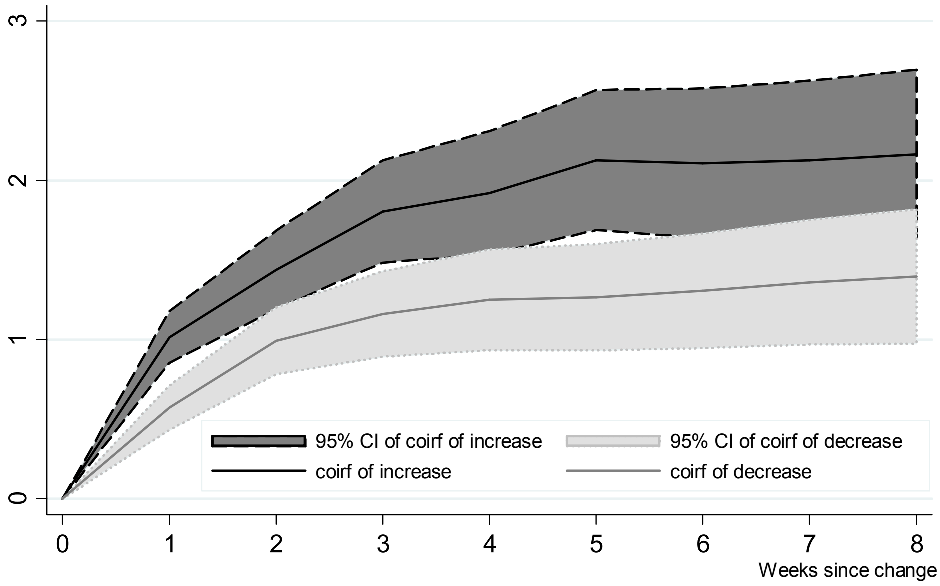
Determinant resid covariance (dof adj.)	31.18658
Determinant resid covariance	29.63883
Log likelihood	-5659.742
Akaike information criterion	12.00366
Schwarz criterion	12.24884

A14-6 COIRFS TABLE AND GRAPH

```
. irf ctable (aut_d pwp ddp coirf, ci) (aut_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.01662	.854919	1.17832	.571932	.432181	.711682
2	1.43685	1.19	1.6837	.99284	.782391	1.20329
3	1.80515	1.48427	2.12604	1.16062	.892246	1.42899
4	1.92159	1.53397	2.3092	1.24962	.933196	1.56604
5	2.1276	1.68774	2.56746	1.2658	.931337	1.60025
6	2.10779	1.63812	2.57746	1.30686	.946568	1.66716
7	2.1252	1.62487	2.62553	1.36009	.968845	1.75133
8	2.1643	1.63416	2.69444	1.39748	.975201	1.81976

```
95% lower and upper bounds reported
(1) irfname = aut_d, impulse = pwp, and response = ddp
(2) irfname = aut_d, impulse = nwp, and response = ddp
```



1.a Austria Diesel

A15. AUSTRIA GASOLINE

A15-1 UNIT ROOT TESTS ON GP

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.328102	0.6182
Test critical values:	1% level	-3.436984	
	5% level	-2.864357	
	10% level	-2.568323	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 4 957
Included observations: 954 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.003317	0.002498	-1.328102	0.1845
D(GP(-1))	0.137099	0.032233	4.253309	0.0000
D(GP(-2))	0.117507	0.032334	3.634177	0.0003
C	0.321184	0.215430	1.490898	0.1363

R-squared	0.038120	Mean dependent var	0.076851
Adjusted R-squared	0.035083	S.D. dependent var	2.593161
S.E. of regression	2.547267	Akaike info criterion	4.712103
Sum squared resid	6164.142	Schwarz criterion	4.732483
Log likelihood	-2243.673	Hannan-Quinn criter.	4.719867
F-statistic	12.54983	Durbin-Watson stat	2.016961
Prob(F-statistic)	0.000000		

A15-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
None *	0.019879	22.01598	20.26184
At most 1	0.003042	2.900845	9.164546

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value
None *	0.019879	19.11513	15.89210
At most 1	0.003042	2.900845	9.164546

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.181513	0.177461	5.023329
0.018560	0.008505	-2.379385

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.273224	-0.028667
D(SP)	-0.026268	-0.160736

1 Cointegrating Equation(s): Log likelihood -4356.336

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-0.977676	-27.67480
	(0.03745)	(2.34935)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.049594
	(0.01175)
D(SP)	0.004768
	(0.01726)

A15-3 CAUSALITY

Pairwise Granger Causality Tests

Sample: 1 957
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause GP	955	219.847	3.E-79
GP does not Granger Cause SP		3.47648	0.0313

A15-4 LAG LENGTH TESTS

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6230.187	NA	103.1880	13.15018	13.16555	13.15604
1	-5892.893	671.7415	51.62206	12.45758	12.51903	12.48099
2	-5746.456	290.7112	38.62882	12.16763	12.27516	12.20860
3	-5700.183	91.57085	35.70761	12.08899	12.24261*	12.14753
4	-5674.060	51.52968	34.44081	12.05287	12.25257	12.12897
5	-5648.876	49.51621	33.28494	12.01873	12.26452	12.11239
6	-5619.920	56.75207	31.91287	11.97662	12.26850	12.08784
7	-5600.396	38.14239	31.21239	11.95442	12.29238	12.08320*
8	-5591.130	18.04261*	31.19527*	11.95386*	12.33791	12.10020

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A15-5 THE VECM

Vector Autoregression Estimates

Sample (adjusted): 5 957
Included observations: 953 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.163402	0.007124	0.042102
	(0.03234)	(0.02806)	(0.02957)
	[-5.05313]	[0.25388]	[1.42382]
DGP(-2)	-0.071788	0.014284	0.027994
	(0.03093)	(0.02684)	(0.02828)
	[-2.32095]	[0.53220]	[0.98976]
DGP(-3)	0.029226	0.018566	-0.016330
	(0.02579)	(0.02238)	(0.02358)
	[1.13326]	[0.82963]	[-0.69250]
PSP(-1)	0.415104	0.095951	-0.118660
	(0.04139)	(0.03592)	(0.03785)
	[10.0290]	[2.67147]	[-3.13516]
PSP(-2)	0.265904	0.266290	-0.189863
	(0.04187)	(0.03633)	(0.03829)
	[6.35060]	[7.32899]	[-4.95890]
PSP(-3)	0.227216	0.142626	-0.103601
	(0.04311)	(0.03741)	(0.03942)
	[5.27008]	[3.81221]	[-2.62783]
NSP(-1)	0.459624	-0.095558	0.171118
	(0.03898)	(0.03382)	(0.03564)
	[11.7917]	[-2.82515]	[4.80091]
NSP(-2)	0.257930	-0.164179	0.177115
	(0.04034)	(0.03500)	(0.03688)
	[6.39463]	[-4.69064]	[4.80202]
NSP(-3)	0.165418	-0.042935	0.092591
	(0.04147)	(0.03599)	(0.03792)
	[3.98897]	[-1.19313]	[2.44176]
RG(-1)	-0.052863	-0.003949	0.004191
	(0.01172)	(0.01017)	(0.01072)
	[-4.50860]	[-0.38813]	[0.39085]
R-squared	0.410343	0.015157	0.090128
Adj. R-squared	0.404715	0.005758	0.081444
Sum sq. resids	3778.509	2845.264	3159.442
S.E. equation	2.001725	1.737023	1.830414
F-statistic	72.91497	1.612584	10.37880
Log likelihood	-2008.613	-1873.442	-1923.351
Akaike AIC	4.236333	3.952660	4.057399
Schwarz SC	4.287326	4.003653	4.108392
Mean dependent	0.076143	1.038539	-0.947135
S.D. dependent	2.594430	1.742045	1.909838

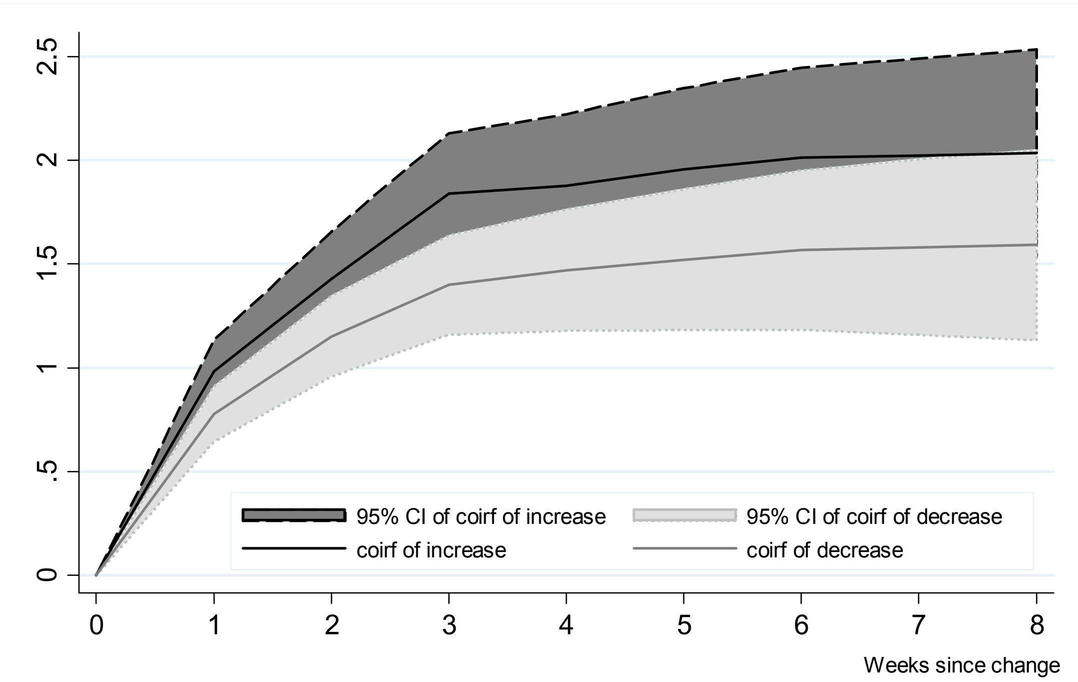
Determinant resid covariance (dof adj.)	34.11346
Determinant resid covariance	33.05081
Log likelihood	-5723.564
Akaike information criterion	12.07464
Schwarz criterion	12.22761

A15-6 COIRFS AND GRAPH

```
. irf ctable (aut_g psp dgp coirf, ci) (aut_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.983576	.833096	1.13406	.776517	.643478	.909556
2	1.42926	1.20442	1.65409	1.15125	.956802	1.34571
3	1.83939	1.54902	2.12976	1.39874	1.15974	1.63775
4	1.87582	1.53171	2.21994	1.46986	1.1775	1.76223
5	1.95593	1.56468	2.34717	1.52075	1.18134	1.86015
6	2.01233	1.57921	2.44546	1.56655	1.18335	1.94974
7	2.02234	1.55493	2.48975	1.5813	1.15808	2.00453
8	2.03404	1.53591	2.53218	1.59093	1.13202	2.04984

```
95% lower and upper bounds reported
(1) irfname = aut_g, impulse = psp, and response = dgp
(2) irfname = aut_g, impulse = nsp, and response = dgp
```



1.b Austria gasoline

A16: BELGIUM DIESEL

A16-1 UNIT ROOT TESTS

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.184202	0.6832
Test critical values:	1% level	-3.436969	
	5% level	-2.864351	
	10% level	-2.568319	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares
Date: 05/02/13 Time: 16:08
Sample (adjusted): 2 957
Included observations: 956 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.003358	0.002836	-1.184202	0.2366
C	0.388259	0.269120	1.442699	0.1494

R-squared	0.001468	Mean dependent var	0.106959
Adjusted R-squared	0.000421	S.D. dependent var	3.911658
S.E. of regression	3.910834	Akaike info criterion	5.567468
Sum squared resid	14591.07	Schwarz criterion	5.577642
Log likelihood	-2659.250	Hannan-Quinn criter.	5.571343
F-statistic	1.402335	Durbin-Watson stat	2.129504
Prob(F-statistic)	0.236628		

A16-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.056589	57.64719	20.26184	0.0000
At most 1	0.002297	2.189594	9.164546	0.7397

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.056589	55.45760	15.89210	0.0000
At most 1	0.002297	2.189594	9.164546	0.7397

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.278274	0.307839	4.772040
0.010403	0.008802	-1.982711

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.719737	-0.059264
D(WP)	-0.127024	-0.140812

1 Cointegrating Equation(s): Log likelihood -4822.035

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.106243	-17.14869
	(0.01191)	(0.86191)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.200284
	(0.02889)
D(WP)	0.035347
	(0.02703)

A16-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 952

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	96.17939	4	0.0000
All	96.17939	4	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	6.624620	4	0.1571
All	6.624620	4	0.1571

16-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 957
Included observations: 826

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5548.507	NA	138.1410	13.44191	13.45904	13.44848
1	-5226.042	641.8080	64.66877	12.68291	12.75143	12.70919
2	-5123.661	203.0255	51.58221	12.45681	12.57672	12.50280
3	-5083.922	78.51625	47.88250	12.38238	12.55368	12.44809
4	-5057.452	52.10712	45.89947	12.34008	12.56277	12.42550
5	-5023.109	67.35533	43.16791	12.27871	12.55280*	12.38385
6	-5013.617	18.54656	43.11698	12.27752	12.60300	12.40237
7	-4995.004	36.23516	42.12551	12.25425	12.63112	12.39880
8	-4970.005	48.48467*	40.52556*	12.21551*	12.64377	12.37978*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A16-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 7 957
Included observations: 951 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.253700	0.001637	-0.049996
	(0.03944)	(0.02217)	(0.02109)
	[-6.43179]	[0.07384]	[-2.37072]
DDP(-2)	-0.164056	0.027901	-0.045175
	(0.03859)	(0.02169)	(0.02063)
	[-4.25111]	[1.28616]	[-2.18949]
DDP(-3)	-0.126421	0.044546	-0.028485
	(0.03623)	(0.02036)	(0.01937)
	[-3.48964]	[2.18746]	[-1.47066]
DDP(-4)	-0.055761	0.056059	0.001907
	(0.03325)	(0.01869)	(0.01778)
	[-1.67683]	[2.99893]	[0.10724]
DDP(-5)	-0.022952	0.021628	0.011708
	(0.02877)	(0.01617)	(0.01538)
	[-0.79765]	[1.33717]	[0.76105]
PWP(-1)	0.395087	0.033768	-0.099664
	(0.07144)	(0.04016)	(0.03820)
	[5.52999]	[0.84082]	[-2.60917]
PWP(-2)	0.448484	0.112111	-0.032498
	(0.07169)	(0.04030)	(0.03833)
	[6.25629]	[2.78218]	[-0.84793]
PWP(-3)	0.163041	0.126545	0.046592
	(0.07234)	(0.04066)	(0.03867)
	[2.25391]	[3.11209]	[1.20472]
PWP(-4)	0.178300	0.096271	-0.054969
	(0.07012)	(0.03941)	(0.03749)
	[2.54294]	[2.44256]	[-1.46635]
PWP(-5)	0.064691	0.057697	-0.120205
	(0.06883)	(0.03869)	(0.03680)
	[0.93986]	[1.49122]	[-3.26647]
NWP(-1)	0.361278	-0.032639	0.196068
	(0.07347)	(0.04130)	(0.03928)
	[4.91704]	[-0.79026]	[4.99120]
NWP(-2)	0.190525	-0.130728	0.101864
	(0.07439)	(0.04182)	(0.03977)
	[2.56125]	[-3.12634]	[2.56126]
NWP(-3)	0.435438	-0.067395	0.094891
	(0.07520)	(0.04227)	(0.04021)

	[5.79030]	[-1.59429]	[2.36012]
NWP(-4)	0.207731	-0.124720	0.116682
	(0.07530)	(0.04233)	(0.04026)
	[2.75861]	[-2.94640]	[2.89819]
NWP(-5)	-0.012830	-0.095522	0.193248
	(0.07361)	(0.04138)	(0.03936)
	[-0.17430]	[-2.30851]	[4.91032]
RD(-1)	-0.195697	0.011566	0.021593
	(0.02991)	(0.01681)	(0.01599)
	[-6.54268]	[0.68792]	[1.35026]
R-squared	0.345391	0.059132	0.180287
Adj. R-squared	0.334889	0.044037	0.167137
Sum sq. resids	9565.180	3022.447	2734.163
S.E. equation	3.198459	1.797933	1.710040
F-statistic	32.88884	3.917517	13.70957
Log likelihood	-2447.041	-1899.235	-1851.570
Akaike AIC	5.179897	4.027834	3.927592
Schwarz SC	5.261621	4.109559	4.009317
Mean dependent	0.107010	1.089946	-0.989760
S.D. dependent	3.921874	1.838879	1.873784

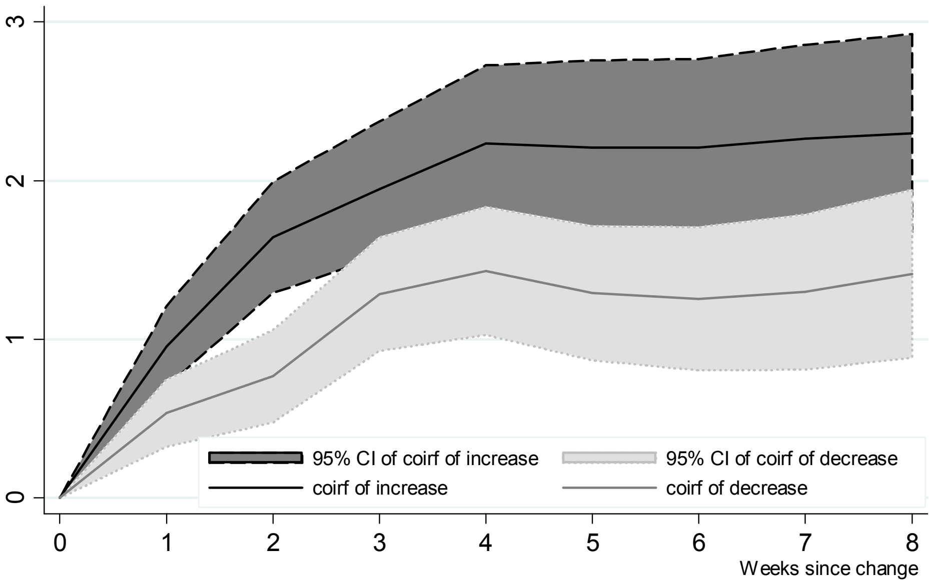
Determinant resid covariance (dof adj.)	72.05740
Determinant resid covariance	68.48128
Log likelihood	-6057.961
Akaike information criterion	12.84114
Schwarz criterion	13.08631

A16-6 COIRFS AND GRAPH

```
. irf ctable (bel_d pwp ddp coirf, ci) (bel_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.955406	.701704	1.20911	.534303	.321765	.746841
2	1.64198	1.29038	1.99358	.766212	.474783	1.05764
3	1.94683	1.52162	2.37205	1.28393	.926003	1.64186
4	2.23312	1.73975	2.72648	1.43062	1.02726	1.83398
5	2.20905	1.66004	2.75805	1.2903	.86726	1.71333
6	2.20684	1.64732	2.76637	1.2555	.803433	1.70757
7	2.26598	1.67532	2.85663	1.29799	.809132	1.78684
8	2.29956	1.67569	2.92343	1.41308	.883333	1.94284

```
95% lower and upper bounds reported
(1) irfname = bel_d, impulse = pwp, and response = ddp
(2) irfname = bel_d, impulse = nwp, and response = ddp
```



1.c Belgium Diesel

A17: BELGIUM GASOLINE

A17-1 UNIT ROOT TEST

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.366319	0.6000
Test critical values:	1% level	-3.436969	
	5% level	-2.864351	
	10% level	-2.568319	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 2 957
Included observations: 956 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.004567	0.003342	-1.366319	0.1722
C	0.463469	0.296463	1.563328	0.1183

R-squared	0.001953	Mean dependent var	0.101257
Adjusted R-squared	0.000907	S.D. dependent var	4.105157
S.E. of regression	4.103295	Akaike info criterion	5.663548
Sum squared resid	16062.53	Schwarz criterion	5.673721
Log likelihood	-2705.176	Hannan-Quinn criter.	5.667423
F-statistic	1.866828	Durbin-Watson stat	2.137911
Prob(F-statistic)	0.172161		

A17-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.044476	45.95751	20.26184	0.0000
At most 1	0.002775	2.645745	9.164546	0.6487

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.044476	43.31177	15.89210	0.0000
At most 1	0.002775	2.645745	9.164546	0.6487

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.250866	0.294934	4.277034
0.022546	-0.000272	-2.250624

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.647723	-0.060610
D(SP)	-0.130433	-0.150399

1 Cointegrating Equation(s): Log likelihood -4821.219

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.175661	-17.04906
	(0.01787)	(1.12129)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.162492
	(0.02627)
D(SP)	0.032721
	(0.02384)

A17-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 955

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	180.9532	1	0.0000
All	180.9532	1	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	3.770984	1	0.0521
All	3.770984	1	0.0521

A17-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6593.174	NA	221.9267	13.91598	13.93134	13.92183
1	-6344.916	494.4200	133.9658	13.41122	13.47266	13.43463
2	-6207.664	272.4772	102.2081	13.14064	13.24817	13.18162
3	-6161.206	91.93596	94.44215	13.06162	13.21524	13.12015
4	-6128.741	64.04005	89.88091	13.01211	13.21182*	13.08821
5	-6108.062	40.66048	87.69372	12.98747	13.23326	13.08113
6	-6085.057	45.08818	85.14111	12.95793	13.24980	13.06915
7	-6058.400	52.07649	82.02861	12.92067	13.25864	13.04946*
8	-6046.376	23.41310*	81.50798*	12.91430*	13.29834	13.06064

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A17-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.319082	0.020082	-0.023999
	(0.03668)	(0.01944)	(0.02086)
	[-8.69925]	[1.03293]	[-1.15060]
DGP(-2)	-0.249566	0.012800	-0.001921
	(0.03511)	(0.01861)	(0.01997)
	[-7.10799]	[0.68782]	[-0.09623]
DGP(-3)	-0.168996	0.017782	-0.014413
	(0.03147)	(0.01668)	(0.01790)
	[-5.36995]	[1.06600]	[-0.80537]
DGP(-4)	-0.054590	0.015386	0.008304
	(0.02744)	(0.01454)	(0.01560)
	[-1.98977]	[1.05803]	[0.53229]
PSP(-1)	0.480935	0.085961	-0.102485
	(0.07059)	(0.03742)	(0.04014)
	[6.81313]	[2.29749]	[-2.55308]
PSP(-2)	0.380065	0.199126	-0.128234
	(0.07212)	(0.03823)	(0.04101)
	[5.26968]	[5.20890]	[-3.12664]
PSP(-3)	0.465746	0.107430	-0.070356
	(0.07241)	(0.03838)	(0.04118)
	[6.43217]	[2.79914]	[-1.70865]
PSP(-4)	0.168083	0.149596	-0.026256
	(0.07072)	(0.03748)	(0.04021)
	[2.37686]	[3.99107]	[-0.65290]
NSP(-1)	0.347257	-0.053206	0.185471
	(0.06810)	(0.03609)	(0.03872)
	[5.09933]	[-1.47406]	[4.78943]
NSP(-2)	0.571508	-0.104610	0.193599
	(0.06882)	(0.03648)	(0.03913)
	[8.30482]	[-2.86794]	[4.94718]
NSP(-3)	0.284627	-0.014270	0.117650
	(0.06968)	(0.03693)	(0.03962)
	[4.08501]	[-0.38639]	[2.96932]
NSP(-4)	0.269732	-0.146285	0.044284
	(0.06803)	(0.03606)	(0.03869)
	[3.96465]	[-4.05661]	[1.14462]
RG(-1)	-0.162050	0.017070	0.009607
	(0.02631)	(0.01395)	(0.01496)
	[-6.15877]	[1.22396]	[0.64204]

R-squared	0.393649	0.050700	0.091198
Adj. R-squared	0.385900	0.038568	0.079584
Sum sq. resids	9758.416	2741.555	3155.626
S.E. equation	3.223717	1.708700	1.833201
F-statistic	50.80067	4.179131	7.852352
Log likelihood	-2458.634	-1854.302	-1921.257
Akaike AIC	5.192508	3.922904	4.063565
Schwarz SC	5.258854	3.989250	4.129911
Mean dependent	0.100762	1.039630	-0.947483
S.D. dependent	4.113745	1.742635	1.910812

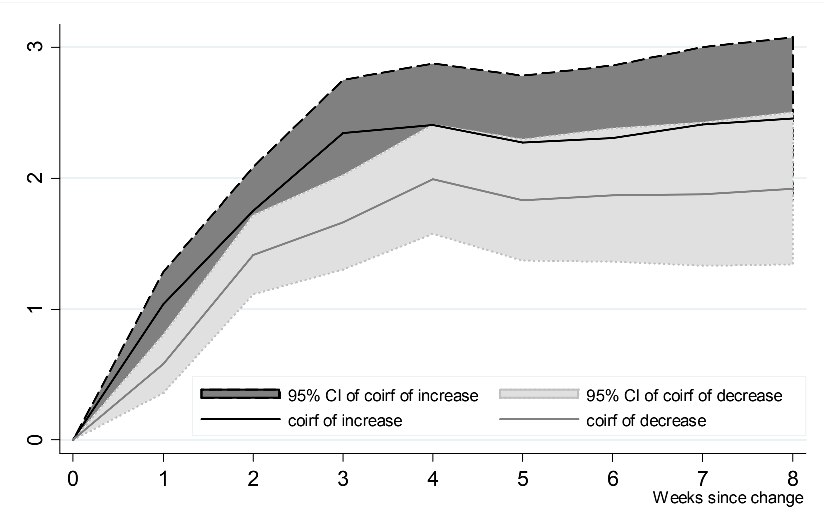
Determinant resid covariance (dof adj.)	85.22867
Determinant resid covariance	81.78462
Log likelihood	-6148.835
Akaike information criterion	12.99965
Schwarz criterion	13.19869

A17-6 COIRFS AND GRAPH

```
. irf ctable (bel_g psp dgp coirf, ci) (bel_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.03668	.792846	1.28051	.579722	.356901	.802543
2	1.75052	1.41705	2.084	1.41364	1.11167	1.71561
3	2.3435	1.93654	2.75046	1.66176	1.30191	2.0216
4	2.40626	1.93475	2.87777	1.99246	1.57528	2.40965
5	2.27322	1.76338	2.78307	1.83257	1.36935	2.29579
6	2.30816	1.755	2.86133	1.8711	1.36219	2.38001
7	2.41089	1.82072	3.00107	1.87806	1.33094	2.42517
8	2.45468	1.83284	3.07652	1.92131	1.33949	2.50314

```
95% lower and upper bounds reported
(1) irfname = bel_g, impulse = psp, and response = dgp
(2) irfname = bel_g, impulse = nsp, and response = dgp
```



1.d Belgium Gasoline

A18: DENMARK DIESEL

A18-1 UNIT ROOT TEST

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.891138	0.7913
Test critical values:	1% level	-3.436969	
	5% level	-2.864351	
	10% level	-2.568319	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 2 957
Included observations: 956 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.002090	0.002346	-0.891138	0.3731
C	0.285783	0.222987	1.281614	0.2003

R-squared	0.000832	Mean dependent var	0.111915
Adjusted R-squared	-0.000216	S.D. dependent var	3.337757
S.E. of regression	3.338117	Akaike info criterion	5.250781
Sum squared resid	10630.45	Schwarz criterion	5.260954
Log likelihood	-2507.873	Hannan-Quinn criter.	5.254656
F-statistic	0.794127	Durbin-Watson stat	1.830618
Prob(F-statistic)	0.373080		

A18-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.033634	34.51213	20.26184	0.0003
At most 1	0.002037	1.941512	9.164546	0.7893

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.033634	32.57062	15.89210	0.0001
At most 1	0.002037	1.941512	9.164546	0.7893

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.266732	0.305728	3.705550
0.027627	-0.011865	-2.192767

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.221208	-0.111525
D(WP)	-0.303127	-0.112243

1 Cointegrating Equation(s): Log likelihood -4549.147

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.146200	-13.89243
	(0.01631)	(1.18041)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.059003
	(0.02380)
D(WP)	0.080853
	(0.02580)

A18-3 CAUSALITY

Pairwise Granger Causality Tests

Sample: 1 957
Lags: 5

Null Hypothesis:	Obs	F-Statistic	Prob.
WP does not Granger Cause DP	952	89.5797	4.E-77
DP does not Granger Cause WP		3.02916	0.0102

A18-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6423.450	NA	155.1326	13.55791	13.57327	13.56376
1	-6011.969	819.4891	66.36466	12.70880	12.77024	12.73221
2	-5890.576	240.9940	52.35506	12.47168	12.57921	12.51265
3	-5842.950	94.24783	48.25792	12.39019	12.54381	12.44873
4	-5804.941	74.97448	45.39326	12.32899	12.52869	12.40509
5	-5770.350	68.01359	43.00771	12.27500	12.52079*	12.36866
6	-5749.255	41.34616	41.92436	12.24948	12.54136	12.36070
7	-5732.352	33.02063	41.23156	12.23281	12.57077	12.36159
8	-5699.312	64.33642*	39.19305*	12.18209*	12.56614	12.32844*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A18-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 7 957
Included observations: 951 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.331702	-0.004663	-0.021501
	(0.04212)	(0.02763)	(0.02612)
	[-7.87448]	[-0.16880]	[-0.82306]
DDP(-2)	-0.267478	-0.002761	-0.062794
	(0.04306)	(0.02824)	(0.02671)
	[-6.21137]	[-0.09775]	[-2.35138]
DDP(-3)	-0.116616	0.019428	-0.078243
	(0.04289)	(0.02813)	(0.02660)
	[-2.71892]	[0.69068]	[-2.94161]
DDP(-4)	-0.090899	0.049590	-0.021509
	(0.03995)	(0.02620)	(0.02478)
	[-2.27504]	[1.89253]	[-0.86808]
DDP(-5)	-0.047306	0.023488	-0.019387
	(0.03160)	(0.02073)	(0.01960)
	[-1.49690]	[1.13329]	[-0.98921]
PWP(-1)	0.629920	0.055436	-0.077357
	(0.06112)	(0.04009)	(0.03791)
	[10.3056]	[1.38293]	[-2.04076]
PWP(-2)	0.410458	0.118778	-0.032206
	(0.06538)	(0.04288)	(0.04054)
	[6.27823]	[2.77027]	[-0.79433]
PWP(-3)	0.347730	0.139100	0.064910
	(0.06643)	(0.04356)	(0.04119)
	[5.23489]	[3.19308]	[1.57571]
PWP(-4)	0.017906	0.099778	-0.029808
	(0.06585)	(0.04318)	(0.04084)
	[0.27193]	[2.31052]	[-0.72994]
PWP(-5)	0.079585	0.060199	-0.104072
	(0.06308)	(0.04137)	(0.03912)
	[1.26158]	[1.45509]	[-2.66023]
NWP(-1)	0.702558	-0.028916	0.191684
	(0.06514)	(0.04272)	(0.04040)
	[10.7850]	[-0.67686]	[4.74487]
NWP(-2)	0.404857	-0.121166	0.106935
	(0.06912)	(0.04533)	(0.04286)
	[5.85736]	[-2.67300]	[2.49473]
NWP(-3)	0.123995	-0.058370	0.128775
	(0.07100)	(0.04656)	(0.04403)
	[1.74635]	[-1.25353]	[2.92457]

NWP(-4)	0.232691	-0.116804	0.141692
	(0.06930)	(0.04545)	(0.04298)
	[3.35765]	[-2.56999]	[3.29690]
NWP(-5)	0.012657	-0.085248	0.205857
	(0.06541)	(0.04290)	(0.04056)
	[0.19350]	[-1.98727]	[5.07482]
RD(-1)	-0.055710	0.031874	0.045477
	(0.02430)	(0.01594)	(0.01507)
	[-2.29224]	[1.99976]	[3.01733]
R-squared	0.336395	0.055129	0.186287
Adj. R-squared	0.325749	0.039971	0.173233
Sum sq. resids	7057.289	3035.304	2714.151
S.E. equation	2.747345	1.801753	1.703771
F-statistic	31.59803	3.636890	14.27025
Log likelihood	-2302.456	-1901.253	-1848.077
Akaike AIC	4.875828	4.032079	3.920246
Schwarz SC	4.957553	4.113804	4.001971
Mean dependent	0.112118	1.089946	-0.989760
S.D. dependent	3.345818	1.838879	1.873784

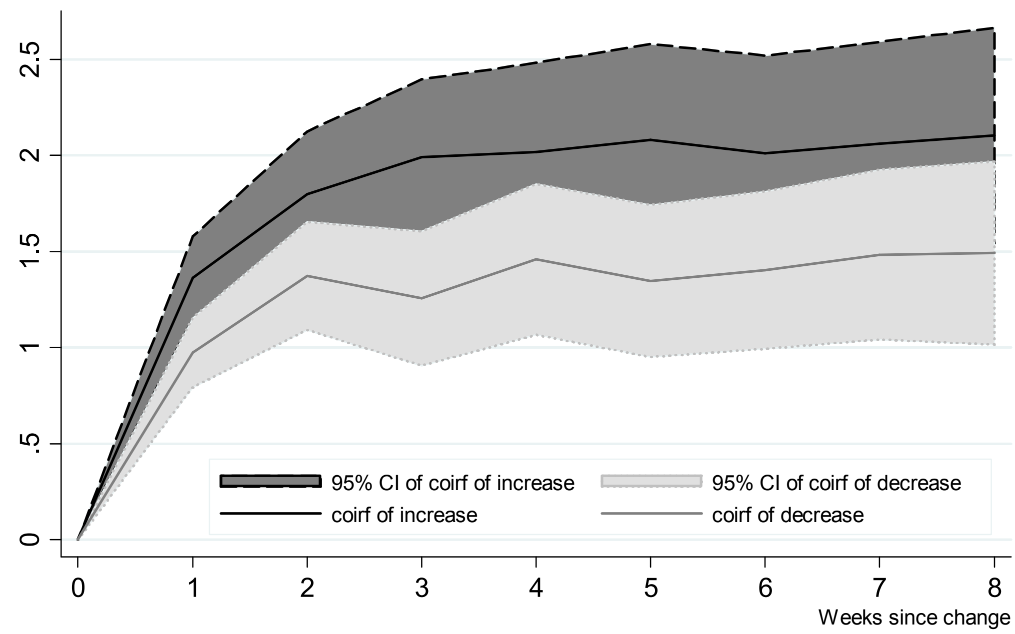
Determinant resid covariance (dof adj.)	40.55888
Determinant resid covariance	38.54599
Log likelihood	-5784.687
Akaike information criterion	12.26643
Schwarz criterion	12.51160

A18-6 COIRFS AND GRAPH

```
. irf ctable (dnk_d pwp ddp coirf, ci) (dnk_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.36317	1.14929	1.57705	.97325	.792503	1.154
2	1.79684	1.46993	2.12375	1.37259	1.09157	1.65361
3	1.9894	1.58442	2.39439	1.25512	.90588	1.60437
4	2.01861	1.55571	2.48151	1.45846	1.06597	1.85094
5	2.07898	1.58005	2.57791	1.34622	.950515	1.74193
6	2.01025	1.50193	2.51857	1.40267	.992811	1.81253
7	2.05924	1.5284	2.59008	1.4832	1.04131	1.92509
8	2.10211	1.54084	2.66338	1.49166	1.01543	1.96788

```
95% lower and upper bounds reported
(1) irfname = dnk_d, impulse = pwp, and response = ddp
(2) irfname = dnk_d, impulse = nwp, and response = ddp
```



1.g Denmark Diesel

A19: DENMARK GASOLINE

A19-1 UNIT ROOT TEST

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.035829	0.7421
Test critical values:	1% level	-3.436969	
	5% level	-2.864351	
	10% level	-2.568319	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares
Date: 07/10/14 Time: 15:24
Sample (adjusted): 2 957
Included observations: 956 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.002884	0.002784	-1.035829	0.3005
C	0.348887	0.257613	1.354306	0.1760

R-squared	0.001123	Mean dependent var	0.110727
Adjusted R-squared	0.000076	S.D. dependent var	3.592669
S.E. of regression	3.592532	Akaike info criterion	5.397681
Sum squared resid	12312.60	Schwarz criterion	5.407855
Log likelihood	-2578.092	Hannan-Quinn criter.	5.401556
F-statistic	1.072942	Durbin-Watson stat	2.108250
Prob(F-statistic)	0.300544		

A19-2 COINTEGRATION TEST

Sample (adjusted): 5 957
Included observations: 953 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.023434	24.65234	20.26184	0.0116
At most 1	0.002153	2.053891	9.164546	0.7670

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.023434	22.59845	15.89210	0.0038
At most 1	0.002153	2.053891	9.164546	0.7670

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.209170	0.261408	3.374623
0.039003	-0.024023	-2.520242

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.148191	-0.123787
D(SP)	-0.297312	-0.100453

1 Cointegrating Equation(s):	Log likelihood	-4584.674

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.249738	-16.13340
	(0.02971)	(1.86674)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.030997
	(0.01927)
D(SP)	0.062189
	(0.01968)

A19-3 CAUSALITY

Pairwise Granger Causality Tests
Sample: 1 957
Lags: 5

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause GP	952	112.107	6.E-93
GP does not Granger Cause SP		3.87348	0.0018

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 954

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	504.7339	2	0.0000
All	504.7339	2	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	11.95741	2	0.0025
All	11.95741	2	0.0025

A19-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6490.206	NA	178.5943	13.69875	13.71411	13.70460
1	-6116.735	743.7920	82.78019	12.92982	12.99127	12.95323
2	-5962.238	306.7118	60.90007	12.62286	12.73040	12.66384
3	-5918.913	85.73589	56.64594	12.55045	12.70407*	12.60899
4	-5889.833	57.36220	54.29654	12.50809	12.70779	12.58418
5	-5865.204	48.42593	52.53572	12.47511	12.72090	12.56877
6	-5838.586	52.16960	50.61917	12.43795	12.72982	12.54917*
7	-5821.867	32.66256	49.80194	12.42166	12.75962	12.55044
8	-5807.915	27.16756*	49.28496*	12.41121*	12.79526	12.55756

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A19-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 5 957
Included observations: 953 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.480640	0.038484	0.021116
	(0.03866)	(0.02345)	(0.02474)
	[-12.4326]	[1.64142]	[0.85366]
DGP(-2)	-0.289961	0.024762	0.031083
	(0.03959)	(0.02401)	(0.02533)
	[-7.32374]	[1.03130]	[1.22703]
DGP(-3)	-0.072158	0.030075	-0.011872
	(0.03075)	(0.01865)	(0.01968)
	[-2.34624]	[1.61248]	[-0.60332]
PSP(-1)	0.826831	0.100021	-0.105846
	(0.06142)	(0.03725)	(0.03930)
	[13.4622]	[2.68528]	[-2.69345]
PSP(-2)	0.397086	0.234536	-0.190959
	(0.06509)	(0.03948)	(0.04165)
	[6.10017]	[5.94108]	[-4.58494]

PSP(-3)	0.271738	0.131939	-0.098279
	(0.06387)	(0.03874)	(0.04087)
	[4.25431]	[3.40605]	[-2.40478]
NSP(-1)	0.762552	-0.097624	0.181893
	(0.05903)	(0.03580)	(0.03777)
	[12.9174]	[-2.72683]	[4.81569]
NSP(-2)	0.471082	-0.186023	0.174823
	(0.06205)	(0.03763)	(0.03970)
	[7.59190]	[-4.94332]	[4.40342]
NSP(-3)	0.257674	-0.060636	0.100250
	(0.06229)	(0.03777)	(0.03985)
	[4.13690]	[-1.60521]	[2.51551]
RG(-1)	-0.035925	0.025187	0.032117
	(0.01968)	(0.01194)	(0.01259)
	[-1.82537]	[2.11021]	[2.55050]
R-squared	0.380112	0.027271	0.099173
Adj. R-squared	0.374196	0.017987	0.090576
Sum sq. resids	7640.890	2810.268	3128.032
S.E. equation	2.846532	1.726307	1.821293
F-statistic	64.24927	2.937462	11.53512
Log likelihood	-2344.157	-1867.545	-1918.590
Akaike AIC	4.940518	3.940284	4.047408
Schwarz SC	4.991511	3.991276	4.098401
Mean dependent	0.110084	1.038539	-0.947135
S.D. dependent	3.598297	1.742045	1.909838

Determinant resid covariance (dof adj.)	54.11933
Determinant resid covariance	52.43349
Log likelihood	-5943.469
Akaike information criterion	12.53614
Schwarz criterion	12.68911

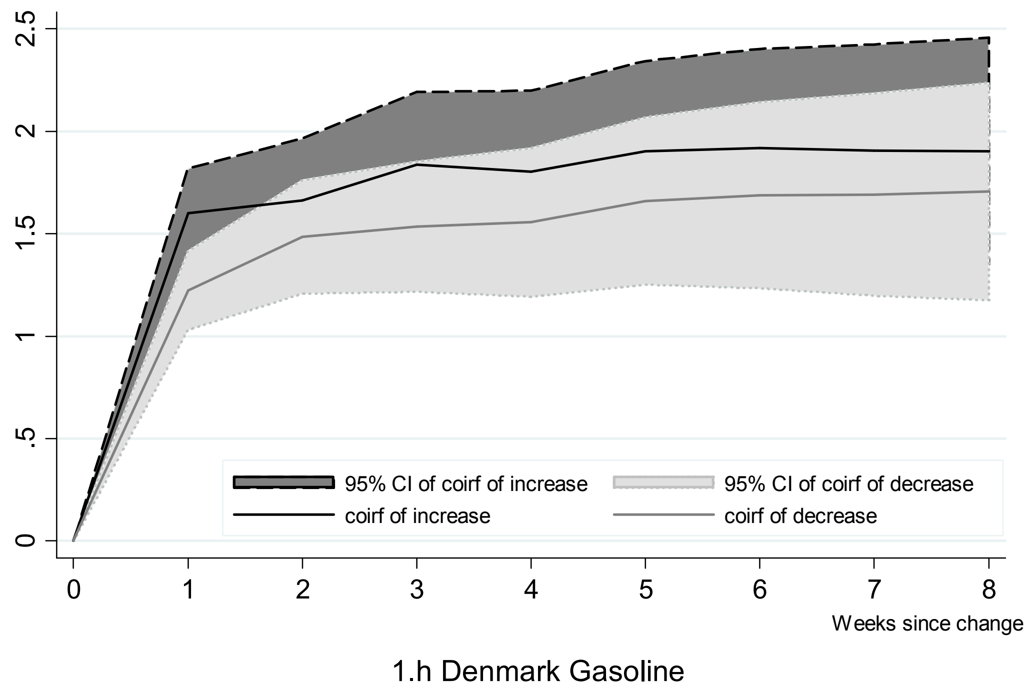
A19-6 COIRFS AND GRAPH

```
. irf ctable (dnk_g psp dgp coirf, ci) (dnk_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.5998	1.38119	1.81842	1.22312	1.03052	1.41572
2	1.66248	1.36017	1.96478	1.48385	1.20678	1.76093
3	1.83847	1.48471	2.19223	1.53479	1.21629	1.85328
4	1.80304	1.40755	2.19853	1.55522	1.19229	1.91815
5	1.90355	1.4637	2.3434	1.66019	1.25118	2.0692
6	1.91841	1.43478	2.40205	1.68809	1.23341	2.14278
7	1.90423	1.38455	2.42392	1.69162	1.19724	2.18599
8	1.90359	1.34985	2.45733	1.70594	1.17508	2.23679

```
95% lower and upper bounds reported
(1) irfname = dnk_g, impulse = psp, and response = dgp
(2) irfname = dnk_g, impulse = nsp, and response = dgp

.
```



1.h Denmark Gasoline

A20: FINLAND DIESEL

A20-1 UNIT ROOT TEST

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.739069	0.8347
Test critical values:	1% level	-3.436969	
	5% level	-2.864351	
	10% level	-2.568319	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 2 957
Included observations: 956 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.001818	0.002460	-0.739069	0.4600
C	0.283961	0.242207	1.172387	0.2413

R-squared	0.000572	Mean dependent var	0.125776
Adjusted R-squared	-0.000475	S.D. dependent var	3.504756
S.E. of regression	3.505589	Akaike info criterion	5.348684
Sum squared resid	11723.85	Schwarz criterion	5.358857
Log likelihood	-2554.671	Hannan-Quinn criter.	5.352559
F-statistic	0.546223	Durbin-Watson stat	2.093996
Prob(F-statistic)	0.460047		

A20-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.056668	57.70906	20.26184	0.0000
At most 1	0.002279	2.171863	9.164546	0.7433

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.056668	55.53720	15.89210	0.0000
At most 1	0.002279	2.171863	9.164546	0.7433

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.174063	0.202458	3.050788
0.018132	-0.000792	-2.130994

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.704235	-0.055456
D(WP)	-0.047034	-0.141129

1 Cointegrating Equation(s): Log likelihood -4763.068

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.163131	-17.52691
	(0.01907)	(1.37772)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.122581
	(0.01757)
D(WP)	0.008187
	(0.01679)

A20-3 CAUSALITY

Pairwise Granger Causality Tests

Sample: 1 957
Lags: 5

Null Hypothesis:	Obs	F-Statistic	Prob.
WP does not Granger Cause DP	952	51.5729	3.E-47
DP does not Granger Cause WP		4.20639	0.0009

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 952

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	81.17408	4	0.0000
All	81.17408	4	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	20.88745	4	0.0003
All	20.88745	4	0.0003

A20-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6540.347	NA	198.5217	13.80453	13.81989	13.81038
1	-6202.767	672.3114	99.25493	13.11132	13.17277	13.13474
2	-6109.329	185.4964	83.05912	12.93318	13.04072	12.97416
3	-6073.026	71.84057	78.41008	12.87558	13.02920	12.93412
4	-6028.786	87.26604	72.79228	12.80124	13.00094	12.87733
5	-5997.749	61.02542	69.48590	12.75475	13.00054*	12.84840
6	-5983.297	28.32544	68.69163	12.74324	13.03512	12.85446
7	-5965.152	35.44711	67.37970	12.72395	13.06191	12.85273
8	-5936.727	55.35208*	64.67489*	12.68297*	13.06701	12.82931*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A20-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 7 957
Included observations: 951 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.179124	-0.003352	-0.035703
	(0.03521)	(0.02029)	(0.01915)
	[-5.08735]	[-0.16522]	[-1.86469]
DDP(-2)	-0.115457	0.001466	-0.060814
	(0.03520)	(0.02028)	(0.01914)
	[-3.28026]	[0.07227]	[-3.17724]
DDP(-3)	-0.029615	0.029232	-0.014562
	(0.03528)	(0.02033)	(0.01919)
	[-0.83942]	[1.43770]	[-0.75899]
DDP(-4)	-0.039826	0.070324	0.053342
	(0.03438)	(0.01981)	(0.01869)
	[-1.15846]	[3.54951]	[2.85330]
DDP(-5)	0.018489	0.010878	0.009525
	(0.03144)	(0.01812)	(0.01710)
	[0.58805]	[0.60036]	[0.55711]

PWP(-1)	0.433157	0.033209	-0.108674
	(0.06605)	(0.03806)	(0.03592)
	[6.55839]	[0.87248]	[-3.02580]
PWP(-2)	0.142537	0.117258	-0.033553
	(0.06733)	(0.03880)	(0.03661)
	[2.11708]	[3.02202]	[-0.91644]
PWP(-3)	0.017815	0.142691	0.044494
	(0.06713)	(0.03869)	(0.03650)
	[0.26539]	[3.68843]	[1.21889]
PWP(-4)	-0.028440	0.102442	-0.086858
	(0.06597)	(0.03802)	(0.03588)
	[-0.43108]	[2.69435]	[-2.42104]
PWP(-5)	0.005585	0.066303	-0.160212
	(0.06544)	(0.03771)	(0.03559)
	[0.08535]	[1.75804]	[-4.50196]
NWP(-1)	0.254432	-0.044662	0.178179
	(0.06857)	(0.03952)	(0.03729)
	[3.71049]	[-1.13018]	[4.77835]
NWP(-2)	0.124338	-0.117991	0.102865
	(0.06940)	(0.04000)	(0.03774)
	[1.79151]	[-2.94992]	[2.72547]
NWP(-3)	0.023010	-0.054001	0.083605
	(0.07061)	(0.04069)	(0.03840)
	[0.32588]	[-1.32703]	[2.17731]
NWP(-4)	0.128977	-0.118817	0.078460
	(0.07067)	(0.04073)	(0.03843)
	[1.82494]	[-2.91717]	[2.04147]
NWP(-5)	-0.020550	-0.078869	0.173210
	(0.07007)	(0.04038)	(0.03811)
	[-0.29327]	[-1.95295]	[4.54544]
RD(-1)	-0.123216	-0.000132	0.006939
	(0.01865)	(0.01075)	(0.01014)
	[-6.60848]	[-0.01226]	[0.68438]
R-squared	0.222598	0.057792	0.192046
Adj. R-squared	0.210127	0.042676	0.179085
Sum sq. resids	9113.184	3026.750	2694.940
S.E. equation	3.121974	1.799213	1.697730
F-statistic	17.84831	3.823334	14.81631
Log likelihood	-2424.023	-1899.911	-1844.699
Akaike AIC	5.131489	4.029257	3.913143
Schwarz SC	5.213214	4.110981	3.994868
Mean dependent	0.123793	1.089946	-0.989760
S.D. dependent	3.512777	1.838879	1.873784

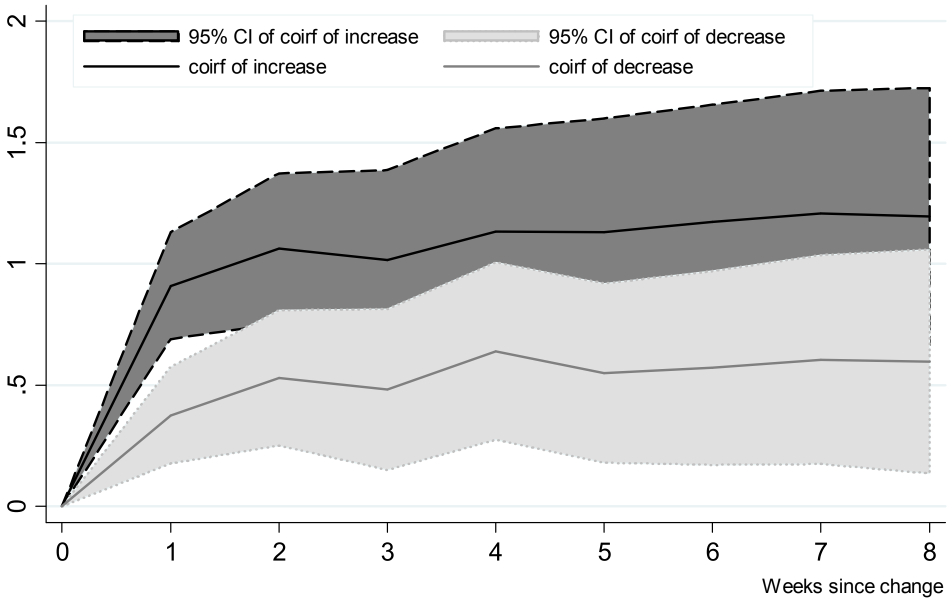
Determinant resid covariance (dof adj.)	65.50305
Determinant resid covariance	62.25221
Log likelihood	-6012.614
Akaike information criterion	12.74577
Schwarz criterion	12.99095

A20-6 COIRFS AND GRAPH

```
. irf ctable (fin_d pwp ddp coirf, ci) (fin_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.909645	.689466	1.12982	.375738	.176615	.574861
2	1.06399	.754508	1.37347	.530017	.251157	.808877
3	1.01464	.642962	1.38632	.481875	.150341	.813409
4	1.13253	.706918	1.55815	.640401	.274686	1.00612
5	1.13135	.66269	1.60001	.549481	.179942	.919021
6	1.17301	.690075	1.65595	.570588	.171319	.969858
7	1.20672	.699575	1.71387	.605263	.174395	1.03613
8	1.19627	.667372	1.72518	.597672	.135921	1.05942

```
95% lower and upper bounds reported
(1) irfname = fin_d, impulse = pwp, and response = ddp
(2) irfname = fin_d, impulse = nwp, and response = ddp
```



2.a Finland Diesel

A1: FINLAND GASOLINE

A21-1 UNIT ROOT TEST

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.846338	0.8049
Test critical values:	1% level	-3.436977	
	5% level	-2.864354	
	10% level	-2.568321	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares
Date: 07/10/14 Time: 15:39
Sample (adjusted): 3 957
Included observations: 955 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.002667	0.003152	-0.846338	0.3976
D(GP(-1))	-0.127514	0.032188	-3.961578	0.0001
C	0.334427	0.279018	1.198585	0.2310

R-squared	0.017429	Mean dependent var	0.108850
Adjusted R-squared	0.015365	S.D. dependent var	3.862012
S.E. of regression	3.832228	Akaike info criterion	5.527906
Sum squared resid	13981.04	Schwarz criterion	5.543178
Log likelihood	-2636.575	Hannan-Quinn criter.	5.533724
F-statistic	8.443448	Durbin-Watson stat	2.004213
Prob(F-statistic)	0.000232		

A21-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.077957	80.09633	20.26184	0.0000
At most 1	0.002967	2.829190	9.164546	0.6131

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.077957	77.26714	15.89210	0.0000
At most 1	0.002967	2.829190	9.164546	0.6131

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.199875	0.235665	3.437803
0.025744	-0.003608	-2.315452

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.924848	-0.055146
D(SP)	-0.056371	-0.158697

1 Cointegrating Equation(s): Log likelihood -4841.110

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.179060	-17.19974
	(0.01669)	(1.04544)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.184854
	(0.02173)

D(SP)	0.011267 (0.01900)

A21-3 CAUSALITY

Pairwise Granger Causality Tests

Sample: 1 957
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause GP	956	234.946	1.E-47
GP does not Granger Cause SP		2.05659	0.1519

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 954

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	39.96444	2	0.0000
All	39.96444	2	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	2.253838	2	0.3240
All	2.253838	2	0.3240

A21-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6576.840	NA	214.4094	13.88152	13.89688	13.88737
1	-6328.511	494.5624	129.4085	13.37660	13.43805	13.40002
2	-6205.960	243.2916	101.8413	13.13705	13.24458*	13.17802
3	-6184.508	42.45163	99.20092	13.11078	13.26439	13.16931
4	-6155.740	56.74747	95.14909	13.06907	13.26878	13.14517
5	-6136.787	37.26523	93.17250	13.04807	13.29386	13.14173
6	-6112.338	47.91900	90.18519	13.01548	13.30736	13.12670
7	-6087.666	48.19788	87.25300	12.98242	13.32038	13.11120*
8	-6075.680	23.33966*	86.70610*	12.97612*	13.36017	13.12246

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A21-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 4 957
Included observations: 954 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.191580	0.010898	0.002678
	(0.03231)	(0.01684)	(0.01770)
	[-5.92907]	[0.64725]	[0.15133]
DGP(-2)	-0.066724	0.021992	0.017855
	(0.02975)	(0.01550)	(0.01630)
	[-2.24255]	[1.41846]	[1.09553]
PSP(-1)	0.384022	0.142388	-0.162666
	(0.06490)	(0.03382)	(0.03555)
	[5.91687]	[4.21026]	[-4.57541]
PSP(-2)	0.023155	0.288810	-0.205873
	(0.06400)	(0.03335)	(0.03506)
	[0.36179]	[8.66021]	[-5.87238]
NSP(-1)	0.171486	-0.140543	0.219087
	(0.06279)	(0.03272)	(0.03439)
	[2.73131]	[-4.29587]	[6.37025]
NSP(-2)	0.125319	-0.197230	0.227316
	(0.06375)	(0.03322)	(0.03492)
	[1.96575]	[-5.93721]	[6.50935]
RG(-1)	-0.201192	-0.009247	0.002662
	(0.01999)	(0.01042)	(0.01095)
	[-10.0638]	[-0.88763]	[0.24311]
R-squared	0.248713	-0.004308	0.076428
Adj. R-squared	0.243953	-0.010671	0.070576
Sum sq. resids	10690.09	2902.583	3207.656
S.E. equation	3.359818	1.750723	1.840428
F-statistic	52.25055	-0.677050	13.06111
Log likelihood	-2506.294	-1884.422	-1932.093
Akaike AIC	5.268961	3.965245	4.065184
Schwarz SC	5.304626	4.000910	4.100849
Mean dependent	0.108755	1.037450	-0.946260
S.D. dependent	3.864037	1.741455	1.909027

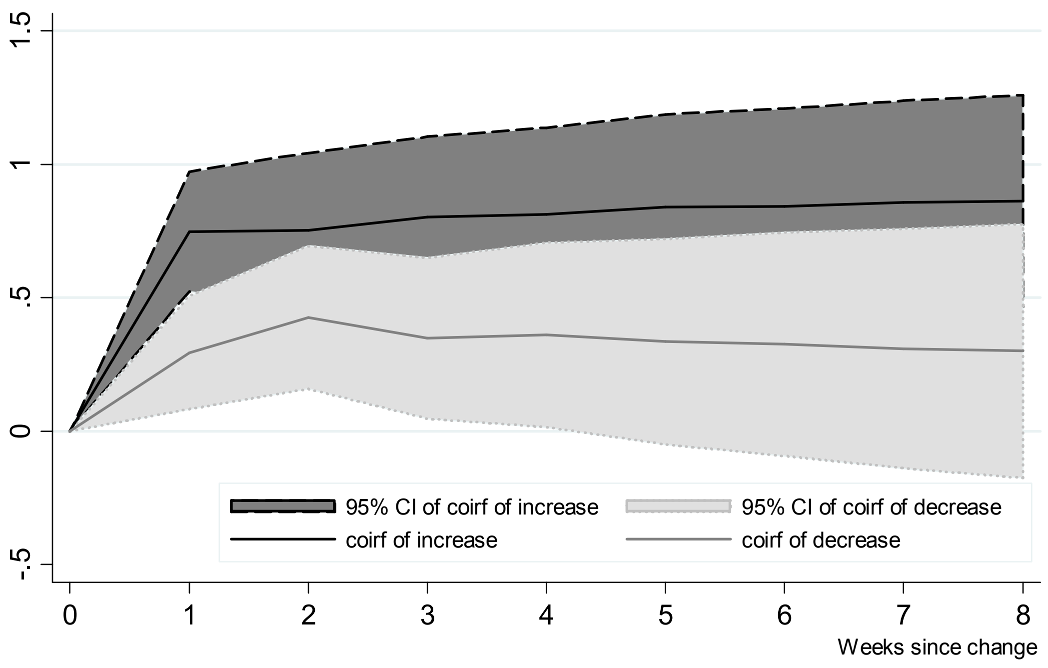
Determinant resid covariance (dof adj.)	97.96646
Determinant resid covariance	95.82575
Log likelihood	-6237.330
Akaike information criterion	13.12019
Schwarz criterion	13.22718

A21-6 COIRFS AND GRAPH

```
. irf ctable (fin_g psp dgp coirf, ci) (fin_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.74802	.522762	.973277	.294649	.082531	.506766
2	.752223	.461579	1.04287	.426314	.158512	.694116
3	.803839	.504083	1.10359	.34829	.046806	.649775
4	.81169	.485659	1.13772	.360759	.015127	.706391
5	.839623	.491627	1.18762	.335483	-.049505	.720472
6	.843368	.477891	1.20884	.325948	-.092877	.744772
7	.856703	.474978	1.23843	.309884	-.138954	.758723
8	.862911	.466326	1.2595	.300415	-.175243	.776074

```
95% lower and upper bounds reported
(1) irfname = fin_g, impulse = psp, and response = dgp
(2) irfname = fin_g, impulse = nsp, and response = dgp
```



2.b Finland Gasoline

A22: PORTUGAL DIESEL

A22-1 UNIT ROOT TEST

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.684490	0.8484
Test critical values:	1% level	-3.436977	
	5% level	-2.864354	
	10% level	-2.568321	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 3 957
Included observations: 955 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.001083	0.001582	-0.684490	0.4938
D(DP(-1))	0.239726	0.031494	7.611738	0.0000
C	0.182380	0.153084	1.191370	0.2338

R-squared	0.057525	Mean dependent var	0.119839
Adjusted R-squared	0.055545	S.D. dependent var	2.431224
S.E. of regression	2.362739	Akaike info criterion	4.560656
Sum squared resid	5314.573	Schwarz criterion	4.575929
Log likelihood	-2174.713	Hannan-Quinn criter.	4.566474
F-statistic	29.05306	Durbin-Watson stat	2.035343
Prob(F-statistic)	0.000000		

A22-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.035645	36.47410	20.26184	0.0001
At most 1	0.002015	1.920615	9.164546	0.7934

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.035645	34.55349	15.89210	0.0000
At most 1	0.002015	1.920615	9.164546	0.7934

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.168577	0.204938	1.825458
0.016227	-0.001812	-1.957257

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.279187	-0.068059
D(WP)	-0.280238	-0.116296

1 Cointegrating Equation(s): Log likelihood -4402.895

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.215692	-10.82863
	(0.02508)	(1.81277)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.047064
	(0.01152)
D(WP)	0.047242
	(0.01632)

A22-3 CAUSALITY

Pairwise Granger Causality Tests

Sample: 1 957
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
WP does not Granger Cause DP	955	52.0175	4.E-22
DP does not Granger Cause WP		5.06574	0.0065

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 954

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	163.6251	2	0.0000
All	163.6251	2	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	5.112715	2	0.0776
All	5.112715	2	0.0776

A22-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)
Date: 05/04/13 Time: 11:45
Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6213.062	NA	99.52645	13.11405	13.12942	13.11991
1	-5880.119	663.0755	50.24950	12.43063	12.49208	12.45405
2	-5740.513	277.1502	38.14754	12.15509	12.26262	12.19607
3	-5692.296	95.41774	35.11841	12.07235	12.22597	12.13089
4	-5657.108	69.41077	33.23088	12.01711	12.21681	12.09320
5	-5625.887	61.38722	31.70915	11.97023	12.21602*	12.06389
6	-5595.307	59.93487	30.29806	11.92470	12.21657	12.03592
7	-5578.155	33.50831	29.78169	11.90750	12.24546	12.03628
8	-5549.085	56.60671*	28.54734*	11.86516*	12.24921	12.01150*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A22-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 7 957
Included observations: 951 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.040479	0.008069	0.007144
	(0.03474)	(0.02966)	(0.02813)
	[1.16506]	[0.27204]	[0.25401]
DDP(-2)	-0.074246	0.007719	-0.060611
	(0.03453)	(0.02948)	(0.02795)
	[-2.15010]	[0.26185]	[-2.16824]
DDP(-3)	0.022249	0.043145	0.003909
	(0.03380)	(0.02885)	(0.02736)
	[0.65827]	[1.49536]	[0.14286]
DDP(-4)	-0.046030	0.034002	0.010302
	(0.03136)	(0.02677)	(0.02539)
	[-1.46783]	[1.27014]	[0.40580]
DDP(-5)	-0.004661	-0.010375	0.021415
	(0.03064)	(0.02616)	(0.02480)
	[-0.15212]	[-0.39662]	[0.86335]
PWP(-1)	0.101347	0.055032	-0.097086
	(0.04387)	(0.03745)	(0.03551)
	[2.31027]	[1.46953]	[-2.73386]
PWP(-2)	0.284549	0.129030	-0.053280
	(0.04392)	(0.03749)	(0.03555)
	[6.47876]	[3.44142]	[-1.49856]
PWP(-3)	0.208785	0.148670	0.018694
	(0.04524)	(0.03862)	(0.03662)
	[4.61496]	[3.84949]	[0.51043]
PWP(-4)	0.088277	0.119583	-0.066758
	(0.04515)	(0.03854)	(0.03655)
	[1.95542]	[3.10291]	[-1.82670]
PWP(-5)	0.027677	0.077244	-0.123055
	(0.04481)	(0.03825)	(0.03627)
	[0.61766]	[2.01935]	[-3.39242]
NWP(-1)	0.117783	-0.035794	0.179128
	(0.04691)	(0.04004)	(0.03797)
	[2.51094]	[-0.89387]	[4.71723]
NWP(-2)	0.288996	-0.116878	0.096923
	(0.04727)	(0.04035)	(0.03826)
	[6.11432]	[-2.89669]	[2.53311]
NWP(-3)	0.092796	-0.054549	0.067729
	(0.04845)	(0.04136)	(0.03922)
	[1.91529]	[-1.31886]	[1.72683]

NWP(-4)	0.075328	-0.088726	0.107192
	(0.04768)	(0.04071)	(0.03860)
	[1.57972]	[-2.17965]	[2.77687]
NWP(-5)	0.084503	-0.050366	0.188941
	(0.04727)	(0.04035)	(0.03826)
	[1.78775]	[-1.24821]	[4.93779]
RD(-1)	-0.043622	0.023406	0.026162
	(0.01188)	(0.01014)	(0.00962)
	[-3.67213]	[2.30811]	[2.72051]
R-squared	0.262272	0.056360	0.182754
Adj. R-squared	0.250436	0.041221	0.169644
Sum sq. resids	4159.674	3031.351	2725.933
S.E. equation	2.109230	1.800579	1.707465
F-statistic	22.16027	3.722932	13.93913
Log likelihood	-2051.095	-1900.634	-1850.137
Akaike AIC	4.347204	4.030775	3.924578
Schwarz SC	4.428929	4.112500	4.006303
Mean dependent	0.120326	1.089946	-0.989760
S.D. dependent	2.436237	1.838879	1.873784

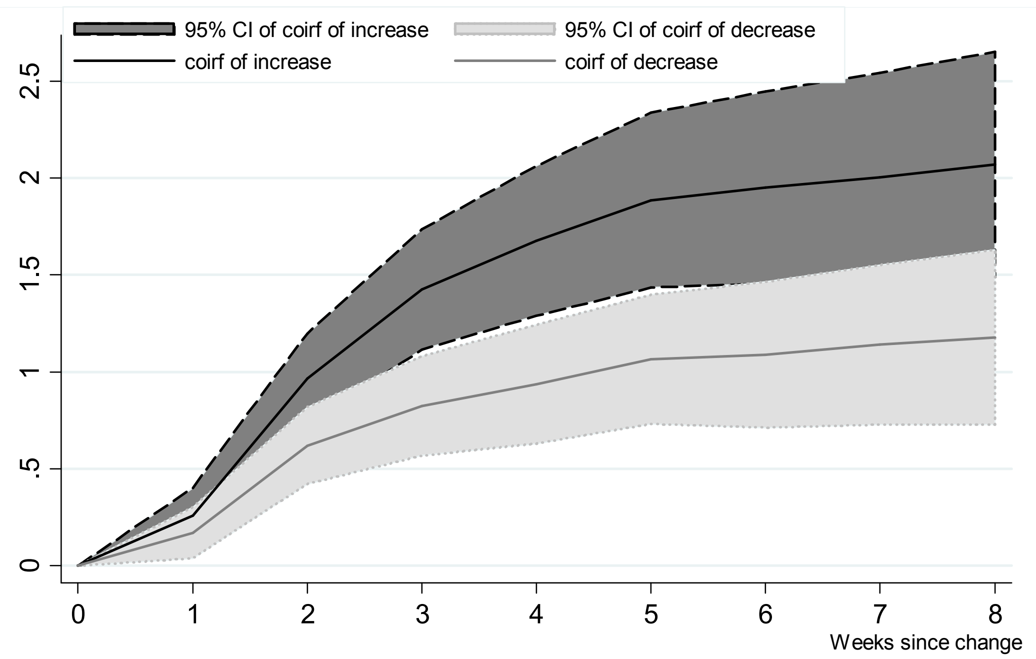
Determinant resid covariance (dof adj.)	29.87826
Determinant resid covariance	28.39544
Log likelihood	-5639.363
Akaike information criterion	11.96081
Schwarz criterion	12.20598

A22-6 COIRFS AND GRAPH

```
. irf ctable (prt_d pwp ddp coirf, ci) (prt_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.258159	.114738	.401581	.17019	.038245	.302135
2	.966761	.735127	1.19839	.619906	.421436	.818376
3	1.42404	1.11344	1.73464	.82413	.567672	1.08059
4	1.67537	1.28891	2.06183	.93658	.630098	1.24306
5	1.88552	1.43479	2.33626	1.06425	.731069	1.39743
6	1.9501	1.45397	2.44622	1.08812	.712418	1.46382
7	2.00169	1.46116	2.54222	1.13929	.727444	1.55114
8	2.06817	1.48683	2.64951	1.17863	.7285	1.62876

95% lower and upper bounds reported
(1) irfname = prt_d, impulse = pwp, and response = ddp



3.c Portugal Diesel

A23: PORTUGAL GASOLINE

A23-1 UNIT ROOT TEST

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.060255	0.7330
Test critical values:	1% level	-3.436977	
	5% level	-2.864354	
	10% level	-2.568321	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 3 957
Included observations: 955 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.002313	0.002182	-1.060255	0.2893
D(GP(-1))	0.224258	0.031615	7.093319	0.0000
C	0.271837	0.200147	1.358186	0.1747

R-squared	0.050726	Mean dependent var	0.102506
Adjusted R-squared	0.048732	S.D. dependent var	2.711405
S.E. of regression	2.644514	Akaike info criterion	4.785988
Sum squared resid	6657.766	Schwarz criterion	4.801260
Log likelihood	-2282.309	Hannan-Quinn criter.	4.791805
F-statistic	25.43596	Durbin-Watson stat	2.017567
Prob(F-statistic)	0.000000		

A23-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.035693	37.21664	20.26184	0.0001
At most 1	0.002744	2.615716	9.164546	0.6546

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.035693	34.60093	15.89210	0.0000
At most 1	0.002744	2.615716	9.164546	0.6546

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.162165	0.189837	3.425753
0.018275	0.004744	-2.259702

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.400026	-0.046932
D(SP)	-0.124647	-0.148959

1 Cointegrating Equation(s): Log likelihood -4482.630

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-1.170642	-21.12510
	(0.03107)	(1.94654)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.064870

	(0.01196)
D(SP)	0.020213
	(0.01540)

A23-3 CAUSALITY

Pairwise Granger Causality Tests

Sample: 1 957
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause GP	955	86.9087	2.E-35
GP does not Granger Cause SP		1.40681	0.2454

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 955

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	47.22579	1	0.0000
All	47.22579	1	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	2.585997	1	0.1078
All	2.585997	1	0.1078

A23-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)
D
Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6327.819	NA	126.7894	13.35616	13.37152	13.36201
1	-6072.479	508.5266	75.40110	12.83645	12.89790	12.85987
2	-5883.422	375.3207	51.57087	12.45659	12.56412	12.49756
3	-5841.860	82.24832	48.14711	12.38789	12.54151*	12.44643
4	-5811.033	60.80839	45.98041	12.34184	12.54155	12.41794
5	-5792.029	37.36718	45.02031	12.32074	12.56653	12.41439
6	-5768.685	45.75214	43.67862	12.29047	12.58235	12.40169*
7	-5752.465	31.68611	43.01878	12.27524	12.61320	12.40402
8	-5739.642	24.96987*	42.67370*	12.26718*	12.65122	12.41352

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A23-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 5 957
Included observations: 953 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	0.011587	0.017318	-0.015505
	(0.03261)	(0.02437)	(0.02570)
	[0.35538]	[0.71071]	[-0.60336]
DGP(-2)	-0.063433	0.012360	-0.019469
	(0.02999)	(0.02241)	(0.02364)
	[-2.11501]	[0.55145]	[-0.82365]
DGP(-3)	0.062255	0.021601	-0.024370
	(0.02909)	(0.02174)	(0.02293)
	[2.13992]	[0.99351]	[-1.06287]
PSP(-1)	0.141977	0.094033	-0.103460
	(0.04764)	(0.03560)	(0.03755)
	[2.98011]	[2.64108]	[-2.75547]
PSP(-2)	0.367769	0.265745	-0.155553
	(0.04481)	(0.03349)	(0.03532)
	[8.20725]	[7.93547]	[-4.40463]
PSP(-3)	0.216073	0.142414	-0.072307
	(0.04806)	(0.03591)	(0.03787)
	[4.49621]	[3.96538]	[-1.90913]
NSP(-1)	0.221316	-0.095320	0.182211
	(0.04531)	(0.03386)	(0.03571)
	[4.88434]	[-2.81489]	[5.10243]
NSP(-2)	0.372088	-0.163912	0.207472
	(0.04372)	(0.03267)	(0.03446)
	[8.51069]	[-5.01665]	[6.02126]
NSP(-3)	0.112023	-0.046475	0.128658
	(0.04620)	(0.03452)	(0.03641)
	[2.42493]	[-1.34616]	[3.53377]
RG(-1)	-0.023802	-0.004118	0.009040
	(0.01342)	(0.01003)	(0.01058)
	[-1.77331]	[-0.41055]	[0.85452]
R-squared	0.274407	0.016239	0.089737
Adj. R-squared	0.267482	0.006850	0.081049
Sum sq. resids	5088.802	2842.138	3160.799
S.E. equation	2.323015	1.736068	1.830807
F-statistic	39.62527	1.729604	10.32934
Log likelihood	-2150.473	-1872.919	-1923.555
Akaike AIC	4.534046	3.951560	4.057829
Schwarz SC	4.585039	4.002553	4.108821
Mean dependent	0.102068	1.038539	-0.947135
S.D. dependent	2.714207	1.742045	1.909838

Determinant resid covariance (dof adj.)	45.95033
Determinant resid covariance	44.51896
Log likelihood	-5865.499
Akaike information criterion	12.37251
Schwarz criterion	12.52548

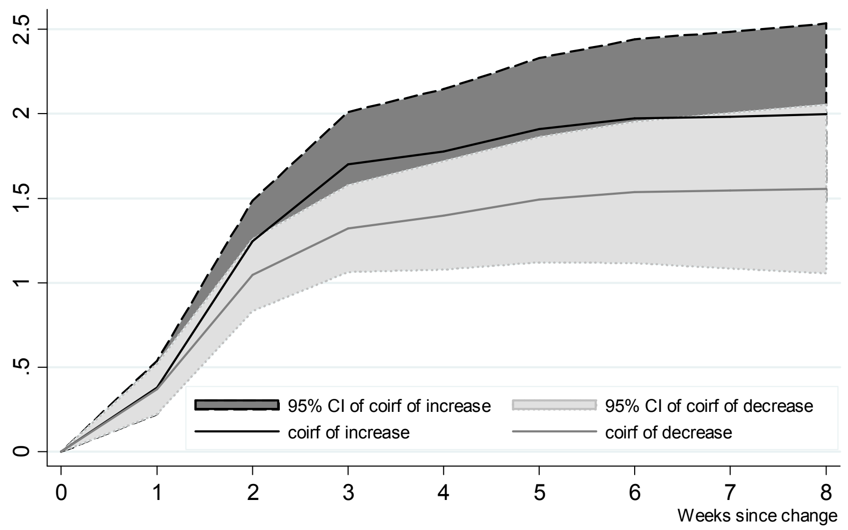
A23-6 COIRFS AND GRAPH

```
. irf ctable (prt_g psp dgp coirf, ci) (prt_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.379933	.221561	.538306	.371639	.222359	.520919
2	1.24506	1.00449	1.48563	1.04576	.832868	1.25864
3	1.70108	1.39126	2.01089	1.32048	1.06342	1.57754
4	1.77616	1.40705	2.14528	1.39864	1.07786	1.71941
5	1.90843	1.48652	2.33034	1.49186	1.12091	1.86281
6	1.97342	1.50665	2.44019	1.53522	1.11649	1.95395
7	1.98356	1.48095	2.48618	1.54495	1.08408	2.00583
8	1.9983	1.46252	2.53408	1.55494	1.05615	2.05374

```
95% lower and upper bounds reported
(1) irfname = prt_g, impulse = psp, and response = dgp
(2) irfname = prt_g, impulse = nsp, and response = dgp

.
```



3.d Portugal Gasoline

A24: SWEDEN DIESEL

A24-1 UNIT ROOT TEST

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.879822	0.7948
Test critical values:	1% level	-3.436969	
	5% level	-2.864351	
	10% level	-2.568319	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares
Date: 07/10/14 Time: 16:22
Sample (adjusted): 2 957
Included observations: 956 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.002401	0.002729	-0.879822	0.3792
C	0.287383	0.259578	1.107117	0.2685

R-squared	0.000811	Mean dependent var	0.081742
Adjusted R-squared	-0.000237	S.D. dependent var	3.490955
S.E. of regression	3.491368	Akaike info criterion	5.340554
Sum squared resid	11628.93	Schwarz criterion	5.350728
Log likelihood	-2550.785	Hannan-Quinn criter.	5.344429
F-statistic	0.774087	Durbin-Watson stat	1.888998
Prob(F-statistic)	0.379177		

A24-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.029615	30.46952	20.26184	0.0014
At most 1	0.001941	1.849818	9.164546	0.8074

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.029615	28.61970	15.89210	0.0003
At most 1	0.001941	1.849818	9.164546	0.8074

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.162373	0.168660	3.638374
0.029753	-0.010604	-2.498956

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.404661	-0.080865
D(WP)	-0.128479	-0.127345

1 Cointegrating Equation(s): Log likelihood -4686.605

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.038719	-22.40744
	(0.02863)	(2.07193)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.065706
	(0.01563)
D(WP)	0.020862
	(0.01577)

A24-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 954

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
DWP	306.7358	2	0.0000
All	306.7358	2	0.0000

Dependent variable: DWP

Excluded	Chi-sq	df	Prob.
DDP	4.445019	2	0.1083
All	4.445019	2	0.1083

A24-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6533.577	NA	195.7063	13.79025	13.80561	13.79610
1	-6124.213	815.2733	84.09654	12.94560	13.00704	12.96901
2	-6020.794	205.3099	68.90790	12.74640	12.85393	12.78738
3	-5974.910	90.79987	63.74929	12.66859	12.82221	12.72712
4	-5938.680	71.46699	60.19041	12.61114	12.81084	12.68724
5	-5906.851	62.58253	57.36051	12.56298	12.80877*	12.65664
6	-5891.425	30.23540	56.58839	12.54942	12.84129	12.66064
7	-5877.028	28.12463	55.94829	12.53803	12.87600	12.66682
8	-5854.080	44.68549*	54.32658*	12.50861*	12.89266	12.65495*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A24-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 7 957
Included observations: 951 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.217241	0.020536	0.018957
	(0.03688)	(0.02239)	(0.02127)
	[-5.89041]	[0.91719]	[0.89120]
DDP(-2)	-0.172777	0.023070	-0.019867
	(0.03762)	(0.02284)	(0.02170)
	[-4.59231]	[1.01004]	[-0.91554]
DDP(-3)	-0.147832	0.038529	-0.030775
	(0.03737)	(0.02269)	(0.02155)
	[-3.95615]	[1.69835]	[-1.42790]
DDP(-4)	-0.046239	0.057367	0.006573
	(0.03671)	(0.02229)	(0.02117)
	[-1.25950]	[2.57389]	[0.31041]
DDP(-5)	-0.050154	0.007867	-0.002801
	(0.03111)	(0.01889)	(0.01794)
	[-1.61228]	[0.41658]	[-0.15609]
PWP(-1)	0.605537	0.029428	-0.117473
	(0.06210)	(0.03770)	(0.03582)
	[9.75025]	[0.78052]	[-3.27947]
PWP(-2)	0.277180	0.096654	-0.076130
	(0.06616)	(0.04016)	(0.03816)
	[4.18965]	[2.40644]	[-1.99508]
PWP(-3)	0.223605	0.121696	0.020146
	(0.06670)	(0.04050)	(0.03847)
	[3.35217]	[3.00511]	[0.52362]
PWP(-4)	0.010629	0.089617	-0.068213
	(0.06597)	(0.04005)	(0.03805)
	[0.16113]	[2.23772]	[-1.79279]
PWP(-5)	0.068758	0.060246	-0.130044
	(0.06508)	(0.03951)	(0.03754)
	[1.05655]	[1.52489]	[-3.46457]
NWP(-1)	0.581003	-0.054562	0.157173
	(0.06591)	(0.04001)	(0.03802)
	[8.81520]	[-1.36360]	[4.13448]
NWP(-2)	0.250108	-0.151006	0.063306
	(0.06860)	(0.04165)	(0.03957)
	[3.64600]	[-3.62599]	[1.60001]
NWP(-3)	0.179861	-0.080061	0.077362
	(0.06994)	(0.04246)	(0.04034)
	[2.57151]	[-1.88544]	[1.91765]

NWP(-4)	0.200399	-0.126280	0.097923
	(0.06954)	(0.04222)	(0.04011)
	[2.88185]	[-2.99124]	[2.44146]
NWP(-5)	0.008693	-0.076019	0.182740
	(0.06751)	(0.04099)	(0.03894)
	[0.12876]	[-1.85473]	[4.69288]
RD(-1)	-0.067705	0.004853	0.009151
	(0.01626)	(0.00987)	(0.00938)
	[-4.16399]	[0.49160]	[0.97574]
R-squared	0.290819	0.053131	0.176886
Adj. R-squared	0.279442	0.037941	0.163680
Sum sq. resids	8252.830	3041.723	2745.509
S.E. equation	2.970952	1.803657	1.713585
F-statistic	25.56152	3.497686	13.39530
Log likelihood	-2376.870	-1902.258	-1853.539
Akaike AIC	5.032323	4.034191	3.931734
Schwarz SC	5.114048	4.115916	4.013458
Mean dependent	0.081222	1.089946	-0.989760
S.D. dependent	3.499945	1.838879	1.873784

Determinant resid covariance (dof adj.)	54.97459
Determinant resid covariance	52.24627
Log likelihood	-5929.295
Akaike information criterion	12.57055
Schwarz criterion	12.81572

A24-6 COIRFS AND GRAPH

```
. irf ctable (swe_d pwp ddp coirf, ci) (swe_d nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.37456	1.16189	1.58723	.835331	.647386	1.02328
2	1.64399	1.32972	1.95827	1.09724	.815871	1.37861
3	1.83048	1.44646	2.2145	1.14751	.806016	1.48901
4	1.8188	1.38712	2.25048	1.26678	.893565	1.64
5	1.8881	1.42181	2.35439	1.16926	.802559	1.53596
6	1.83763	1.36134	2.31392	1.22698	.845239	1.60872
7	1.87695	1.37748	2.37641	1.27141	.858038	1.68478
8	1.88716	1.35867	2.41565	1.31469	.868363	1.76102

```
95% lower and upper bounds reported
(1) irfname = swe_d, impulse = pwp, and response = ddp
(2) irfname = swe_d, impulse = nwp, and response = ddp
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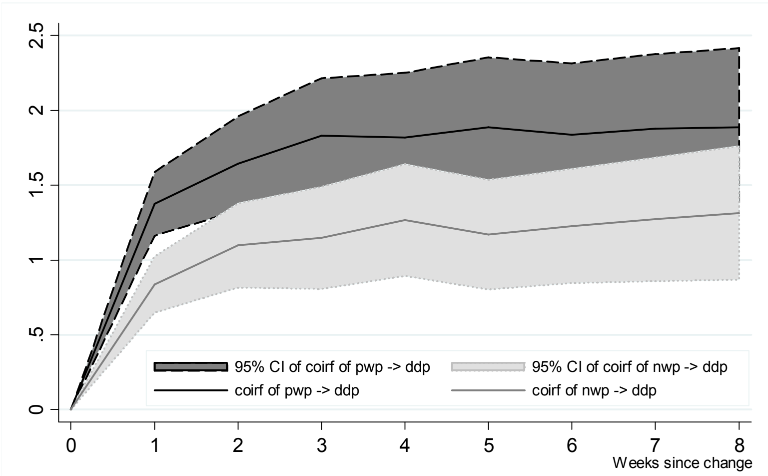


3.e Sweden Diesel

A25: SWEDEN GASOLINE

A25-1 UNIT ROOT TEST

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.030283	0.7442
Test critical values:	1% level	-3.436969	
	5% level	-2.864351	
	10% level	-2.568319	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares
Date: 07/10/14 Time: 16:31
Sample (adjusted): 2 957
Included observations: 956 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.003059	0.002969	-1.030283	0.3031
C	0.334699	0.249232	1.342919	0.1796

R-squared	0.001111	Mean dependent var	0.101839
Adjusted R-squared	0.000064	S.D. dependent var	3.247937
S.E. of regression	3.247833	Akaike info criterion	5.195943
Sum squared resid	10063.19	Schwarz criterion	5.206116
Log likelihood	-2481.661	Hannan-Quinn criter.	5.199818
F-statistic	1.061483	Durbin-Watson stat	1.947462
Prob(F-statistic)	0.303138		

A25-2 COINTEGRATION TEST

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.029615	30.46952	20.26184	0.0014
At most 1	0.001941	1.849818	9.164546	0.8074

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.029615	28.61970	15.89210	0.0003
At most 1	0.001941	1.849818	9.164546	0.8074

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.162373	0.168660	3.638374
0.029753	-0.010604	-2.498956

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.404661	-0.080865
D(WP)	-0.128479	-0.127345

1 Cointegrating Equation(s): Log likelihood -4686.605

Normalized cointegrating coefficients (standard error in parentheses)

DP	WP	C
1.000000	-1.038719	-22.40744
	(0.02863)	(2.07193)

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.065706
	(0.01563)
D(WP)	0.020862
	(0.01577)

A25-3 CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 957
Included observations: 954

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
DSP	500.3359	2	0.0000
All	500.3359	2	0.0000

Dependent variable: DSP

Excluded	Chi-sq	df	Prob.
DGP	34.59837	2	0.0000
All	34.59837	2	0.0000

A25-4 LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 957
Included observations: 948

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6367.936	NA	137.9873	13.44079	13.45616	13.44665
1	-5980.193	772.2148	62.06147	12.64176	12.70320	12.66517
2	-5826.814	304.4914	45.76550	12.33716	12.44469	12.37814
3	-5789.959	72.93383	43.15355	12.27839	12.43201	12.33693
4	-5755.789	67.40240	40.92196	12.22529	12.42500*	12.30139
5	-5732.849	45.10607	39.73616	12.19588	12.44167	12.28954
6	-5699.446	65.46589	37.74248	12.14440	12.43628	12.25562
7	-5680.026	37.93936	36.92213	12.12242	12.46038	12.25120*
8	-5669.859	19.79746*	36.83178*	12.11996*	12.50400	12.26630

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

A25-5 VECM

Vector Autoregression Estimates

Sample (adjusted): 6 957
Included observations: 952 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.398223	0.108006	0.124741
	(0.04169)	(0.02743)	(0.02930)
	[-9.55156]	[3.93745]	[4.25763]
DGP(-2)	-0.254267	0.066441	0.081654
	(0.04491)	(0.02954)	(0.03156)
	[-5.66227]	[2.24883]	[2.58754]
DGP(-3)	-0.172608	0.078118	0.008321
	(0.04276)	(0.02813)	(0.03005)
	[-4.03686]	[2.77687]	[0.27692]
DGP(-4)	-0.085502	0.031201	0.016674
	(0.03155)	(0.02076)	(0.02217)
	[-2.70987]	[1.50301]	[0.75201]
PSP(-1)	0.695718	0.028173	-0.155341
	(0.05808)	(0.03821)	(0.04082)
	[11.9782]	[0.73726]	[-3.80589]
PSP(-2)	0.367753	0.111784	-0.253045
	(0.06423)	(0.04226)	(0.04514)
	[5.72548]	[2.64518]	[-5.60613]
PSP(-3)	0.277281	0.046567	-0.134046
	(0.06555)	(0.04312)	(0.04606)
	[4.23032]	[1.07983]	[-2.91017]
PSP(-4)	0.171475	0.106130	-0.057803
	(0.06128)	(0.04032)	(0.04307)
	[2.79804]	[2.63216]	[-1.34218]
NSP(-1)	0.776008	-0.124508	0.100086
	(0.05728)	(0.03768)	(0.04025)
	[13.5487]	[-3.30406]	[2.48664]
NSP(-2)	0.411881	-0.201550	0.076484
	(0.06365)	(0.04188)	(0.04473)
	[6.47116]	[-4.81298]	[1.70997]
NSP(-3)	0.198350	-0.069851	0.051212
	(0.06234)	(0.04101)	(0.04381)
	[3.18182]	[-1.70310]	[1.16902]
NSP(-4)	0.132113	-0.173302	0.038031
	(0.05734)	(0.03773)	(0.04030)
	[2.30400]	[-4.59368]	[0.94381]
RG(-1)	-0.066209	0.000162	0.006536
	(0.02295)	(0.01510)	(0.01613)
	[-2.88500]	[0.01070]	[0.40527]

R-squared	0.380965	0.066082	0.113848
Adj. R-squared	0.373054	0.054147	0.102524
Sum sq. resids	6230.790	2697.131	3076.977
S.E. equation	2.575958	1.694799	1.810211
F-statistic	48.15646	5.536805	10.05318
Log likelihood	-2245.088	-1846.526	-1909.243
Akaike AIC	4.743881	3.906567	4.038326
Schwarz SC	4.810227	3.972913	4.104672
Mean dependent	0.098938	1.039630	-0.947483
S.D. dependent	3.253297	1.742635	1.910812

Determinant resid covariance (dof adj.)	38.81857
Determinant resid covariance	37.24993
Log likelihood	-5774.490
Akaike information criterion	12.21321
Schwarz criterion	12.41225

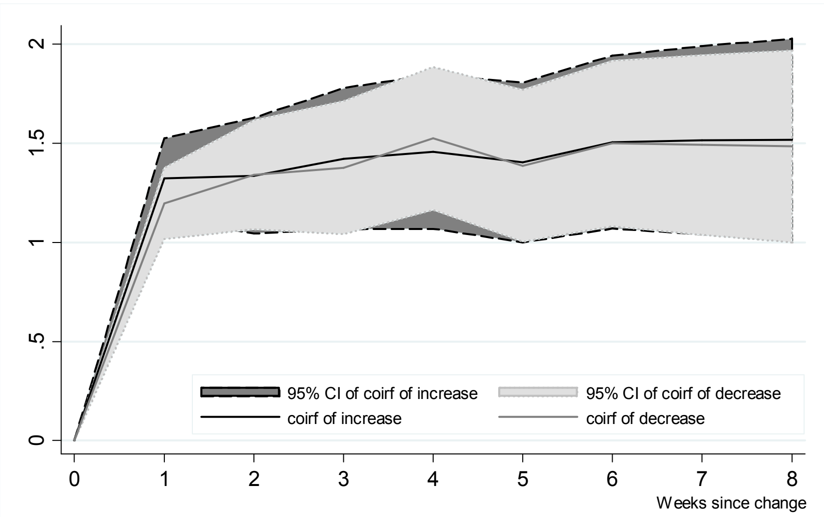
A25-6 COIRFS AND GRAPH

```
. irf ctable (swe_g psp dgp coirf, ci) (swe_g nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1.32289	1.12127	1.5245	1.19647	1.01637	1.37658
2	1.33685	1.04431	1.6294	1.34125	1.0662	1.61631
3	1.42226	1.06578	1.77875	1.37719	1.0411	1.71329
4	1.45752	1.06874	1.84629	1.52415	1.16356	1.88475
5	1.40331	.999884	1.80673	1.38643	1.00346	1.7694
6	1.50542	1.06892	1.94192	1.49883	1.0814	1.91626
7	1.5151	1.03985	1.99034	1.4915	1.03784	1.94516
8	1.51855	1.00968	2.02742	1.48444	1.0002	1.96867

```
95% lower and upper bounds reported
(1) irfname = swe_g, impulse = psp, and response = dgp
(2) irfname = swe_g, impulse = nsp, and response = dgp

.
```



3.f Sweden Gasoline

APPENDIX B: APT in the UK petroleum industry

NOMENCLATURE:

DP= RETAIL DIESEL PRICE

DDP= FIRST DIFFERENCE OF DP

DGP= FIRST DIFFERENCE OF RETAIL GP

DSP= FIRST DIFFERENCE OF SP

DWP= FIRST DIFFERENCE OF WP

GP= RETAIL GASOLINE PRICE

NSP= NEGATIVE CHANGE IN SP

NWP= NEGATIVE CHANGE IN WP

PSP= POSITIVE CHANGE IN SP

NSP= NEGATIVE CHANGE IN WP

RD= ERROR-CORRECTION TERM FOR DIESEL VECM (-1 FOR 1^{ST} LAG)

RG= ERROR-CORRECTION TERM FOR GASOLINE VECM (-1 FOR 1^{ST} LAG)

SP= WHOLESALE GASOLINE PRICE

WP= WHOLESALE DIESEL PRICE

B1: WEEKLY DIESEL IN GBP

Unit root test

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=18)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.076328	0.7266
Test critical values:	1% level	-3.441573	
	5% level	-2.866383	
	10% level	-2.569409	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares

Sample (adjusted): 4 574
Included observations: 571 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.002130	0.001979	-1.076328	0.2822
D(DP(-1))	0.506678	0.041719	12.14505	0.0000
D(DP(-2))	0.114299	0.041852	2.731026	0.0065
C	0.134063	0.099848	1.342677	0.1799

R-squared	0.333906	Mean dependent var	0.084667
Adjusted R-squared	0.330382	S.D. dependent var	0.966694
S.E. of regression	0.791048	Akaike info criterion	2.376064
Sum squared resid	354.8039	Schwarz criterion	2.406518
Log likelihood	-674.3662	Hannan-Quinn criter.	2.387945
F-statistic	94.74369	Durbin-Watson stat	2.020350
Prob(F-statistic)	0.000000		

Cointegration test: (DP, WP)

Sample (adjusted): 3 574
Included observations: 572 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.044739	29.74700	20.26184	0.0018
At most 1	0.006215	3.565916	9.164546	0.4806

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.044739	26.18108	15.89210	0.0009
At most 1	0.006215	3.565916	9.164546	0.4806

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.194192	0.106249	2.721143
0.040927	0.008143	-2.817075

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.150133	-0.002639
D(WP)	0.060530	-0.256940

1 Cointegrating Equation(s): Log likelihood -2087.552

Normalized cointegrating coefficients (standard error in parentheses)

DP	**WP**	**C**
1.000000	**-0.547135**	**-14.01262**
	(0.03133)	**(2.21661)**

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.029155
	(0.00565)
D(WP)	-0.011754
	(0.02663)

Granger Causality/Block Exogeneity tests

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 574
Included observations: 570

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
PWP	125.2658	3	0.0000
NWP	142.3419	3	0.0000
All	214.4974	6	0.0000

Dependent variable: PWP

Excluded	Chi-sq	df	Prob.
DDP	13.57602	3	0.0035
NWP	40.63648	3	0.0000
All	47.24564	6	0.0000

Dependent variable: NWP

Excluded	Chi-sq	df	Prob.
DDP	0.874919	3	0.8315
PWP	57.97524	3	0.0000
All	73.07440	6	0.0000

Choice of lag order based on VECM:

VAR Lag Order Selection Criteria
Endogenous variables: DDP PWP NWP
Exogenous variables: RD(-1)

Sample: 1 574
Included observations: 565

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3314.353	NA	25.25976	11.74284	11.76587	11.75183
1	-2987.137	649.7997	8.188932	10.61641	10.70852	10.65237
2	-2897.810	176.4401	6.162263	10.33207	10.49326	10.39499
3	**-2863.791**	**66.83479**	**5.640015**	**10.24351**	**10.47378***	**10.33339***
4	-2857.372	12.54191	5.691862	10.25264	10.55200	10.36949
5	-2836.136	41.26972	5.450702	10.20933	10.57777	10.35314
6	-2825.867	19.84612	5.426451	10.20484	10.64236	10.37561
7	-2809.726	31.02633	5.291210	10.17956	10.68616	10.37730
8	-2796.395	25.48097*	5.211010*	10.16423*	10.73992	10.38893

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Exclusion Wald Tests

Sample: 1 574
Included observations: 569

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DDP	PWP	NWP	Joint
Lag 1	208.6292	2.743808	26.14838	248.9714
	[0.000000]	[0.432834]	[8.88e-06]	[0.000000]
Lag 2	75.65071	24.75074	12.02956	131.8037
	[2.22e-16]	[1.74e-05]	[0.007283]	[0.000000]
Lag 3	18.52589	6.255988	20.37935	63.58649
	[0.000343]	[0.099799]	[0.000142]	[2.72e-10]
Lag 4	**3.254624**	**7.059783**	**2.189237**	**12.73127**
	[0.354008]	**[0.070017]**	**[0.534072]**	**[0.175148]**
df	3	3	3	9

The VECM

Vector Autoregression Estimates

Sample (adjusted): 5 574
Included observations: 570 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.248129	0.125248	0.021118
	(0.04188)	(0.12557)	(0.12148)
	[5.92449]	[0.99742]	[0.17384]
DDP(-2)	0.067508	0.317405	0.097853
	(0.04137)	(0.12402)	(0.11999)
	[1.63198]	[2.55923]	[0.81554]
DDP(-3)	0.098101	-0.026267	-0.064071
	(0.03607)	(0.10813)	(0.10461)
	[2.72004]	[-0.24291]	[-0.61245]
PWP(-1)	0.085904	0.090620	-0.170996
	(0.01508)	(0.04521)	(0.04373)
	[5.69742]	[2.00457]	[-3.90983]
PWP(-2)	0.086551	0.218575	-0.113179
	(0.01549)	(0.04646)	(0.04494)
	[5.58600]	[4.70507]	[-2.51830]
PWP(-3)	0.056066	0.083548	-0.165831
	(0.01620)	(0.04858)	(0.04700)
	[3.45990]	[1.71963]	[-3.52810]
NWP(-1)	0.130260	-0.076947	0.200602
	(0.01565)	(0.04691)	(0.04539)
	[8.32498]	[-1.64021]	[4.41994]
NWP(-2)	0.082432	-0.161013	0.124901
	(0.01633)	(0.04895)	(0.04736)
	[5.04904]	[-3.28934]	[2.63747]
NWP(-3)	0.004332	-0.151271	0.155563
	(0.01619)	(0.04854)	(0.04696)
	[0.26755]	[-3.11618]	[3.31242]
RD(-1)	-0.004749	-0.004595	-0.013791
	(0.00385)	(0.01154)	(0.01116)
	[-1.23411]	[-0.39825]	[-1.23565]
R-squared	0.538974	-0.037565	0.160410
Adj. R-squared	0.531564	-0.054240	0.146916
Sum sq. resids	245.5684	2207.515	2066.121
S.E. equation	0.662205	1.985445	1.920808
F-statistic	72.74233	-2.252729	11.88801
Log likelihood	-568.8077	-1194.681	-1175.816
Akaike AIC	2.030904	4.226951	4.160757
Schwarz SC	2.107143	4.303190	4.236996
Mean dependent	0.084818	1.251793	-1.122168
S.D. dependent	0.967536	1.933695	2.079640

Determinant resid covariance (dof adj.)	5.248459
Determinant resid covariance	4.977043
Log likelihood	-2883.763
Akaike information criterion	10.22373
Schwarz criterion	10.45245

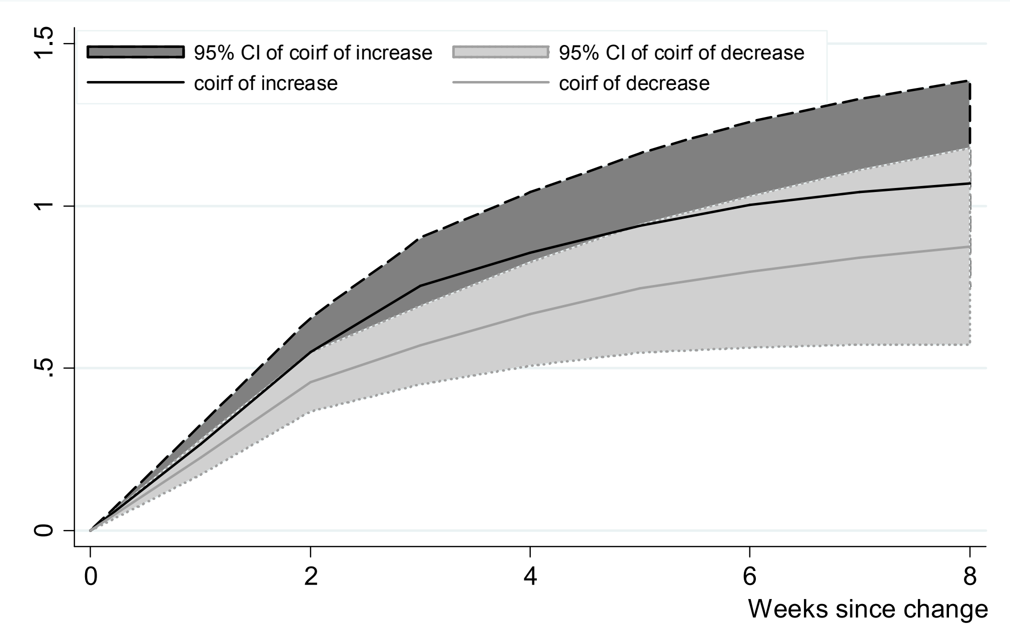
COIRF table

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.266008	.206708	.325307	.225457	.171242	.279672
2	.549688	.4448	.654576	.457861	.366696	.549026
3	.754432	.606818	.902045	.571312	.450175	.692448
4	.856048	.669443	1.04265	.667463	.507477	.827449
5	.939804	.716414	1.16319	.745648	.54833	.942966
6	1.00266	.74596	1.25936	.79734	.563857	1.03082
7	1.04256	.754685	1.33043	.841867	.572599	1.11113
8	1.06968	.752111	1.38724	.87542	.572386	1.17845

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```

Graph of COIRF



Weekly - Diesel price response in GBP

B2: WEEKLY GASOLINE IN GBP

Unit root test

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=18)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.406811	0.5798
Test critical values:	1% level	-3.441573	
	5% level	-2.866383	
	10% level	-2.569409	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 4 574
Included observations: 571 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.003246	0.002308	-1.406811	0.1600
D(GP(-1))	0.522787	0.041673	12.54509	0.0000
D(GP(-2))	0.117702	0.041836	2.813434	0.0051
C	0.169226	0.104922	1.612882	0.1073

R-squared	0.357144	Mean dependent var	0.080582
Adjusted R-squared	0.353743	S.D. dependent var	1.015764
S.E. of regression	0.816574	Akaike info criterion	2.439582
Sum squared resid	378.0715	Schwarz criterion	2.470036
Log likelihood	-692.5006	Hannan-Quinn criter.	2.451463
F-statistic	105.0006	Durbin-Watson stat	2.018777
Prob(F-statistic)	0.000000		

Cointegration test: (GP, SP)

Sample (adjusted): 3 574
Included observations: 572 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.043534	28.98289	20.26184	0.0024
At most 1	0.006141	3.523359	9.164546	0.4877

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.043534	25.45953	15.89210	0.0012
At most 1	0.006141	3.523359	9.164546	0.4877

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.213209	0.134439	1.888909
0.055829	0.003285	-3.007440

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.142827	-0.016514
D(SP)	-0.040685	-0.246429

1 Cointegrating Equation(s): Log likelihood -2059.910

Normalized cointegrating coefficients (standard error in parentheses)

GP	SP	C
1.000000	-0.630550	-8.859424
	(0.03703)	(2.24215)

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.030452
	(0.00627)
D(SP)	0.008674
	(0.02816)

Choice of lag order based on VECM:

VAR Lag Order Selection Criteria
Endogenous variables: DGP PSP NSP
Exogenous variables: RG(-1)

Sample: 1 574
Included observations: 565

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3297.413	NA	23.78954	11.68288	11.70590	11.69187
1	-2962.361	665.3597	7.501332	10.52871	10.62082	10.56466
2	-2883.020	156.7161	5.847936	10.27972	10.44091	10.34263
3	**-2834.507**	**95.30875**	**5.084654**	**10.13985**	**10.37012***	**10.22973**
4	-2817.440	33.34915	4.941572	10.11129	10.41065	10.22814
5	-2798.858	36.11149	4.776873	10.07737	10.44581	10.22118
6	-2781.868	32.83711*	4.643805*	10.04909*	10.48661	10.21986*
7	-2775.306	12.61280	4.684253	10.05772	10.56432	10.25546
8	-2769.138	11.79023	4.731709	10.06774	10.64343	10.29245

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Exclusion Wald Tests

Sample: 1 574
Included observations: 569

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DGP	PSP	NSP	Joint
Lag 1	262.0390 [0.000000]	6.619881 [0.085053]	29.40125 [1.84e-06]	313.5473 [0.000000]
Lag 2	72.04783 [1.55e-15]	5.992834 [0.111959]	20.54759 [0.000131]	105.4546 [0.000000]
Lag 3	44.22077 [1.35e-09]	16.55430 [0.000873]	13.18708 [0.004249]	84.53000 [2.02e-14]
Lag 4	**9.651958** **[0.021769]**	**14.45905** **[0.002342]**	**3.289609** **[0.349092]**	**34.06784** **[8.69e-05]**
df	3	3	3	9

The VECM

Vector Autoregression Estimates

Sample (adjusted): 5 574
Included observations: 570 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	0.185000	0.076434	-0.370780
	(0.04172)	(0.12234)	(0.11843)
	[4.43407]	[0.62475]	[-3.13069]
DGP(-2)	0.055473	0.088086	0.259732
	(0.04164)	(0.12210)	(0.11820)
	[1.33222]	[0.72143]	[2.19745]
DGP(-3)	0.112022	0.060216	-0.015726
	(0.03518)	(0.10315)	(0.09986)
	[3.18443]	[0.58376]	[-0.15749]
PSP(-1)	0.131407	0.149166	-0.121945
	(0.01515)	(0.04443)	(0.04301)
	[8.67232]	[3.35719]	[-2.83514]
PSP(-2)	0.072551	0.105578	-0.075613
	(0.01600)	(0.04690)	(0.04540)
	[4.53582]	[2.25102]	[-1.66535]
PSP(-3)	0.081654	0.213863	-0.074741
	(0.01594)	(0.04673)	(0.04524)
	[5.12389]	[4.57665]	[-1.65226]
NSP(-1)	0.139268	-0.070434	0.224009
	(0.01575)	(0.04618)	(0.04470)
	[8.84345]	[-1.52524]	[5.01105]
NSP(-2)	0.099656	-0.133490	0.197092
	(0.01679)	(0.04924)	(0.04767)
	[5.93459]	[-2.71097]	[4.13474]
NSP(-3)	0.043134	-0.127874	0.188809
	(0.01674)	(0.04908)	(0.04752)
	[2.57690]	[-2.60523]	[3.97367]
RG(-1)	-0.003651	-0.000837	-0.005050
	(0.00405)	(0.01188)	(0.01150)
	[-0.90118]	[-0.07045]	[-0.43912]
R-squared	0.586293	-0.051855	0.103292
Adj. R-squared	0.579644	-0.068760	0.088881
Sum sq. resids	243.3012	2092.010	1960.447
S.E. equation	0.659141	1.932804	1.871042
F-statistic	88.17944	-3.067462	7.167400
Log likelihood	-566.1641	-1179.365	-1160.853
Akaike AIC	2.021628	4.173209	4.108256
Schwarz SC	2.097868	4.249448	4.184496
Mean dependent	0.080777	1.223204	-1.109228
S.D. dependent	1.016645	1.869596	1.960180

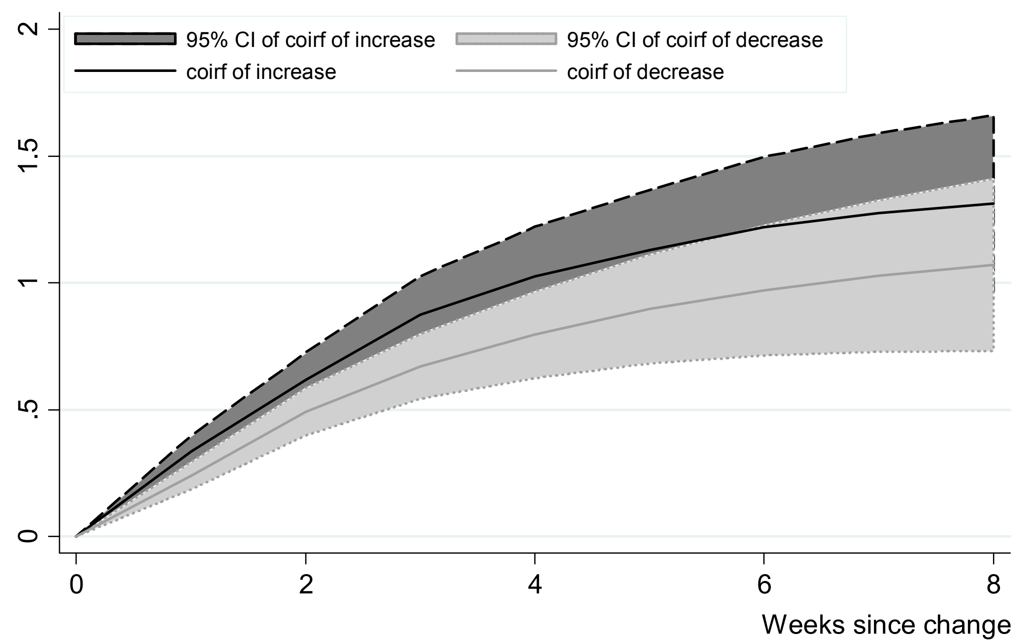
Determinant resid covariance (dof adj.)	4.730187
Determinant resid covariance	4.485572
Log likelihood	-2854.132
Akaike information criterion	10.11976
Schwarz criterion	10.34848

COIRF table with 95% CI (Stata):

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.335851	.275585	.396118	.238934	.184644	.293224
2	.616465	.508785	.724145	.491756	.397955	.585556
3	.873954	.721356	1.02655	.670493	.542854	.798132
4	1.02433	.827668	1.22099	.795013	.624022	.966004
5	1.12812	.889622	1.36662	.896838	.682086	1.11159
6	1.21889	.940969	1.49682	.970554	.713625	1.22748
7	1.27536	.960879	1.58984	1.02726	.728052	1.32646
8	1.31292	.963975	1.66186	1.07094	.731063	1.41083

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



Weekly - Gasoline price response in GBP

B3: DAILY DIESEL PRICES IN GBP

Unit root tests

Retail diesel price DP in GBP

Null Hypothesis: DP has a unit root
Exogenous: Constant
Lag Length: 15 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.074088	0.7281
Test critical values:	1% level	-3.432527	
	5% level	-2.862387	
	10% level	-2.567266	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DP)
Method: Least Squares
Date: 02/05/14 Time: 17:43
Sample (adjusted): 1/25/2000 12/30/2010
Included observations: 2761 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DP(-1)	-0.000356	0.000331	-1.074088	0.2829
D(DP(-1))	0.054408	0.018982	2.866376	0.0042
D(DP(-2))	0.104676	0.019021	5.503174	0.0000
D(DP(-3))	0.125968	0.019118	6.589016	0.0000
D(DP(-4))	0.062721	0.019253	3.257734	0.0011
D(DP(-5))	0.275015	0.019243	14.29147	0.0000
D(DP(-6))	0.002601	0.019876	0.130867	0.8959
D(DP(-7))	0.048275	0.019874	2.428982	0.0152
D(DP(-8))	0.010793	0.019895	0.542491	0.5875
D(DP(-9))	-0.016179	0.019876	-0.813993	0.4157
D(DP(-10))	0.087986	0.019879	4.426137	0.0000
D(DP(-11))	-0.069339	0.019250	-3.602088	0.0003
D(DP(-12))	-0.039572	0.019260	-2.054645	0.0400
D(DP(-13))	-0.028159	0.019128	-1.472098	0.1411
D(DP(-14))	0.003147	0.019037	0.165292	0.8687
D(DP(-15))	0.105478	0.019013	5.547843	0.0000
C	0.022488	0.016740	1.343364	0.1793

R-squared	0.235268	Mean dependent var	0.018408
Adjusted R-squared	0.230809	S.D. dependent var	0.331330
S.E. of regression	0.290588	Akaike info criterion	0.372319
Sum squared resid	231.7075	Schwarz criterion	0.408790
Log likelihood	-496.9866	Hannan-Quinn criter.	0.385493
F-statistic	52.76168	Durbin-Watson stat	1.996826
Prob(F-statistic)	0.000000		

Spot diesel price WP in USD

Null Hypothesis: WP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.136902	0.7032
Test critical values:	1% level	-3.432514	
	5% level	-2.862382	
	10% level	-2.567263	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WP)
Method: Least Squares

Sample (adjusted): 1/04/2000 12/30/2010
Included observations: 2776 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WP(-1)	-0.001008	0.000887	-1.136902	0.2557
C	0.090718	0.063301	1.433135	0.1519

R-squared	0.000466	Mean dependent var	0.026507
Adjusted R-squared	0.000105	S.D. dependent var	1.506116
S.E. of regression	1.506037	Akaike info criterion	3.657560
Sum squared resid	6291.838	Schwarz criterion	3.661832
Log likelihood	-5074.693	Hannan-Quinn criter.	3.659103
F-statistic	1.292547	Durbin-Watson stat	1.968908
Prob(F-statistic)	0.255677		

Cointegration test: (DP, WP)

Sample (adjusted): 1/10/2000 12/30/2010
Included observations: 2772 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: DP WP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.023060	68.16060	20.26184	0.0000
At most 1	0.001258	3.489989	9.164546	0.4933

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.023060	64.67061	15.89210	0.0000
At most 1	0.001258	3.489989	9.164546	0.4933

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DP	WP	C
-0.205646	0.113434	2.815502
0.047785	0.004456	-2.909702

Unrestricted Adjustment Coefficients (alpha):

D(DP)	0.046355	0.000532
D(WP)	0.003606	-0.053246

1 Cointegrating Equation(s): Log likelihood -5673.149

Normalized cointegrating coefficients (standard error in parentheses)

DP	**WP**	**C**
1.000000	**-0.551601**	**-13.69102**
	(0.01893)	**(1.34135)**

Adjustment coefficients (standard error in parentheses)

D(DP)	-0.009533
	(0.00118)
D(WP)	-0.000742
	(0.00587)

Granger Causality/Block Exogeneity tests

Pairwise Granger Causality Tests

Sample: 1/03/2000 12/30/2010
Lags: 17

Null Hypothesis:	Obs	F-Statistic	Prob.
WP does not Granger Cause DP	2760	19.1286	**2.E-55**
DP does not Granger Cause WP		1.99195	**0.0091**

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 02/05/14 Time: 18:57
Sample: 1/03/2000 12/30/2010
Included observations: 2759

Dependent variable: DDP

Excluded	Chi-sq	df	Prob.
PWP	190.8958	17	**0.0000**
NWP	200.2719	17	**0.0000**
All	288.7953	34	**0.0000**

Dependent variable: PWP

Excluded	Chi-sq	df	**Prob.**
DDP	27.55266	17	**0.0504**
NWP	75.44996	17	**0.0000**
All	104.7900	34	**0.0000**

Dependent variable: NWP

Excluded	Chi-sq	df	**Prob.**
DDP	30.56805	17	**0.0225**
PWP	84.64523	17	**0.0000**
All	137.7589	34	**0.0000**

Choice of lag order based on asymmetric and asymmetric VECM:

Symmetric VECM

VAR Lag Order Selection Criteria
Endogenous variables: DDP DWP
Exogenous variables: RD(-1)

Sample: 1/03/2000 12/30/2010
Included observations: 2746

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5812.946	NA	0.236799	4.235212	4.239522	4.236769
1	-5790.398	45.04628	0.233622	4.221703	4.234633	4.226375
2	-5735.547	109.5012	0.225128	4.184667	4.206218	4.192454
3	-5674.767	121.2508	0.216007	4.143312	4.173483	4.154213
4	-5649.709	49.95118	0.212720	4.127975	4.166767	4.141991
5	-5490.457	317.2279	0.189977	4.014900	4.062312	4.032031
6	-5472.142	36.45849	0.188006	4.004473	4.060506	4.024719
7	-5448.837	46.35388	0.185381	3.990413	4.055066	4.013774
8	-5441.509	14.56546	0.184932	3.987989	4.061263	4.014464
9	-5428.943	24.95823	0.183782	3.981750	4.063644	4.011340
10	**-5400.979**	**55.50057**	**0.180602**	**3.964296**	**4.054811***	**3.997001**
11	**-5388.417**	**24.91375**	**0.179480**	**3.958060**	**4.057195**	**3.993880***
12	-5384.476	7.810803	0.179487	3.958103	4.065858	3.997037
13	-5382.280	4.348522	0.179724	3.959417	4.075792	4.001466
14	-5374.907	14.59040	0.179283	3.956960	4.081956	4.002124
15	-5357.534	34.35319	0.177545	3.947221	4.080837	3.995499
16	-5353.898	7.184408	0.177592	3.947486	4.089722	3.998879
17	**-5346.841**	**13.93445**	**0.177197***	**3.945259***	**4.096116**	**3.999767**
18	-5345.407	2.828489	0.177529	3.947128	4.106606	4.004751
19	-5340.915	8.857334	0.177465	3.946770	4.114867	4.007507
20	-5339.431	2.923897	0.177791	3.948602	4.125320	4.012454
21	-5334.956	8.808559	0.177730	3.948257	4.133595	4.015223
22	-5329.986	9.777341	0.177604	3.947550	4.141509	4.017631
23	-5327.223	5.431871	0.177764	3.948451	4.151030	4.021647
24	-5323.586	7.143828	0.177812	3.948715	4.159915	4.025026
25	-5319.652	7.721801	0.177820	3.948764	4.168584	4.028189
26	-5317.478	4.265459	0.178057	3.950093	4.178533	4.032633
27	-5314.930	4.993943	0.178246	3.951150	4.188211	4.036805
28	-5313.298	3.194977	0.178554	3.952876	4.198557	4.041645
29	-5307.171	11.99136*	0.178277	3.951326	4.205628	4.043210
30	-5303.693	6.801058	0.178345	3.951707	4.214629	4.046705

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Asymmetric VECM:

VAR Lag Exclusion Wald Tests

Sample: 1/03/2000 12/30/2010
Included observations: 2755

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DDP	PWP	NWP	Joint
Lag 1	**7.724970**	**3.029730**	**1.955687**	**15.43691**
	[0.052051]	**[0.387064]**	**[0.581655]**	**[0.079613]**
Lag 2	1.856096	15.01787	5.125296	29.13651
	[0.602804]	[0.001801]	[0.162849]	[0.000615]
Lag 3	52.63016	0.586228	6.026163	61.25547
	[2.20e-11]	[0.899578]	[0.110344]	[7.68e-10]
Lag 4	48.78482	4.134181	10.07451	63.43682
	[1.45e-10]	[0.247335]	[0.017943]	[2.90e-10]
Lag 5	166.7605	17.78602	17.78053	215.2758
	[0.000000]	[0.000487]	[0.000488]	[0.000000]
Lag 6	55.84285	2.230421	1.482235	62.60155
	[4.54e-12]	[0.525981]	[0.686376]	[4.21e-10]
Lag 7	67.12354	1.345174	2.903103	74.58745
	[1.77e-14]	[0.718435]	[0.406807]	[1.91e-12]
Lag 8	24.37686	1.517730	4.455072	33.67753
	[2.08e-05]	[0.678184]	[0.216333]	[0.000102]
Lag 9	40.43799	0.502876	9.228844	49.66897
	[8.60e-09]	[0.918259]	[0.026398]	[1.24e-07]
Lag 10	40.74660	1.723518	5.142079	50.99850
	[7.40e-09]	[0.631718]	[0.161684]	[6.99e-08]
Lag 11	25.04865	6.833263	1.585850	34.43612
	[1.51e-05]	[0.077406]	[0.662602]	[7.49e-05]
Lag 12	10.58091	1.130824	6.853069	19.87670
	[0.014222]	[0.769639]	[0.076731]	[0.018689]
Lag 13	5.880416	8.971441	0.231166	18.32765
	[0.117575]	[0.029673]	[0.972408]	[0.031557]
Lag 14	11.01866	13.24755	6.702572	35.69844
	[0.011625]	[0.004131]	[0.082007]	[4.48e-05]
Lag 15	29.61863	4.025799	4.620036	37.73846
	[1.66e-06]	[0.258692]	[0.201830]	[1.94e-05]
Lag 16	8.878697	2.505154	7.331577	18.67767
	[0.030948]	[0.474360]	[0.062048]	[0.028077]

Lag 17	5.118644 [0.163313]	14.94146 [0.001867]	13.36371 [0.003913]	37.57299 [2.08e-05]
Lag 18	**1.797196** **[0.615545]**	**2.329085** **[0.506972]**	**9.932447** **[0.019149]**	**15.33637** **[0.082101]**
Lag 19	**1.979696** **[0.576632]**	**6.417611** **[0.092969]**	**6.592162** **[0.086098]**	**15.05474** **[0.089443]**
Lag 20	**3.885749** **[0.274068]**	**7.221210** **[0.065171]**	**1.188555** **[0.755751]**	**12.61317** **[0.180905]**
Lag 21	4.241407 [0.236549]	16.00845 [0.001129]	5.938186 [0.114657]	21.14186 [0.012035]
df	3	3	3	9

The VECM with 17 lags

Vector Autoregression Estimates

Sample (adjusted): 1/27/2000 12/30/2010
Included observations: 2759 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.040805 (0.01922) [-2.12259]	-0.013190 (0.06450) [-0.20449]	0.040303 (0.06083) [0.66250]
DDP(-2)	0.020422 (0.01922) [1.06265]	0.119731 (0.06448) [1.85688]	0.085682 (0.06081) [1.40891]
DDP(-3)	0.052278 (0.01912) [2.73366]	-0.007749 (0.06417) [-0.12076]	-0.076062 (0.06052) [-1.25685]
DDP(-4)	0.007347 (0.01912) [0.38421]	0.116094 (0.06416) [1.80938]	0.130873 (0.06052) [2.16265]
DDP(-5)	0.225868 (0.01913) [11.8094]	-0.029035 (0.06417) [-0.45245]	-0.055487 (0.06052) [-0.91677]
DDP(-6)	-0.004543 (0.01959) [-0.23187]	0.046614 (0.06574) [0.70905]	-0.056607 (0.06200) [-0.91294]
DDP(-7)	0.050276 (0.01953) [2.57492]	0.060558 (0.06551) [0.92439]	0.006317 (0.06179) [0.10224]
DDP(-8)	0.013811 (0.01943)	-0.042558 (0.06518)	0.002770 (0.06147)

	[0.71100]	[-0.65297]	[0.04506]
DDP(-9)	-0.007401	0.006475	-0.039296
	(0.01936)	(0.06495)	(0.06125)
	[-0.38237]	[0.09969]	[-0.64153]
DDP(-10)	0.093378	0.006790	0.020848
	(0.01932)	(0.06483)	(0.06114)
	[4.83278]	[0.10474]	[0.34096]
DDP(-11)	-0.048139	-0.032716	0.057309
	(0.01930)	(0.06475)	(0.06107)
	[-2.49457]	[-0.50528]	[0.93845]
DDP(-12)	-0.019422	-0.031300	-0.028887
	(0.01925)	(0.06460)	(0.06093)
	[-1.00879]	[-0.48453]	[-0.47414]
DDP(-13)	-0.022905	0.013242	0.010951
	(0.01858)	(0.06235)	(0.05881)
	[-1.23249]	[0.21236]	[0.18621]
DDP(-14)	0.004764	0.108125	0.035812
	(0.01854)	(0.06221)	(0.05867)
	[0.25695]	[1.73818]	[0.61040]
DDP(-15)	0.107566	-0.110794	-0.097714
	(0.01840)	(0.06175)	(0.05824)
	[5.84466]	[-1.79424]	[-1.67778]
DDP(-16)	-0.006689	0.106944	0.125155
	(0.01836)	(0.06160)	(0.05809)
	[-0.36436]	[1.73621]	[2.15431]
DDP(-17)	-0.023832	0.026818	0.108407
	(0.01835)	(0.06158)	(0.05808)
	[-1.29860]	[0.43553]	[1.86665]
PWP(-1)	0.004514	0.038982	-0.023735
	(0.00628)	(0.02106)	(0.01987)
	[0.71912]	[1.85071]	[-1.19478]
PWP(-2)	0.003874	0.079142	-0.036061
	(0.00628)	(0.02109)	(0.01989)
	[0.61640]	[3.75304]	[-1.81314]
PWP(-3)	0.030975	0.003760	-0.026631
	(0.00631)	(0.02117)	(0.01997)
	[4.90857]	[0.17759]	[-1.33362]
PWP(-4)	0.030149	0.023451	-0.037702
	(0.00632)	(0.02121)	(0.02000)
	[4.77019]	[1.10590]	[-1.88508]
PWP(-5)	0.010553	0.013972	-0.074099
	(0.00635)	(0.02129)	(0.02008)
	[1.66278]	[0.65616]	[-3.68961]
PWP(-6)	0.034379	0.033444	-0.015282
	(0.00636)	(0.02136)	(0.02014)
	[5.40136]	[1.56605]	[-0.75870]

PWP(-7)	0.030437	0.025873	-0.031234
	(0.00640)	(0.02146)	(0.02024)
	[4.75901]	[1.20569]	[-1.54328]
PWP(-8)	0.014204	0.019772	-0.044094
	(0.00643)	(0.02157)	(0.02035)
	[2.20929]	[0.91658]	[-2.16724]
PWP(-9)	0.015406	-0.008971	-0.035590
	(0.00644)	(0.02161)	(0.02038)
	[2.39201]	[-0.41512]	[-1.74618]
PWP(-10)	0.015851	0.017543	-0.045994
	(0.00644)	(0.02162)	(0.02039)
	[2.45967]	[0.81137]	[-2.25538]
PWP(-11)	0.019332	0.046408	0.018311
	(0.00646)	(0.02167)	(0.02043)
	[2.99366]	[2.14193]	[0.89606]
PWP(-12)	0.017474	-0.002914	-0.054525
	(0.00647)	(0.02171)	(0.02047)
	[2.70098]	[-0.13424]	[-2.66322]
PWP(-13)	0.007479	0.061563	-0.012204
	(0.00642)	(0.02155)	(0.02032)
	[1.16443]	[2.85680]	[-0.60046]
PWP(-14)	0.000781	0.065078	-0.036228
	(0.00643)	(0.02158)	(0.02035)
	[0.12135]	[3.01575]	[-1.78001]
PWP(-15)	0.000489	0.012456	-0.005728
	(0.00643)	(0.02157)	(0.02035)
	[0.07611]	[0.57739]	[-0.28154]
PWP(-16)	0.015355	0.008435	-0.042286
	(0.00641)	(0.02150)	(0.02027)
	[2.39673]	[0.39241]	[-2.08573]
PWP(-17)	0.002635	0.048813	-0.049109
	(0.00641)	(0.02150)	(0.02028)
	[0.41130]	[2.27061]	[-2.42205]
NWP(-1)	0.008019	-0.006731	0.026655
	(0.00662)	(0.02223)	(0.02096)
	[1.21056]	[-0.30282]	[1.27150]
NWP(-2)	0.002554	-0.049457	0.010473
	(0.00662)	(0.02220)	(0.02094)
	[0.38604]	[-2.22810]	[0.50028]
NWP(-3)	0.016653	-0.025876	0.046265
	(0.00661)	(0.02219)	(0.02093)
	[2.51839]	[-1.16628]	[2.21094]
NWP(-4)	0.020243	0.002152	0.052449
	(0.00661)	(0.02219)	(0.02093)
	[3.06039]	[0.09696]	[2.50568]
NWP(-5)	0.030833	-0.092848	0.071538
	(0.00663)	(0.02224)	(0.02098)

	[4.65113]	[-4.17436]	[3.41014]
NWP(-6)	0.018628	-0.006589	0.013888
	(0.00670)	(0.02248)	(0.02120)
	[2.78003]	[-0.29309]	[0.65497]
NWP(-7)	0.028621	-0.021275	-0.007679
	(0.00671)	(0.02251)	(0.02123)
	[4.26703]	[-0.94535]	[-0.36179]
NWP(-8)	0.022256	-0.009476	0.021345
	(0.00671)	(0.02253)	(0.02125)
	[3.31445]	[-0.42060]	[1.00455]
NWP(-9)	0.031663	0.009216	0.061776
	(0.00672)	(0.02254)	(0.02126)
	[4.71373]	[0.40890]	[2.90622]
NWP(-10)	0.020412	0.011528	0.032055
	(0.00674)	(0.02262)	(0.02133)
	[3.02813]	[0.50971]	[1.50268]
NWP(-11)	0.011979	-0.048104	-0.007571
	(0.00674)	(0.02262)	(0.02133)
	[1.77711]	[-2.12689]	[-0.35493]
NWP(-12)	0.000741	-0.030036	0.009260
	(0.00674)	(0.02261)	(0.02132)
	[0.11000]	[-1.32862]	[0.43428]
NWP(-13)	0.008214	-0.041368	0.003714
	(0.00669)	(0.02246)	(0.02118)
	[1.22735]	[-1.84226]	[0.17535]
NWP(-14)	0.020619	-0.001311	0.059040
	(0.00668)	(0.02241)	(0.02113)
	[3.08748]	[-0.05849]	[2.79366]
NWP(-15)	0.013154	-0.030672	0.034380
	(0.00668)	(0.02241)	(0.02114)
	[1.96941]	[-1.36870]	[1.62660]
NWP(-16)	-0.016173	0.005012	0.029958
	(0.00666)	(0.02234)	(0.02107)
	[-2.42933]	[0.22438]	[1.42201]
NWP(-17)	0.009159	-0.095592	-0.018237
	(0.00665)	(0.02231)	(0.02104)
	[1.37757]	[-4.28535]	[-0.86685]
RD(-1)	-0.001579	-0.003246	0.000946
	(0.00088)	(0.00296)	(0.00279)
	[-1.79265]	[-1.09828]	[0.33930]
R-squared	0.324193	0.059067	0.127474
Adj. R-squared	0.311461	0.041340	0.111036
Sum sq. resids	204.7630	2305.141	2050.518
S.E. equation	0.275031	0.922794	0.870338
F-statistic	25.46236	3.332020	7.754641
Log likelihood	-327.0888	-3666.919	-3505.449
Akaike AIC	0.274802	2.695846	2.578796
Schwarz SC	0.386428	2.807472	2.690422

Mean dependent	0.018428	0.531707	-0.505575
S.D. dependent	0.331449	0.942481	0.923093

Determinant resid covariance (dof adj.)	0.040867
Determinant resid covariance	0.038600
Log likelihood	-7254.959
Akaike information criterion	5.372206
Schwarz criterion	5.707085

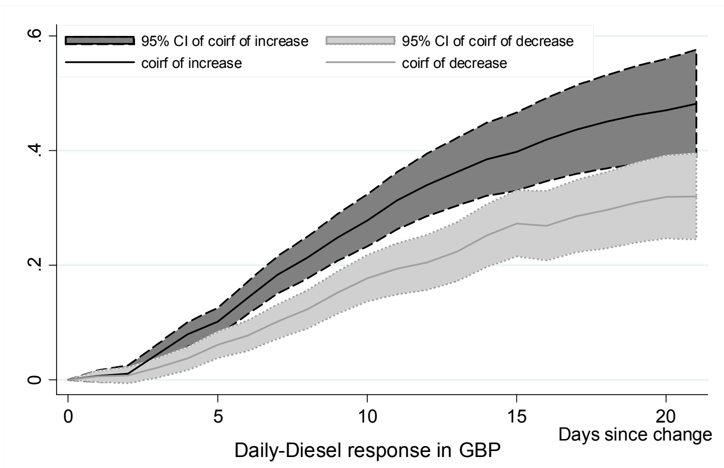
COIRF table

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.00689	-.00338	.01716	.006335	-.003826	.016495
2	.011078	-.003313	.025469	.008238	-.00583	.022307
3	.045186	.027312	.063061	.021373	.004109	.038637
4	.079634	.05839	.100878	.037463	.017224	.057701
5	.101421	.077046	.125796	.061134	.038153	.084115
6	.142984	.114472	.171496	.077148	.050558	.103738
7	.183193	.150783	.215604	.101742	.071795	.131689
8	.213513	.176964	.250063	.122996	.089518	.156474
9	.248485	.207625	.289344	.15227	.115245	.189296
10	.278224	.233059	.323389	.177496	.13696	.218031
11	.312869	.262861	.362877	.193863	.149351	.238374
12	.340093	.285513	.394672	.2051	.156931	.253269
13	.363082	.303994	.422169	.223661	.172087	.275235
14	.385198	.321567	.448829	.251965	.197215	.306716
15	.398233	.330103	.466363	.273153	.215409	.330897
16	.419639	.34682	.492458	.269122	.208403	.329841
17	.437027	.359783	.514271	.286016	.222884	.349148
18	.450465	.369037	.531893	.296089	.22955	.362627
19	.461921	.376291	.54755	.309423	.239777	.379069
20	.470786	.381067	.560505	.319338	.246858	.391818
21	.482137	.388275	.575998	.320275	.244953	.395596

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```

Graph of COIRF



B4: DAILY GASOLINE PRICES IN GBP:

Unit root tests

Retail gasoline price GP in GBP

Null Hypothesis: GP has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.129168	0.7064
Test critical values:	1% level	-3.432518	
	5% level	-2.862384	
	10% level	-2.567264	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GP)
Method: Least Squares

Sample (adjusted): 1/11/2000 12/30/2010
Included observations: 2771 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP(-1)	-0.000374	0.000331	-1.129168	0.2589
D(GP(-1))	0.157462	0.018383	8.565763	0.0000
D(GP(-2))	0.193941	0.018622	10.41445	0.0000
D(GP(-3))	0.107478	0.018903	5.685707	0.0000
D(GP(-4))	0.021182	0.018656	1.135393	0.2563
D(GP(-5))	0.257229	0.018423	13.96253	0.0000
C	0.021104	0.015171	1.391018	0.1643

R-squared	0.273223	Mean dependent var	0.017490
Adjusted R-squared	0.271645	S.D. dependent var	0.302369
S.E. of regression	0.258053	Akaike info criterion	0.131218
Sum squared resid	184.0582	Schwarz criterion	0.146190
Log likelihood	-174.8022	Hannan-Quinn criter.	0.136625
F-statistic	173.1816	Durbin-Watson stat	1.996457
Prob(F-statistic)	0.000000		

Spot gasoline price SP in USD

Null Hypothesis: SP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.495686	0.5359
Test critical values:	1% level	-3.432515	
	5% level	-2.862382	
	10% level	-2.567263	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SP)
Method: Least Squares

Sample (adjusted): 1/05/2000 12/30/2010
Included observations: 2775 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SP(-1)	-0.001497	0.001001	-1.495686	0.1348
D(SP(-1))	0.125437	0.018849	6.654968	0.0000
C	0.104190	0.061085	1.705661	0.0882

R-squared	0.016312	Mean dependent var	0.024058
Adjusted R-squared	0.015602	S.D. dependent var	1.344371
S.E. of regression	1.333842	Akaike info criterion	3.415085
Sum squared resid	4931.762	Schwarz criterion	3.421494
Log likelihood	-4735.430	Hannan-Quinn criter.	3.417399
F-statistic	22.98328	Durbin-Watson stat	2.000236
Prob(F-statistic)	0.000000		

Cointegration test: (GP, SP)

Sample (adjusted): 1/10/2000 12/30/2010
Included observations: 2772 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: GP SP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.016864	50.94760	20.26184	0.0000
At most 1	0.001371	3.802543	9.164546	0.4423

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.016864	47.14506	15.89210	0.0000
At most 1	0.001371	3.802543	9.164546	0.4423

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GP	SP	C
-0.221595	0.139189	2.063036
0.060301	0.001456	-3.073162

Unrestricted Adjustment Coefficients (alpha):

D(GP)	0.033415	-0.000531
D(SP)	-0.001869	-0.049365

1 Cointegrating Equation(s): Log likelihood -4879.213

Normalized cointegrating coefficients (standard error in parentheses)

GP	**SP**	**C**
1.000000	**-0.628124**	**-9.309942**
	(0.02633)	**(1.59540)**

Adjustment coefficients (standard error in parentheses)

D(GP)	-0.007405
	(0.00108)
D(SP)	0.000414
	(0.00562)

Granger Causality/Block Exogeneity tests

Pairwise Granger Causality Tests

Sample: 1/03/2000 12/30/2010
Lags: 15

Null Hypothesis:	Obs	F-Statistic	Prob.
SP does not Granger Cause GP	2762	30.1363	**6.E-80**
GP does not Granger Cause SP		1.61333	**0.0626**

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1/03/2000 12/30/2010
Included observations: 2761

Dependent variable: DGP

Excluded	Chi-sq	df	Prob.
PSP	265.6359	15	**0.0000**
NSP	273.4484	15	**0.0000**
All	402.5582	30	**0.0000**

Dependent variable: PSP

Excluded	Chi-sq	df	**Prob.**
DGP	15.14502	15	0.4410
NSP	38.29092	15	**0.0008**
All	71.50672	30	**0.0000**

Dependent variable: NSP

Excluded	Chi-sq	df	**Prob.**
DGP	23.02491	15	**0.0836**
PSP	45.46728	15	**0.0001**
All	106.0717	30	**0.0000**

Choice of lag order based on asymmetric and asymmetric VECM:

Symmetric VECM

VAR Lag Order Selection Criteria
Endogenous variables: DGP DSP
Exogenous variables: RG(-1)

Sample: 1/03/2000 12/30/2010
Included observations: 2746

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5212.878	NA	0.152958	3.798163	3.802473	3.799721
1	-5074.081	277.2905	0.138655	3.699986	3.712917	3.704658
2	-4948.338	251.0292	0.126890	3.611317	3.632868	3.619103
3	-4888.484	119.4031	0.121831	3.570636	3.600808	3.581538
4	-4861.803	53.18711	0.119835	3.554117	3.592909	3.568133
5	-4738.236	246.1429	0.109841	3.467033	3.514445	3.484164
6	-4715.577	45.10331	0.108358	3.453443	3.509476	3.473689
7	**-4699.377**	**32.22257**	**0.107400**	**3.444557**	**3.509210***	**3.467918**
8	-4689.089	20.44913	0.106909	3.439978	3.513251	3.466453
9	-4680.100	17.85381	0.106521	3.436344	3.518238	3.465934
10	**-4657.792**	**44.27494**	**0.105110**	**3.423009**	**3.513524**	**3.455714***
11	-4656.096	3.363245	0.105287	3.424688	3.523822	3.460507
12	-4653.507	5.130751	0.105395	3.425715	3.533470	3.464649
13	-4642.746	21.31046	0.104878	3.420791	3.537166	3.462840
14	-4635.028	15.27353	0.104594	3.418083	3.543079	3.463246
15	**-4619.225**	**31.24867**	**0.103699***	**3.409487***	**3.543103**	**3.457765**
16	-4617.670	3.072530	0.103884	3.411267	3.553504	3.462660
17	-4614.708	5.848556	0.103962	3.412023	3.562880	3.466531
18	-4614.211	0.981547	0.104228	3.414574	3.574052	3.472197
19	-4605.887	16.41165	0.103900	3.411425	3.579523	3.472162
20	-4602.256	7.153481	0.103928	3.411694	3.588412	3.475546
21	-4598.379	7.631716	0.103938	3.411784	3.597122	3.478750
22	-4595.548	5.568992	0.104026	3.412635	3.606594	3.482716
23	-4588.837	13.19253*	0.103821	3.410661	3.613240	3.483857
24	-4584.683	8.159161	0.103810	3.410549	3.621748	3.486859
25	-4583.599	2.129555	0.104030	3.412672	3.632492	3.492097
26	-4580.876	5.339615	0.104127	3.413602	3.642043	3.496142
27	-4579.607	2.487415	0.104335	3.415591	3.652652	3.501246
28	-4577.336	4.448173	0.104466	3.416851	3.662532	3.505620
29	-4574.202	6.132633	0.104532	3.417482	3.671783	3.509366
30	-4572.626	3.081656	0.104717	3.419247	3.682169	3.514246

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Asymmetric VECM:

VAR Lag Exclusion Wald Tests
Date: 02/05/14 Time: 18:18
Sample: 1/03/2000 12/30/2010
Included observations: 2755

Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	DGP	PSP	NSP	Joint
Lag 1	9.923990	63.03847	18.07124	89.30530
	[0.019223]	[1.32e-13]	[0.000425]	[2.22e-15]
Lag 2	96.20444	0.457575	11.83752	112.7218
	[0.000000]	[0.928108]	[0.007961]	[0.000000]
Lag 3	60.38721	3.272786	9.085324	80.94471
	[4.86e-13]	[0.351448]	[0.028178]	[1.05e-13]
Lag 4	89.64963	8.156921	5.173555	110.1767
	[0.000000]	[0.042878]	[0.159521]	[0.000000]
Lag 5	151.2786	1.768259	5.198143	156.0808
	[0.000000]	[0.621866]	[0.157850]	[0.000000]
Lag 6	72.70271	2.442696	3.281575	79.38500
	[1.11e-15]	[0.485736]	[0.350215]	[2.14e-13]
Lag 7	39.65391	3.824895	6.123738	50.53873
	[1.26e-08]	[0.281004]	[0.105743]	[8.53e-08]
Lag 8	23.51216	4.628635	15.91763	45.22829
	[3.16e-05]	[0.201099]	[0.001179]	[8.37e-07]
Lag 9	28.07580	0.159072	13.23800	43.15315
	[3.50e-06]	[0.983909]	[0.004149]	[2.02e-06]
Lag 10	33.87875	4.234301	7.567844	42.06615
	[2.10e-07]	[0.237250]	[0.055841]	[3.20e-06]
Lag 11	10.15616	2.708815	4.322743	20.16921
	[0.017284]	[0.438731]	[0.228657]	[0.016896]
Lag 12	1.896950	7.715516	2.921293	11.84762
	[0.594068]	[0.052272]	[0.403920]	[0.222037]
Lag 13	23.67085	9.611763	3.024362	38.46388
	[2.93e-05]	[0.022172]	[0.387884]	[1.44e-05]
Lag 14	10.76799	9.012301	6.094248	27.66887
	[0.013049]	[0.029128]	[0.107114]	[0.001083]
Lag 15	18.45578	5.314359	3.618097	26.45837
	[0.000354]	[0.150173]	[0.305765]	[0.001718]
Lag 16	**7.594430**	**6.142543**	**3.233775**	**14.43953**
	[0.055181]	**[0.104877]**	**[0.356967]**	**[0.107527]**
Lag 17	**2.059082**	**7.129794**	**4.721213**	**11.99137**

	[0.560235]	**[0.067874]**	**[0.193387]**	**[0.213796]**
Lag 18	**1.778860**	**1.551092**	**9.043920**	**16.58597**
	[0.619546]	**[0.670529]**	**[0.028713]**	**[0.055608]**
Lag 19	3.952152	9.326003	8.608908	18.77051
	[0.266677]	[0.025256]	[0.034969]	[0.027217]
Lag 20	**6.860661**	**2.832001**	**2.251165**	**13.51769**
	[0.076474]	**[0.418259]**	**[0.521941]**	**[0.140546]**
Lag 21	2.687693	11.16731	4.778731	21.39923
	[0.442323]	[0.010855]	[0.188735]	[0.010991]
df	3	3	3	9

The VECM

Vector Autoregression Estimates

Sample (adjusted): 1/25/2000 12/30/2010
Included observations: 2761 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	0.022724	-0.025522	-0.056496
	(0.01910)	(0.06497)	(0.06347)
	[1.18983]	[-0.39283]	[-0.89012]
DGP(-2)	0.083426	-0.010231	-0.093442
	(0.01907)	(0.06486)	(0.06337)
	[4.37538]	[-0.15773]	[-1.47465]
DGP(-3)	0.037465	0.035598	-0.034921
	(0.01911)	(0.06501)	(0.06351)
	[1.96031]	[0.54754]	[-0.54983]
DGP(-4)	-0.021718	0.003670	0.024949
	(0.01913)	(0.06506)	(0.06356)
	[-1.13555]	[0.05640]	[0.39253]
DGP(-5)	0.197466	0.086156	0.133300
	(0.01912)	(0.06504)	(0.06354)
	[10.3280]	[1.32464]	[2.09791]
DGP(-6)	0.009849	0.021483	-0.102512
	(0.01939)	(0.06597)	(0.06444)
	[0.50789]	[0.32565]	[-1.59071]
DGP(-7)	0.021029	0.066599	0.044396
	(0.01935)	(0.06582)	(0.06430)
	[1.08686]	[1.01181]	[0.69043]
DGP(-8)	-0.006713	-0.161081	-0.128826
	(0.01934)	(0.06578)	(0.06426)
	[-0.34721]	[-2.44897]	[-2.00488]
DGP(-9)	-0.035263	-0.025913	0.023566

	(0.01928)	(0.06560)	(0.06409)
	[-1.82855]	[-0.39499]	[0.36770]
DGP(-10)	0.068041	-0.011948	-0.037950
	(0.01918)	(0.06526)	(0.06375)
	[3.54674]	[-0.18307]	[-0.59526]
DGP(-11)	-0.047397	-0.065127	-0.040635
	(0.01869)	(0.06358)	(0.06212)
	[-2.53580]	[-1.02427]	[-0.65419]
DGP(-12)	-0.023772	0.077889	0.116895
	(0.01866)	(0.06348)	(0.06202)
	[-1.27387]	[1.22693]	[1.88490]
DGP(-13)	0.001330	0.086601	0.085612
	(0.01856)	(0.06314)	(0.06169)
	[0.07166]	[1.37148]	[1.38788]
DGP(-14)	0.046700	0.027680	0.009711
	(0.01827)	(0.06215)	(0.06072)
	[2.55597]	[0.44535]	[0.15994]
DGP(-15)	0.089734	0.016538	-0.062411
	(0.01807)	(0.06147)	(0.06005)
	[4.96619]	[0.26904]	[-1.03935]
PSP(-1)	0.014639	0.159829	0.013429
	(0.00615)	(0.02092)	(0.02044)
	[2.38042]	[7.63992]	[0.65708]
PSP(-2)	0.044812	0.014073	-0.043636
	(0.00621)	(0.02113)	(0.02064)
	[7.21498]	[0.66604]	[-2.11404]
PSP(-3)	0.031882	0.041985	-0.067400
	(0.00627)	(0.02132)	(0.02083)
	[5.08604]	[1.96889]	[-3.23542]
PSP(-4)	0.022560	0.054839	-0.035367
	(0.00632)	(0.02149)	(0.02099)
	[3.57114]	[2.55186]	[-1.68465]
PSP(-5)	0.027048	0.022657	-0.015259
	(0.00633)	(0.02155)	(0.02105)
	[4.27058]	[1.05155]	[-0.72495]
PSP(-6)	0.028236	0.025117	-0.010016
	(0.00636)	(0.02164)	(0.02114)
	[4.43972]	[1.16094]	[-0.47389]
PSP(-7)	0.011098	0.012024	-0.052309
	(0.00637)	(0.02169)	(0.02118)
	[1.74089]	[0.55448]	[-2.46915]
PSP(-8)	0.017579	0.010247	-0.044464
	(0.00637)	(0.02168)	(0.02118)
	[2.75882]	[0.47275]	[-2.09983]
PSP(-9)	0.013610	-0.001126	-0.041645
	(0.00638)	(0.02169)	(0.02119)
	[2.13476]	[-0.05192]	[-1.96556]

PSP(-10)	0.018842	0.012661	0.004190
	(0.00639)	(0.02173)	(0.02122)
	[2.95020]	[0.58276]	[0.19741]
PSP(-11)	0.005399	0.030335	-0.023207
	(0.00639)	(0.02173)	(0.02123)
	[0.84529]	[1.39605]	[-1.09327]
PSP(-12)	0.000749	0.065860	0.011349
	(0.00636)	(0.02162)	(0.02112)
	[0.11777]	[3.04586]	[0.53729]
PSP(-13)	0.015585	0.069222	-0.015340
	(0.00635)	(0.02161)	(0.02111)
	[2.45389]	[3.20382]	[-0.72675]
PSP(-14)	0.008580	0.069652	0.011549
	(0.00634)	(0.02158)	(0.02108)
	[1.35243]	[3.22749]	[0.54779]
PSP(-15)	0.009856	0.051536	0.009626
	(0.00631)	(0.02146)	(0.02097)
	[1.56210]	[2.40101]	[0.45904]
NSP(-1)	0.004114	-0.012750	0.077756
	(0.00627)	(0.02134)	(0.02085)
	[0.65584]	[-0.59754]	[3.73012]
NSP(-2)	0.014405	-0.025096	0.059150
	(0.00628)	(0.02137)	(0.02087)
	[2.29340]	[-1.17452]	[2.83375]
NSP(-3)	0.021043	-0.011118	0.035691
	(0.00629)	(0.02141)	(0.02092)
	[3.34306]	[-0.51924]	[1.70623]
NSP(-4)	0.043405	-0.050099	0.050170
	(0.00631)	(0.02146)	(0.02097)
	[6.87994]	[-2.33432]	[2.39287]
NSP(-5)	0.021958	-0.017326	0.005687
	(0.00637)	(0.02167)	(0.02116)
	[3.44782]	[-0.79970]	[0.26868]
NSP(-6)	0.033559	0.010448	0.019000
	(0.00638)	(0.02169)	(0.02119)
	[5.26386]	[0.48176]	[0.89676]
NSP(-7)	0.032580	-0.049555	0.012386
	(0.00639)	(0.02173)	(0.02123)
	[5.10071]	[-2.28065]	[0.58351]
NSP(-8)	0.017988	-0.014823	0.082297
	(0.00640)	(0.02176)	(0.02126)
	[2.81164]	[-0.68106]	[3.87071]
NSP(-9)	0.024201	-0.006358	0.086877
	(0.00640)	(0.02179)	(0.02128)
	[3.77881]	[-0.29182]	[4.08188]
NSP(-10)	0.017297	0.032786	0.065121

	(0.00642)	(0.02185)	(0.02135)
	[2.69284]	[1.50046]	[3.05070]
NSP(-11)	0.007914	-0.035154	0.054748
	(0.00643)	(0.02188)	(0.02137)
	[1.23048]	[-1.60682]	[2.56156]
NSP(-12)	0.002372	-0.034933	-0.003065
	(0.00642)	(0.02185)	(0.02134)
	[0.36934]	[-1.59894]	[-0.14362]
NSP(-13)	0.020920	-0.022496	0.034972
	(0.00637)	(0.02168)	(0.02118)
	[3.28268]	[-1.03764]	[1.65123]
NSP(-14)	0.007113	-0.048526	0.051561
	(0.00636)	(0.02164)	(0.02114)
	[1.11827]	[-2.24267]	[2.43923]
NSP(-15)	0.000907	-0.002465	0.034433
	(0.00633)	(0.02154)	(0.02104)
	[0.14321]	[-0.11445]	[1.63649]
RG(-1)	-0.001450	-0.000328	0.003723
	(0.00080)	(0.00272)	(0.00265)
	[-1.81669]	[-0.12071]	[1.40340]
R-squared	0.394301	0.053175	0.116894
Adj. R-squared	0.384261	0.037482	0.102257
Sum sq. resids	153.3515	1774.651	1693.634
S.E. equation	0.237662	0.808484	0.789814
F-statistic	39.27603	3.388406	7.986155
Log likelihood	72.80530	-3307.523	-3243.016
Akaike AIC	-0.019417	2.429209	2.382482
Schwarz SC	0.079270	2.527896	2.481169
Mean dependent	0.017601	0.481517	-0.458373
S.D. dependent	0.302873	0.824076	0.833583

Determinant resid covariance (dof adj.)	0.019575
Determinant resid covariance	0.018613
Log likelihood	-6253.318
Akaike information criterion	4.629712
Schwarz criterion	4.925772

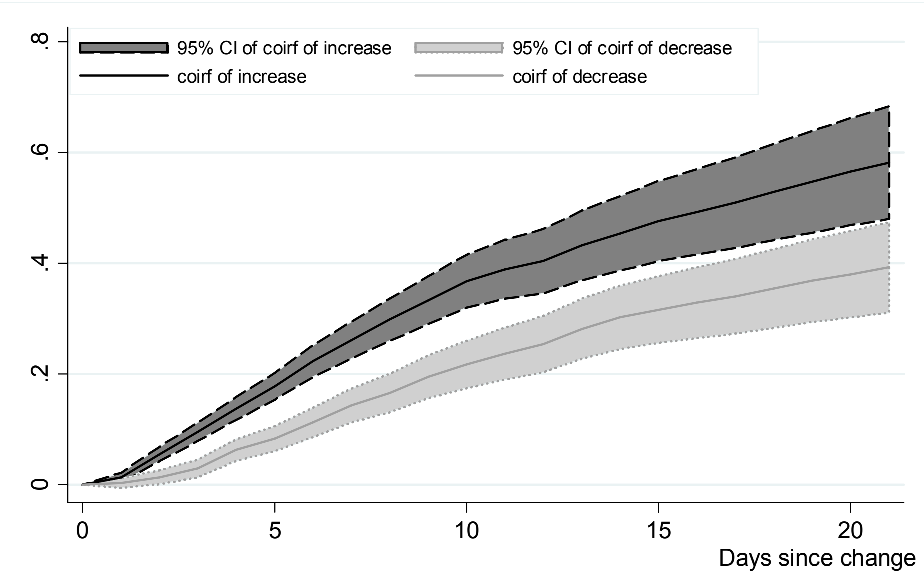
COIRF table with 95% CI (Stata):

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.012977	.004081	.021873	.002971	-.005833	.011774
2	.055504	.042521	.068487	.013536	.000911	.026161
3	.095802	.078958	.112646	.029509	.013359	.045659
4	.137728	.117112	.158344	.062786	.043247	.082324
5	.177618	.153376	.201859	.083038	.060299	.105776
6	.223561	.19477	.252353	.112671	.085948	.139393
7	.261261	.227811	.294712	.143355	.11263	.17408
8	.298326	.260036	.336617	.165834	.131022	.200646
9	.333328	.290118	.376537	.195129	.156215	.234044
10	.367777	.319697	.415856	.217307	.174398	.260216
11	.389313	.336109	.442516	.236888	.189746	.28403
12	.403909	.345881	.461937	.254353	.203429	.305278
13	.432469	.36966	.495277	.281973	.227658	.336288
14	.454147	.386568	.521727	.30268	.245221	.360138
15	.476493	.404224	.548762	.316504	.256327	.376682
16	.4931	.415867	.570334	.328857	.264805	.39291
17	.509644	.427596	.591693	.340532	.272925	.408138
18	.529149	.442254	.616045	.354454	.28332	.425588
19	.547341	.455538	.639143	.368779	.294158	.443401
20	.565614	.468845	.662383	.380348	.302211	.458485
21	.581851	.480047	.683654	.392799	.310983	.474615

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```

Graph of COIRF in with 95% CI:



Daily-Gasoline response in GBP

B5: DIESEL SEGMENTS

Diesel 1: 03/01/2000 to 14/03/2001

Vector Autoregression Estimates

Sample (adjusted): 1/27/2000 3/14/2001
Included observations: 286 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.096230	0.086277	0.058143
	(0.06605)	(0.07103)	(0.07194)
	[1.45683]	[1.21464]	[0.80827]
DDP(-2)	-0.103573	0.039146	-0.076947
	(0.06667)	(0.07170)	(0.07261)
	[-1.55346]	[0.54600]	[-1.05974]
DDP(-3)	-0.007460	-0.016692	-0.077978
	(0.06746)	(0.07254)	(0.07346)
	[-0.11059]	[-0.23012]	[-1.06149]
DDP(-4)	0.012400	0.085614	0.056444
	(0.06930)	(0.07452)	(0.07547)
	[0.17892]	[1.14881]	[0.74787]
DDP(-5)	0.027606	-0.052400	-0.041698
	(0.07039)	(0.07569)	(0.07665)
	[0.39221]	[-0.69230]	[-0.54398]
DDP(-6)	0.068473	0.027466	0.273119
	(0.09641)	(0.10367)	(0.10499)
	[0.71026]	[0.26494]	[2.60142]
DDP(-7)	0.090578	-0.086486	-0.120434
	(0.09716)	(0.10448)	(0.10581)
	[0.93222]	[-0.82775]	[-1.13816]
DDP(-8)	-0.040713	0.092672	-0.005064
	(0.09675)	(0.10404)	(0.10537)
	[-0.42079]	[0.89072]	[-0.04806]
DDP(-9)	0.041520	-0.115924	-0.153022
	(0.09608)	(0.10332)	(0.10464)
	[0.43213]	[-1.12198]	[-1.46241]
DDP(-10)	0.043483	0.012816	-0.159686
	(0.09518)	(0.10235)	(0.10365)
	[0.45687]	[0.12522]	[-1.54062]
DDP(-11)	-0.086639	-0.105105	-0.055182
	(0.09576)	(0.10297)	(0.10428)
	[-0.90477]	[-1.02072]	[-0.52916]
DDP(-12)	0.023035	0.111572	-0.012644
	(0.09469)	(0.10182)	(0.10312)
	[0.24327]	[1.09573]	[-0.12261]

DDP(-13)	-0.005004	0.023707	-0.081740
	(0.09435)	(0.10146)	(0.10275)
	[-0.05304]	[0.23367]	[-0.79553]
DDP(-14)	0.060924	0.015477	0.086057
	(0.09393)	(0.10100)	(0.10229)
	[0.64863]	[0.15323]	[0.84131]
DDP(-15)	0.043874	0.030117	-0.111839
	(0.09328)	(0.10030)	(0.10158)
	[0.47036]	[0.30025]	[-1.10097]
DDP(-16)	0.025452	-0.000287	0.204675
	(0.09276)	(0.09975)	(0.10102)
	[0.27438]	[-0.00287]	[2.02601]
DDP(-17)	0.051021	-0.287684	-0.041672
	(0.09175)	(0.09866)	(0.09991)
	[0.55611]	[-2.91596]	[-0.41708]
PWP(-1)	-0.015930	-0.059047	0.007155
	(0.06656)	(0.07158)	(0.07249)
	[-0.23932]	[-0.82491]	[0.09870]
PWP(-2)	-0.110305	0.138801	-0.038583
	(0.06628)	(0.07128)	(0.07218)
	[-1.66417]	[1.94738]	[-0.53451]
PWP(-3)	0.082433	0.103114	-0.106538
	(0.06740)	(0.07247)	(0.07340)
	[1.22309]	[1.42275]	[-1.45151]
PWP(-4)	-0.067438	0.108419	-0.091222
	(0.06693)	(0.07198)	(0.07289)
	[-1.00753]	[1.50631]	[-1.25145]
PWP(-5)	-0.030674	0.005568	-0.037782
	(0.06744)	(0.07252)	(0.07345)
	[-0.45481]	[0.07677]	[-0.51440]
PWP(-6)	0.156995	0.054184	-0.100255
	(0.06636)	(0.07136)	(0.07227)
	[2.36573]	[0.75928]	[-1.38721]
PWP(-7)	0.016825	0.041657	0.052296
	(0.06744)	(0.07252)	(0.07344)
	[0.24950]	[0.57446]	[0.71210]
PWP(-8)	0.096917	-0.007387	0.085875
	(0.06746)	(0.07254)	(0.07346)
	[1.43672]	[-0.10184]	[1.16895]
PWP(-9)	0.052489	-0.035181	-0.112373
	(0.06766)	(0.07276)	(0.07368)
	[0.77577]	[-0.48354]	[-1.52505]
PWP(-10)	-0.044454	-0.033624	-0.062770
	(0.06786)	(0.07298)	(0.07390)
	[-0.65506]	[-0.46076]	[-0.84934]
PWP(-11)	0.151332	0.034850	-0.048398
	(0.06797)	(0.07309)	(0.07402)

	[2.22657]	[0.47684]	[-0.65387]
PWP(-12)	0.030170	0.071619	-0.120094
	(0.06867)	(0.07384)	(0.07478)
	[0.43938]	[0.96993]	[-1.60597]
PWP(-13)	-0.052541	0.057021	-0.030688
	(0.06921)	(0.07442)	(0.07537)
	[-0.75916]	[0.76617]	[-0.40716]
PWP(-14)	-0.034921	-0.016824	-0.078789
	(0.06872)	(0.07390)	(0.07484)
	[-0.50815]	[-0.22767]	[-1.05277]
PWP(-15)	0.035623	-0.059922	-0.099529
	(0.06888)	(0.07406)	(0.07501)
	[0.51721]	[-0.80905]	[-1.32692]
PWP(-16)	0.038044	0.083235	0.143088
	(0.06868)	(0.07386)	(0.07480)
	[0.55392]	[1.12699]	[1.91303]
PWP(-17)	-0.028106	0.019350	-0.008232
	(0.06875)	(0.07393)	(0.07487)
	[-0.40883]	[0.26175]	[-0.10996]
NWP(-1)	0.037865	0.135353	0.020534
	(0.06735)	(0.07242)	(0.07335)
	[0.56221]	[1.86889]	[0.27996]
NWP(-2)	0.112917	-0.114525	-0.060972
	(0.06635)	(0.07135)	(0.07226)
	[1.70183]	[-1.60514]	[-0.84381]
NWP(-3)	0.015437	-0.027453	0.023349
	(0.06548)	(0.07042)	(0.07131)
	[0.23574]	[-0.38987]	[0.32742]
NWP(-4)	0.073217	-0.011793	0.067597
	(0.06509)	(0.06999)	(0.07089)
	[1.12485]	[-0.16849]	[0.95361]
NWP(-5)	0.101810	-0.080237	0.003925
	(0.06513)	(0.07004)	(0.07093)
	[1.56310]	[-1.14558]	[0.05533]
NWP(-6)	-0.090910	-0.006141	-0.022557
	(0.06468)	(0.06956)	(0.07044)
	[-1.40543]	[-0.08829]	[-0.32021]
NWP(-7)	0.002785	0.009311	0.083546
	(0.06454)	(0.06940)	(0.07028)
	[0.04315]	[0.13417]	[1.18868]
NWP(-8)	-0.016202	-0.069141	-0.069085
	(0.06433)	(0.06918)	(0.07006)
	[-0.25185]	[-0.99943]	[-0.98606]
NWP(-9)	0.069502	0.022027	0.011673
	(0.06353)	(0.06832)	(0.06919)
	[1.09400]	[0.32243]	[0.16871]

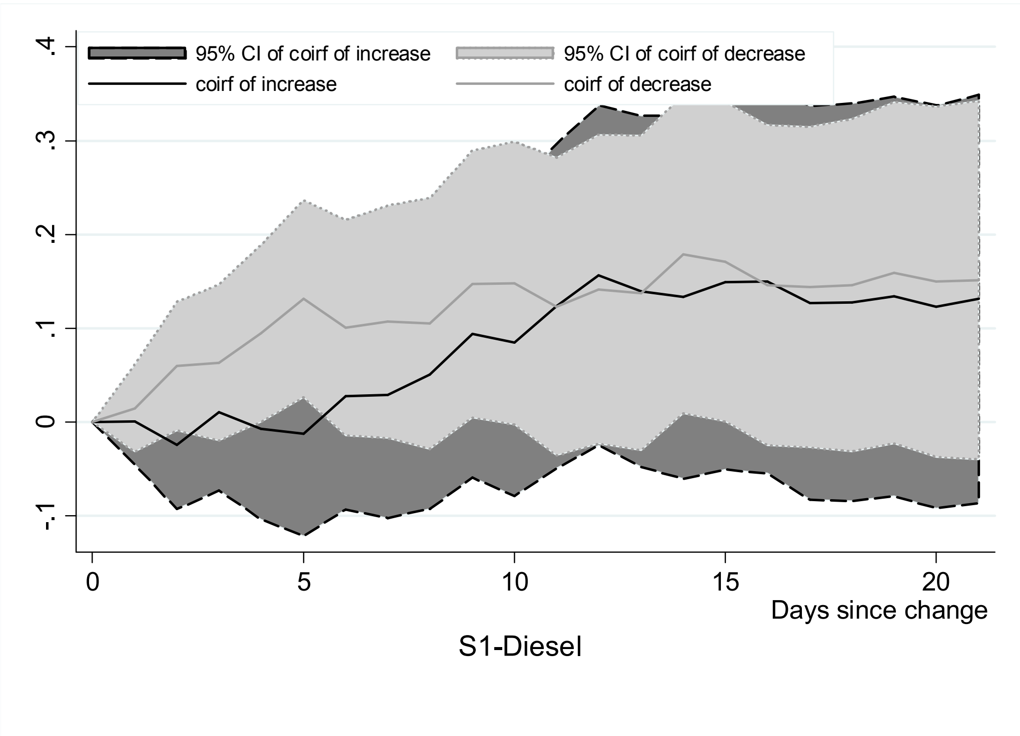
NWP(-10)	-0.015049	0.010696	0.039221
	(0.06362)	(0.06841)	(0.06928)
	[-0.23657]	[0.15635]	[0.56613]
NWP(-11)	-0.043918	-0.046591	0.043180
	(0.06334)	(0.06812)	(0.06898)
	[-0.69331]	[-0.68399]	[0.62594]
NWP(-12)	0.008424	-0.161052	0.096657
	(0.06229)	(0.06698)	(0.06783)
	[0.13524]	[-2.40449]	[1.42494]
NWP(-13)	-0.007524	-0.089275	-0.028179
	(0.06294)	(0.06768)	(0.06854)
	[-0.11954]	[-1.31907]	[-0.41112]
NWP(-14)	0.099073	-0.018497	0.062364
	(0.06303)	(0.06777)	(0.06864)
	[1.57195]	[-0.27293]	[0.90861]
NWP(-15)	-0.037237	0.063044	0.110861
	(0.06308)	(0.06784)	(0.06870)
	[-0.59029]	[0.92937]	[1.61371]
NWP(-16)	-0.083302	0.032859	0.017278
	(0.06311)	(0.06786)	(0.06873)
	[-1.31997]	[0.48419]	[0.25140]
NWP(-17)	-0.012588	-0.075022	-0.054787
	(0.06328)	(0.06805)	(0.06892)
	[-0.19891]	[-1.10245]	[-0.79497]
RD(-1)	-0.034496	-0.015024	-0.029946
	(0.01766)	(0.01899)	(0.01923)
	[-1.95375]	[-0.79130]	[-1.55738]
R-squared	0.194052	0.128150	0.233158
Adj. R-squared	0.018396	-0.061869	0.066026
Sum sq. resids	45.92886	53.10971	54.47123
S.E. equation	0.443032	0.476408	0.482476
F-statistic	1.104729	0.674405	1.395052
Log likelihood	-144.2840	-165.0570	-168.6768
Akaike AIC	1.372615	1.517881	1.543194
Schwarz SC	2.037341	2.182607	2.207920
Mean dependent	0.009352	0.304941	-0.311429
S.D. dependent	0.447164	0.462321	0.499239

Determinant resid covariance (dof adj.)	0.008208
Determinant resid covariance	0.004495
Log likelihood	-444.5755
Akaike information criterion	4.199829
Schwarz criterion	6.194006

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.000595	-.045168	.046357	.014746	-.031769	.061261
2	-.024306	-.092826	.044214	.059602	-.008972	.128176
3	.010671	-.072977	.094319	.063368	-.019959	.146695
4	-.007295	-.10387	.089281	.094714	.000171	.189258
5	-.012314	-.121436	.096809	.131378	.026183	.236573
6	.027539	-.093061	.14814	.100578	-.014312	.215468
7	.028838	-.102219	.159895	.106915	-.017022	.230852
8	.050365	-.092444	.193174	.10525	-.028525	.239026
9	.094397	-.05923	.248025	.147042	.00466	.289423
10	.084586	-.078715	.247887	.148034	-.002736	.298803
11	.123728	-.049268	.296724	.123224	-.035723	.282172
12	.156375	-.024729	.337478	.141645	-.023223	.306513
13	.139299	-.047762	.32636	.137712	-.030111	.305535
14	.13329	-.06039	.32697	.178926	.009068	.348785
15	.149058	-.050631	.348747	.170894	.000521	.341266
16	.150111	-.054577	.3548	.14591	-.024792	.316611
17	.127071	-.0828	.336942	.143914	-.027154	.314982
18	.127628	-.084309	.339565	.145966	-.031268	.3232
19	.13386	-.079014	.346733	.159324	-.022721	.341369
20	.122775	-.091934	.337485	.149635	-.037145	.336414
21	.13118	-.086306	.348665	.151383	-.039697	.342462

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



Diesel 2: 15/03/2001 to 26/08/2004

Vector Autoregression Estimates

Sample (adjusted): 4/10/2001 8/26/2004
Included observations: 852 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.022384	-0.192896	-0.142446
	(0.03520)	(0.14469)	(0.14597)
	[0.63597]	[-1.33320]	[-0.97588]
DDP(-2)	0.155417	0.164836	-0.106874
	(0.03516)	(0.14455)	(0.14583)
	[4.41985]	[1.14035]	[-0.73289]
DDP(-3)	0.153253	0.205350	-0.018574
	(0.03566)	(0.14661)	(0.14791)
	[4.29703]	[1.40066]	[-0.12558]
DDP(-4)	0.092108	0.388320	0.080768
	(0.03616)	(0.14863)	(0.14994)
	[2.54747]	[2.61265]	[0.53865]
DDP(-5)	0.225025	0.001376	0.066867
	(0.03634)	(0.14938)	(0.15070)
	[6.19224]	[0.00921]	[0.44370]
DDP(-6)	0.005686	-0.246995	-0.140523
	(0.03715)	(0.15272)	(0.15407)
	[0.15304]	[-1.61731]	[-0.91207]
DDP(-7)	-0.019583	-0.613919	-0.221590
	(0.03719)	(0.15287)	(0.15422)
	[-0.52660]	[-4.01593]	[-1.43682]
DDP(-8)	-0.007345	-0.194424	0.401864
	(0.03749)	(0.15413)	(0.15549)
	[-0.19590]	[-1.26142]	[2.58445]
DDP(-9)	0.031380	0.173505	-0.071939
	(0.03775)	(0.15517)	(0.15655)
	[0.83129]	[1.11814]	[-0.45954]
DDP(-10)	0.074246	0.250707	0.014379
	(0.03783)	(0.15553)	(0.15690)
	[1.96241]	[1.61198]	[0.09164]
DDP(-11)	0.017552	0.240188	0.038634
	(0.03781)	(0.15543)	(0.15681)
	[0.46420]	[1.54530]	[0.24638]
DDP(-12)	-0.009221	-0.004200	0.137797
	(0.03780)	(0.15540)	(0.15678)
	[-0.24392]	[-0.02702]	[0.87894]
DDP(-13)	-0.050125	-0.391573	-0.259796
	(0.03690)	(0.15170)	(0.15304)

	[-1.35829]	[-2.58123]	[-1.69756]
DDP(-14)	0.063891	-0.114729	-0.102779
	(0.03682)	(0.15138)	(0.15271)
	[1.73500]	[-0.75791]	[-0.67301]
DDP(-15)	0.006628	0.134661	0.036553
	(0.03623)	(0.14892)	(0.15024)
	[0.18295]	[0.90424]	[0.24330]
DDP(-16)	-0.008793	0.192604	-0.150810
	(0.03556)	(0.14618)	(0.14747)
	[-0.24727]	[1.31757]	[-1.02263]
DDP(-17)	-0.010080	-0.101244	-0.094032
	(0.03554)	(0.14609)	(0.14738)
	[-0.28363]	[-0.69302]	[-0.63802]
PWP(-1)	-0.003540	0.061448	-0.102265
	(0.00927)	(0.03809)	(0.03843)
	[-0.38204]	[1.61317]	[-2.66118]
PWP(-2)	0.000115	0.044727	-0.051561
	(0.00934)	(0.03839)	(0.03873)
	[0.01229]	[1.16504]	[-1.33130]
PWP(-3)	0.020241	0.116872	-0.071700
	(0.00936)	(0.03848)	(0.03882)
	[2.16256]	[3.03754]	[-1.84719]
PWP(-4)	0.031377	0.088648	-0.017381
	(0.00946)	(0.03890)	(0.03924)
	[3.31594]	[2.27897]	[-0.44290]
PWP(-5)	-0.011577	-0.052216	-0.148568
	(0.00955)	(0.03925)	(0.03960)
	[-1.21246]	[-1.33031]	[-3.75194]
PWP(-6)	-0.000203	-0.010750	-0.084343
	(0.00963)	(0.03960)	(0.03995)
	[-0.02107]	[-0.27144]	[-2.11100]
PWP(-7)	0.018522	-0.008206	-0.045739
	(0.00964)	(0.03963)	(0.03998)
	[1.92108]	[-0.20705]	[-1.14392]
PWP(-8)	0.006745	-0.019131	-0.005600
	(0.00966)	(0.03972)	(0.04007)
	[0.69814]	[-0.48168]	[-0.13976]
PWP(-9)	-0.001560	0.050745	-0.126275
	(0.00964)	(0.03961)	(0.03996)
	[-0.16188]	[1.28119]	[-3.16019]
PWP(-10)	-0.003254	-0.005180	-0.048458
	(0.00964)	(0.03964)	(0.03999)
	[-0.33744]	[-0.13069]	[-1.21182]
PWP(-11)	0.005663	0.033554	-0.001696
	(0.00956)	(0.03931)	(0.03966)
	[0.59214]	[0.85348]	[-0.04277]

PWP(-12)	0.018654	0.050425	0.006889
	(0.00949)	(0.03900)	(0.03935)
	[1.96617]	[1.29289]	[0.17508]
PWP(-13)	-0.007039	0.031632	-0.001030
	(0.00950)	(0.03905)	(0.03940)
	[-0.74090]	[0.80999]	[-0.02615]
PWP(-14)	0.005349	0.090509	0.064014
	(0.00950)	(0.03907)	(0.03941)
	[0.56280]	[2.31671]	[1.62417]
PWP(-15)	0.000664	0.043614	0.010717
	(0.00951)	(0.03908)	(0.03942)
	[0.06986]	[1.11604]	[0.27183]
PWP(-16)	0.014910	0.025675	0.045320
	(0.00951)	(0.03910)	(0.03944)
	[1.56766]	[0.65673]	[1.14904]
PWP(-17)	0.003397	0.094018	-0.048511
	(0.00946)	(0.03890)	(0.03924)
	[0.35905]	[2.41719]	[-1.23630]
NWP(-1)	-0.000634	-0.066371	-0.001773
	(0.00929)	(0.03820)	(0.03854)
	[-0.06826]	[-1.73738]	[-0.04601]
NWP(-2)	0.001415	-0.011179	0.019646
	(0.00929)	(0.03820)	(0.03854)
	[0.15228]	[-0.29260]	[0.50973]
NWP(-3)	-0.002289	-0.034444	0.106194
	(0.00931)	(0.03828)	(0.03862)
	[-0.24578]	[-0.89986]	[2.75000]
NWP(-4)	-0.003745	-0.008099	0.038081
	(0.00937)	(0.03853)	(0.03887)
	[-0.39956]	[-0.21017]	[0.97958]
NWP(-5)	0.034839	-0.020580	0.040033
	(0.00939)	(0.03859)	(0.03893)
	[3.71121]	[-0.53329]	[1.02829]
NWP(-6)	0.017573	-0.092384	0.017041
	(0.00948)	(0.03896)	(0.03930)
	[1.85427]	[-2.37134]	[0.43358]
NWP(-7)	0.017591	-0.050931	-0.008019
	(0.00954)	(0.03924)	(0.03958)
	[1.84298]	[-1.29806]	[-0.20258]
NWP(-8)	-0.000897	-0.018630	-0.026173
	(0.00957)	(0.03934)	(0.03969)
	[-0.09377]	[-0.47355]	[-0.65946]
NWP(-9)	0.010910	0.057438	0.126015
	(0.00947)	(0.03895)	(0.03929)
	[1.15146]	[1.47473]	[3.20709]
NWP(-10)	0.008330	0.053776	0.011297
	(0.00948)	(0.03895)	(0.03930)

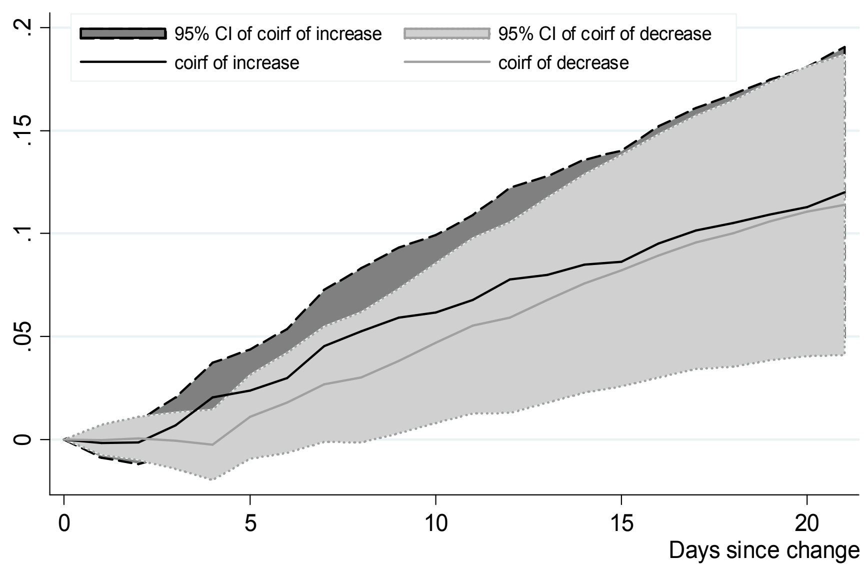
	[0.87909]	[1.38057]	[0.28749]
NWP(-11)	0.008175	-0.017551	-0.004210
	(0.00947)	(0.03893)	(0.03928)
	[0.86316]	[-0.45082]	[-0.10720]
NWP(-12)	-0.005445	0.028080	0.028481
	(0.00943)	(0.03875)	(0.03910)
	[-0.57757]	[0.72460]	[0.72852]
NWP(-13)	0.009887	0.002097	0.004763
	(0.00939)	(0.03860)	(0.03894)
	[1.05285]	[0.05431]	[0.12231]
NWP(-14)	0.002873	-0.050087	-0.038927
	(0.00935)	(0.03845)	(0.03879)
	[0.30720]	[-1.30269]	[-1.00355]
NWP(-15)	-0.001605	-0.026447	-0.023429
	(0.00925)	(0.03802)	(0.03836)
	[-0.17353]	[-0.69551]	[-0.61075]
NWP(-16)	-0.003901	-0.007935	-0.019443
	(0.00920)	(0.03781)	(0.03815)
	[-0.42405]	[-0.20986]	[-0.50971]
NWP(-17)	0.003009	-0.049620	0.036856
	(0.00911)	(0.03746)	(0.03780)
	[0.33020]	[-1.32447]	[0.97515]
RD(-1)	-0.006234	-0.016273	-0.020121
	(0.00246)	(0.01011)	(0.01020)
	[-2.53488]	[-1.60971]	[-1.97281]
R-squared	0.356297	0.063832	0.148174
Adj. R-squared	0.315261	0.004151	0.093870
Sum sq. resids	10.12131	171.0328	174.0702
S.E. equation	0.112479	0.462375	0.466463
F-statistic	8.682519	1.069561	2.728611
Log likelihood	679.4983	-524.8941	-532.3932
Akaike AIC	-1.473001	1.354211	1.371815
Schwarz SC	-1.183242	1.643970	1.661574
Mean dependent	0.006644	0.295684	-0.273351
S.D. dependent	0.135929	0.463338	0.490029

Determinant resid covariance (dof adj.)	0.000504
Determinant resid covariance	0.000417
Log likelihood	-311.3864
Akaike information criterion	1.097151
Schwarz criterion	1.966428

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	-.001695	-.009028	.005639	-.000265	-.007647	.007116
2	-.001466	-.011985	.009052	.000419	-.010178	.011017
3	.00682	-.006836	.020476	-.000553	-.014376	.01327
4	.020433	.003593	.037273	-.00259	-.019747	.014567
5	.023705	.003702	.043709	.010933	-.009508	.031374
6	.029867	.006143	.053591	.017798	-.006554	.04215
7	.045433	.018199	.072666	.026827	-.001209	.054863
8	.052395	.021683	.083106	.030222	-.001477	.061921
9	.059089	.024951	.093227	.038125	.002862	.073387
10	.061635	.024063	.099207	.046874	.007953	.085795
11	.067837	.026671	.109004	.055309	.012572	.098045
12	.077703	.033135	.122271	.059184	.012816	.105552
13	.080021	.032141	.127901	.067674	.017779	.117568
14	.08489	.03392	.13586	.075848	.022697	.128999
15	.086263	.032217	.140309	.082048	.025741	.138354
16	.095042	.03803	.152055	.089241	.030041	.148442
17	.101399	.04173	.161067	.095819	.034129	.157508
18	.105188	.042633	.167744	.100018	.03529	.164746
19	.10941	.04405	.17477	.10601	.038418	.173601
20	.112892	.044808	.180976	.110786	.040422	.181149
21	.120132	.049454	.190809	.113989	.040929	.187048

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



D2

Diesel 3: 26/8/2004 to 1/10/2007

Vector Autoregression Estimates

Sample (adjusted): 9/22/2004 10/01/2007
Included observations: 765 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.088841	-0.257221	-0.051560
	(0.04376)	(0.16055)	(0.15954)
	[-2.03006]	[-1.60211]	[-0.32317]
DDP(-2)	0.074739	0.049397	-0.056811
	(0.04380)	(0.16069)	(0.15968)
	[1.70635]	[0.30741]	[-0.35577]
DDP(-3)	0.092693	-0.259410	-0.516234
	(0.04332)	(0.15894)	(0.15794)
	[2.13955]	[-1.63212]	[-3.26844]
DDP(-4)	0.026926	0.182884	0.097710
	(0.04378)	(0.16060)	(0.15959)
	[0.61508]	[1.13876]	[0.61224]
DDP(-5)	0.360223	-0.135149	0.015124
	(0.04377)	(0.16059)	(0.15958)
	[8.22935]	[-0.84158]	[0.09477]
DDP(-6)	0.008787	0.032080	-0.030449
	(0.04676)	(0.17155)	(0.17047)
	[0.18792]	[0.18700]	[-0.17861]
DDP(-7)	0.024261	0.290610	0.278784
	(0.04659)	(0.17093)	(0.16985)
	[0.52073]	[1.70021]	[1.64131]
DDP(-8)	0.031089	0.309332	0.219029
	(0.04653)	(0.17072)	(0.16965)
	[0.66809]	[1.81195]	[1.29108]
DDP(-9)	-0.027476	-0.247663	-0.297410
	(0.04660)	(0.17098)	(0.16991)
	[-0.58955]	[-1.44852]	[-1.75044]
DDP(-10)	0.055084	0.473031	0.207317
	(0.04667)	(0.17121)	(0.17014)
	[1.18036]	[2.76290]	[1.21854]
DDP(-11)	-0.094082	0.191537	0.395458
	(0.04641)	(0.17027)	(0.16920)
	[-2.02714]	[1.12492]	[2.33721]
DDP(-12)	-0.040096	-0.176179	-0.145130
	(0.04660)	(0.17094)	(0.16987)
	[-0.86050]	[-1.03063]	[-0.85434]
DDP(-13)	-0.063331	-0.040440	-0.130806
	(0.04348)	(0.15951)	(0.15852)

	[-1.45655]	[-0.25352]	[-0.82519]
DDP(-14)	0.034518	0.139893	-0.267149
	(0.04341)	(0.15924)	(0.15824)
	[0.79523]	[0.87850]	[-1.68821]
DDP(-15)	0.168600	-0.374692	-0.364702
	(0.04303)	(0.15785)	(0.15686)
	[3.91845]	[-2.37368]	[-2.32497]
DDP(-16)	0.046893	0.092814	0.332963
	(0.04290)	(0.15740)	(0.15642)
	[1.09296]	[0.58966]	[2.12869]
DDP(-17)	-0.065638	0.050021	0.297005
	(0.04289)	(0.15736)	(0.15638)
	[-1.53026]	[0.31787]	[1.89930]
PWP(-1)	0.015678	-0.054164	-0.047647
	(0.01136)	(0.04166)	(0.04140)
	[1.38060]	[-1.30011]	[-1.15089]
PWP(-2)	-0.020735	0.051669	-0.070870
	(0.01137)	(0.04170)	(0.04144)
	[-1.82400]	[1.23895]	[-1.71008]
PWP(-3)	0.028814	-0.009221	-0.070076
	(0.01149)	(0.04215)	(0.04189)
	[2.50786]	[-0.21875]	[-1.67296]
PWP(-4)	0.036346	0.007301	-0.059102
	(0.01153)	(0.04229)	(0.04202)
	[3.15338]	[0.17265]	[-1.40652]
PWP(-5)	0.017913	0.059042	-0.009245
	(0.01158)	(0.04247)	(0.04221)
	[1.54724]	[1.39008]	[-0.21902]
PWP(-6)	0.027821	0.034813	-8.96E-05
	(0.01159)	(0.04250)	(0.04224)
	[2.40139]	[0.81909]	[-0.00212]
PWP(-7)	0.024235	0.112873	-0.034889
	(0.01163)	(0.04268)	(0.04242)
	[2.08294]	[2.64435]	[-0.82251]
PWP(-8)	-0.002884	0.010722	-0.047775
	(0.01170)	(0.04294)	(0.04267)
	[-0.24636]	[0.24969]	[-1.11957]
PWP(-9)	0.006897	0.037297	-0.086287
	(0.01168)	(0.04285)	(0.04258)
	[0.59047]	[0.87041]	[-2.02639]
PWP(-10)	0.021448	0.026153	0.082578
	(0.01172)	(0.04301)	(0.04274)
	[1.82958]	[0.60811]	[1.93224]
PWP(-11)	0.013265	-0.015346	-0.033106
	(0.01164)	(0.04270)	(0.04243)
	[1.13973]	[-0.35939]	[-0.78021]

PWP(-12)	0.002056	0.002429	-0.046643
	(0.01163)	(0.04266)	(0.04239)
	[0.17680]	[0.05694]	[-1.10033]
PWP(-13)	-0.001036	0.132859	0.009658
	(0.01159)	(0.04251)	(0.04224)
	[-0.08940]	[3.12527]	[0.22862]
PWP(-14)	-0.009056	0.049935	-0.040107
	(0.01164)	(0.04270)	(0.04243)
	[-0.77802]	[1.16939]	[-0.94516]
PWP(-15)	0.018849	0.019172	-0.054938
	(0.01161)	(0.04259)	(0.04232)
	[1.62362]	[0.45015]	[-1.29802]
PWP(-16)	0.025460	0.035893	-0.021079
	(0.01165)	(0.04272)	(0.04246)
	[2.18628]	[0.84013]	[-0.49650]
PWP(-17)	-0.012523	-0.019915	0.001760
	(0.01152)	(0.04225)	(0.04199)
	[-1.08739]	[-0.47136]	[0.04191]
NWP(-1)	-0.002247	-0.019806	-0.007827
	(0.01142)	(0.04190)	(0.04163)
	[-0.19676]	[-0.47273]	[-0.18801]
NWP(-2)	0.016948	0.004546	0.083967
	(0.01135)	(0.04165)	(0.04139)
	[1.49269]	[0.10914]	[2.02856]
NWP(-3)	0.008675	0.000164	0.047767
	(0.01135)	(0.04165)	(0.04139)
	[0.76400]	[0.00393]	[1.15397]
NWP(-4)	0.018952	0.076220	0.018460
	(0.01132)	(0.04152)	(0.04126)
	[1.67441]	[1.83559]	[0.44738]
NWP(-5)	0.033118	-0.070634	0.001256
	(0.01137)	(0.04172)	(0.04146)
	[2.91232]	[-1.69310]	[0.03031]
NWP(-6)	0.019382	-0.035660	0.004530
	(0.01146)	(0.04205)	(0.04178)
	[1.69117]	[-0.84814]	[0.10841]
NWP(-7)	0.032374	-0.100742	0.070250
	(0.01139)	(0.04177)	(0.04151)
	[2.84347]	[-2.41187]	[1.69246]
NWP(-8)	0.014031	0.030899	0.060104
	(0.01157)	(0.04245)	(0.04219)
	[1.21249]	[0.72781]	[1.42466]
NWP(-9)	0.013420	-0.027489	0.112789
	(0.01145)	(0.04199)	(0.04173)
	[1.17255]	[-0.65466]	[2.70306]
NWP(-10)	0.017339	-0.051908	-0.053713
	(0.01154)	(0.04235)	(0.04208)

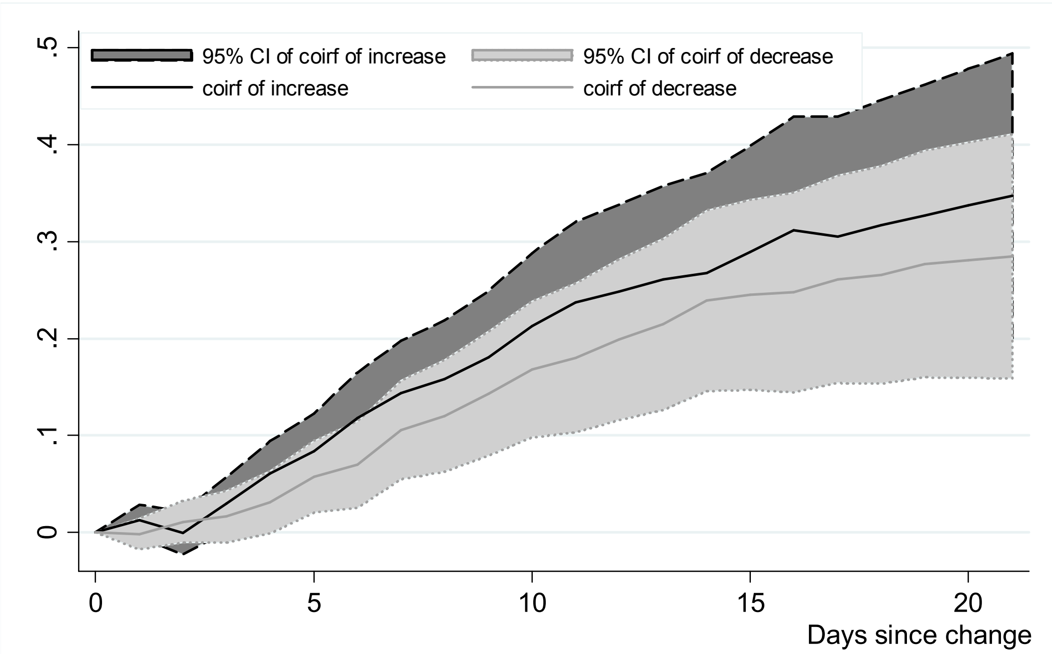
	[1.50205]	[-1.22573]	[-1.27633]
NWP(-11)	0.005907	0.006228	0.065359
	(0.01149)	(0.04216)	(0.04190)
	[0.51404]	[0.14771]	[1.56000]
NWP(-12)	-0.000287	-0.026142	0.000150
	(0.01151)	(0.04224)	(0.04198)
	[-0.02496]	[-0.61882]	[0.00358]
NWP(-13)	0.010094	-0.117086	-0.039252
	(0.01147)	(0.04209)	(0.04183)
	[0.87982]	[-2.78178]	[-0.93845]
NWP(-14)	0.015563	0.027437	0.010349
	(0.01146)	(0.04204)	(0.04178)
	[1.35811]	[0.65261]	[0.24770]
NWP(-15)	-0.010449	-0.040950	-0.010381
	(0.01143)	(0.04192)	(0.04166)
	[-0.91447]	[-0.97689]	[-0.24922]
NWP(-16)	-0.003546	-0.034403	0.038440
	(0.01136)	(0.04169)	(0.04143)
	[-0.31206]	[-0.82524]	[0.92789]
NWP(-17)	0.006777	-0.061395	0.016140
	(0.01135)	(0.04163)	(0.04137)
	[0.59720]	[-1.47467]	[0.39012]
RD(-1)	0.000352	-0.008700	0.001237
	(0.00227)	(0.00834)	(0.00829)
	[0.15495]	[-1.04281]	[0.14916]
R-squared	0.363947	0.067160	0.111802
Adj. R-squared	0.318450	0.000436	0.048271
Sum sq. resids	39.22432	527.9260	521.3308
S.E. equation	0.234549	0.860482	0.855090
F-statistic	7.999508	1.006528	1.759788
Log likelihood	50.75846	-943.6112	-938.8026
Akaike AIC	0.003246	2.602905	2.590334
Schwarz SC	0.318636	2.918295	2.905724
Mean dependent	0.018486	0.585801	-0.537729
S.D. dependent	0.284108	0.860669	0.876507

Determinant resid covariance (dof adj.)	0.024111
Determinant resid covariance	0.019521
Log likelihood	-1750.836
Akaike information criterion	4.985191
Schwarz criterion	5.931362

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.012219	-.004056	.028494	-.001671	-.017736	.014395
2	-.000813	-.023029	.021403	.01086	-.010767	.032486
3	.02936	.00147	.05725	.01621	-.010739	.043158
4	.060403	.026787	.094019	.030941	-.00129	.063172
5	.08391	.045039	.12278	.057357	.020167	.094548
6	.117979	.071064	.164893	.069971	.025227	.114715
7	.143667	.089731	.197604	.105763	.05477	.156757
8	.157868	.096724	.219012	.120255	.062544	.177967
9	.180587	.112104	.24907	.143099	.078864	.207333
10	.212634	.137152	.288116	.168281	.097929	.238634
11	.237282	.153919	.320645	.180106	.102943	.257269
12	.248197	.157986	.338407	.198827	.115875	.281779
13	.260718	.163963	.357473	.214557	.126078	.303037
14	.267871	.164668	.371074	.23899	.145576	.332404
15	.289037	.179402	.398672	.245088	.146957	.34322
16	.311872	.194939	.428804	.247583	.144468	.350699
17	.305317	.18183	.428804	.261036	.153951	.368121
18	.316881	.187529	.446233	.265775	.153403	.378147
19	.326678	.191318	.462039	.277014	.159897	.39413
20	.337275	.196353	.478197	.280887	.159423	.402352
21	.347178	.200076	.494279	.284871	.158753	.410988

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



D3

Diesel 4: 01/10/2007 to 05/01/2009

Vector Autoregression Estimates

Sample (adjusted): 10/25/2007 1/05/2009
Included observations: 302 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.047307	0.204220	0.022830
	(0.06685)	(0.34939)	(0.30559)
	[0.70764]	[0.58451]	[0.07471]
DDP(-2)	0.054267	0.446486	0.469010
	(0.06622)	(0.34610)	(0.30272)
	[0.81945]	[1.29006]	[1.54933]
DDP(-3)	0.020566	0.181235	-0.145279
	(0.06610)	(0.34547)	(0.30217)
	[0.31112]	[0.52461]	[-0.48079]
DDP(-4)	-0.017757	0.169693	0.493705
	(0.06568)	(0.34324)	(0.30022)
	[-0.27037]	[0.49439]	[1.64448]
DDP(-5)	0.355588	0.309775	0.094690
	(0.06640)	(0.34702)	(0.30353)
	[5.35522]	[0.89267]	[0.31197]
DDP(-6)	-0.062385	0.368595	-0.189196
	(0.07012)	(0.36644)	(0.32051)
	[-0.88975]	[1.00589]	[-0.59030]
DDP(-7)	0.127711	-0.279084	-0.062071
	(0.07026)	(0.36717)	(0.32115)
	[1.81779]	[-0.76009]	[-0.19328]
DDP(-8)	0.028667	0.023330	0.004883
	(0.07109)	(0.37153)	(0.32496)
	[0.40325]	[0.06280]	[0.01503]
DDP(-9)	-0.093995	0.138387	0.104111
	(0.07098)	(0.37093)	(0.32444)
	[-1.32434]	[0.37308]	[0.32090]
DDP(-10)	0.052658	-0.501686	0.122848
	(0.07114)	(0.37177)	(0.32517)
	[0.74024]	[-1.34944]	[0.37779]
DDP(-11)	-0.095236	-0.223243	0.273418
	(0.07128)	(0.37255)	(0.32585)
	[-1.33599]	[-0.59923]	[0.83908]
DDP(-12)	-0.092524	-0.057674	-0.517162
	(0.07062)	(0.36909)	(0.32283)
	[-1.31012]	[-0.15626]	[-1.60198]
DDP(-13)	-0.061397	0.062548	0.287751
	(0.06501)	(0.33976)	(0.29717)
	[-0.94441]	[0.18409]	[0.96829]

DDP(-14)	-0.009479	0.200732	0.066374
	(0.06510)	(0.34022)	(0.29758)
	[-0.14561]	[0.59000]	[0.22305]
DDP(-15)	0.256580	-0.170875	-0.310063
	(0.06455)	(0.33737)	(0.29508)
	[3.97473]	[-0.50650]	[-1.05078]
DDP(-16)	-0.057437	0.240631	0.139431
	(0.06401)	(0.33451)	(0.29258)
	[-0.89737]	[0.71936]	[0.47656]
DDP(-17)	-0.069396	0.324208	0.333517
	(0.06221)	(0.32514)	(0.28439)
	[-1.11545]	[0.99713]	[1.17276]
PWP(-1)	0.002730	0.067517	-0.025952
	(0.01317)	(0.06881)	(0.06018)
	[0.20739]	[0.98126]	[-0.43122]
PWP(-2)	0.018156	0.080597	-0.053049
	(0.01321)	(0.06902)	(0.06037)
	[1.37473]	[1.16770]	[-0.87871]
PWP(-3)	0.030610	-0.038994	-0.052465
	(0.01330)	(0.06953)	(0.06082)
	[2.30065]	[-0.56079]	[-0.86266]
PWP(-4)	0.032118	0.024987	-0.040612
	(0.01338)	(0.06992)	(0.06116)
	[2.40053]	[0.35734]	[-0.66403]
PWP(-5)	0.009629	-0.025406	-0.156575
	(0.01353)	(0.07073)	(0.06186)
	[0.71150]	[-0.35920]	[-2.53098]
PWP(-6)	0.032569	0.016142	0.000956
	(0.01364)	(0.07129)	(0.06235)
	[2.38766]	[0.22643]	[0.01533]
PWP(-7)	0.035952	-0.031570	-0.058850
	(0.01370)	(0.07160)	(0.06263)
	[2.62410]	[-0.44091]	[-0.93967]
PWP(-8)	0.017587	-0.038470	-0.164072
	(0.01391)	(0.07268)	(0.06357)
	[1.26466]	[-0.52931]	[-2.58101]
PWP(-9)	0.019640	-0.083740	0.014461
	(0.01400)	(0.07315)	(0.06398)
	[1.40327]	[-1.14484]	[0.22604]
PWP(-10)	0.017510	-0.018980	-0.064130
	(0.01409)	(0.07364)	(0.06441)
	[1.24272]	[-0.25776]	[-0.99570]
PWP(-11)	0.004335	0.097295	0.059601
	(0.01410)	(0.07368)	(0.06445)
	[0.30748]	[1.32046]	[0.92480]
PWP(-12)	0.026880	-0.108862	-0.167185

	(0.01413)	(0.07383)	(0.06458)
	[1.90272]	[-1.47447]	[-2.58893]
PWP(-13)	0.018472	-0.025621	-0.084858
	(0.01394)	(0.07286)	(0.06373)
	[1.32497]	[-0.35165]	[-1.33155]
PWP(-14)	-0.002070	0.078661	-0.098641
	(0.01389)	(0.07259)	(0.06349)
	[-0.14906]	[1.08365]	[-1.55363]
PWP(-15)	-0.004594	-0.038878	0.018315
	(0.01389)	(0.07257)	(0.06347)
	[-0.33083]	[-0.53572]	[0.28854]
PWP(-16)	0.011256	-0.066703	-0.102165
	(0.01375)	(0.07187)	(0.06286)
	[0.81849]	[-0.92813]	[-1.62527]
PWP(-17)	0.017692	0.068867	-0.124827
	(0.01380)	(0.07212)	(0.06308)
	[1.28201]	[0.95484]	[-1.97874]
NWP(-1)	0.024161	-0.001392	0.014972
	(0.01478)	(0.07724)	(0.06756)
	[1.63481]	[-0.01803]	[0.22162]
NWP(-2)	-0.002274	-0.114382	-0.024665
	(0.01480)	(0.07732)	(0.06763)
	[-0.15371]	[-1.47926]	[-0.36470]
NWP(-3)	0.014410	-0.095731	0.030069
	(0.01479)	(0.07732)	(0.06763)
	[0.97402]	[-1.23818]	[0.44465]
NWP(-4)	0.027151	-0.080834	0.069087
	(0.01484)	(0.07755)	(0.06783)
	[1.82976]	[-1.04236]	[1.01855]
NWP(-5)	0.044555	-0.175608	0.103674
	(0.01505)	(0.07867)	(0.06881)
	[2.95977]	[-2.23213]	[1.50664]
NWP(-6)	0.022417	0.009552	-0.013550
	(0.01551)	(0.08108)	(0.07091)
	[1.44498]	[0.11782]	[-0.19107]
NWP(-7)	0.039968	-0.062349	-0.096917
	(0.01547)	(0.08084)	(0.07071)
	[2.58375]	[-0.77121]	[-1.37059]
NWP(-8)	0.022905	0.042481	0.013766
	(0.01559)	(0.08149)	(0.07128)
	[1.46893]	[0.52129]	[0.19313]
NWP(-9)	0.015954	-0.013643	-0.052386
	(0.01563)	(0.08168)	(0.07145)
	[1.02077]	[-0.16702]	[-0.73324]
NWP(-10)	0.007174	-0.013202	-0.012712
	(0.01549)	(0.08094)	(0.07080)
	[0.46319]	[-0.16311]	[-0.17955]

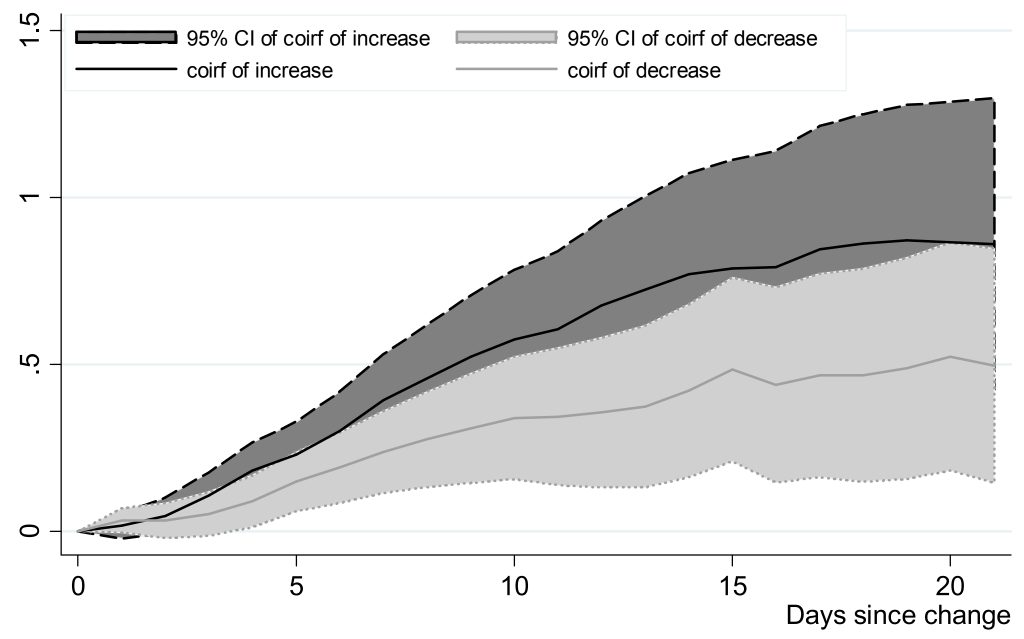
NWP(-11)	-0.009270	-0.135168	-0.113598
	(0.01548)	(0.08093)	(0.07078)
	[-0.59866]	[-1.67024]	[-1.60486]
NWP(-12)	-0.002262	-0.051598	-0.049564
	(0.01560)	(0.08154)	(0.07132)
	[-0.14500]	[-0.63278]	[-0.69493]
NWP(-13)	0.002781	-0.023175	0.045507
	(0.01532)	(0.08007)	(0.07003)
	[0.18150]	[-0.28944]	[0.64978]
NWP(-14)	0.031632	-0.042326	0.055992
	(0.01523)	(0.07960)	(0.06963)
	[2.07673]	[-0.53170]	[0.80418]
NWP(-15)	0.041581	-0.017181	0.056921
	(0.01536)	(0.08028)	(0.07021)
	[2.70703]	[-0.21402]	[0.81067]
NWP(-16)	-0.033787	0.048142	0.034391
	(0.01527)	(0.07979)	(0.06979)
	[-2.21301]	[0.60335]	[0.49278]
NWP(-17)	0.027545	-0.174465	-0.090428
	(0.01528)	(0.07986)	(0.06985)
	[1.80248]	[-2.18453]	[-1.29454]
RD(-1)	-0.001044	-0.019524	-0.030034
	(0.00336)	(0.01758)	(0.01537)
	[-0.31034]	[-1.11076]	[-1.95360]
R-squared	0.687385	0.105373	0.217818
Adj. R-squared	0.623612	-0.077130	0.058253
Sum sq. resids	31.79107	868.3147	664.2849
S.E. equation	0.356601	1.863668	1.630073
F-statistic	10.77856	0.577377	1.365071
Log likelihood	-88.58196	-587.9946	-547.5503
Akaike AIC	0.931006	4.238375	3.970532
Schwarz SC	1.569888	4.877257	4.609413
Mean dependent	-0.022402	1.011084	-1.123024
S.D. dependent	0.581252	1.795703	1.679732

Determinant resid covariance (dof adj.)	1.001263
Determinant resid covariance	0.567999
Log likelihood	-1200.147
Akaike information criterion	8.981107
Schwarz criterion	10.89775

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.016871	-.020612	.054353	.033412	-.003131	.069955
2	.046448	-.008427	.101324	.032343	-.020041	.084726
3	.107344	.037525	.177164	.052739	-.013063	.118542
4	.182713	.098776	.266651	.090543	.012868	.168218
5	.230678	.133251	.328104	.149513	.060393	.238634
6	.301959	.18477	.419149	.191169	.084935	.297403
7	.39365	.256574	.530727	.238216	.115174	.361258
8	.458906	.298709	.619103	.275882	.13297	.418794
9	.523748	.339431	.708065	.309111	.145067	.473154
10	.576117	.36821	.784024	.340081	.156447	.523715
11	.606348	.373477	.839218	.344245	.138937	.549553
12	.67596	.419627	.932294	.35601	.131771	.58025
13	.724494	.444695	1.00429	.374318	.131778	.616858
14	.770282	.467574	1.07299	.421844	.162291	.681398
15	.787798	.46249	1.11311	.485458	.209931	.760984
16	.791775	.443477	1.14007	.438951	.146357	.731544
17	.846241	.477153	1.21533	.46782	.162814	.772826
18	.862056	.474069	1.25004	.468214	.148993	.787434
19	.872218	.466758	1.27768	.488553	.157068	.820038
20	.8656	.444342	1.28686	.52421	.182742	.865678
21	.861232	.424854	1.29761	.496933	.14564	.848226

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



D4

Diesel 5: 06/01/2009 to 31/12/2010

Vector Autoregression Estimates

Sample (adjusted): 2/01/2009 12/30/2010
Included observations: 484 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.109681	-0.047977	0.025273
	(0.04842)	(0.13885)	(0.13556)
	[-2.26535]	[-0.34552]	[0.18643]
DDP(-2)	0.020872	-0.048606	-0.015619
	(0.04867)	(0.13957)	(0.13627)
	[0.42886]	[-0.34826]	[-0.11462]
DDP(-3)	0.057909	-0.321822	0.082493
	(0.04840)	(0.13881)	(0.13552)
	[1.19643]	[-2.31847]	[0.60871]
DDP(-4)	0.041208	0.042320	0.068318
	(0.04882)	(0.14000)	(0.13669)
	[0.84412]	[0.30228]	[0.49981]
DDP(-5)	0.186926	-0.125378	-0.102446
	(0.04873)	(0.13974)	(0.13644)
	[3.83611]	[-0.89720]	[-0.75087]
DDP(-6)	0.020200	0.000146	-0.040792
	(0.04940)	(0.14168)	(0.13833)
	[0.40888]	[0.00103]	[-0.29488]
DDP(-7)	-0.023324	0.003696	-0.199785
	(0.04884)	(0.14007)	(0.13675)
	[-0.47756]	[0.02639]	[-1.46093]
DDP(-8)	0.006924	-0.027879	-0.014232
	(0.04844)	(0.13892)	(0.13563)
	[0.14294]	[-0.20069]	[-0.10494]
DDP(-9)	0.035637	0.104008	0.001466
	(0.04808)	(0.13789)	(0.13463)
	[0.74117]	[0.75427]	[0.01089]
DDP(-10)	0.065360	0.149765	-0.064630
	(0.04808)	(0.13789)	(0.13463)
	[1.35933]	[1.08610]	[-0.48006]
DDP(-11)	0.013469	-0.101074	-0.169420
	(0.04817)	(0.13815)	(0.13488)
	[0.27959]	[-0.73161]	[-1.25606]
DDP(-12)	-0.008607	-0.323515	-0.104199
	(0.04806)	(0.13782)	(0.13455)
	[-0.17911]	[-2.34745]	[-0.77441]
DDP(-13)	-0.029390	0.032574	-0.055221
	(0.04743)	(0.13603)	(0.13281)
	[-0.61959]	[0.23946]	[-0.41579]

DDP(-14)	0.041327	0.039242	-0.072684
	(0.04729)	(0.13563)	(0.13242)
	[0.87381]	[0.28932]	[-0.54888]
DDP(-15)	0.097648	-0.143245	-0.119432
	(0.04719)	(0.13534)	(0.13214)
	[2.06911]	[-1.05838]	[-0.90383]
DDP(-16)	0.039619	-0.000247	-0.004076
	(0.04726)	(0.13552)	(0.13232)
	[0.83837]	[-0.00182]	[-0.03081]
DDP(-17)	0.007681	0.054345	0.023403
	(0.04703)	(0.13488)	(0.13169)
	[0.16331]	[0.40291]	[0.17772]
PWP(-1)	0.008162	-0.014683	0.038087
	(0.01867)	(0.05353)	(0.05226)
	[0.43728]	[-0.27427]	[0.72873]
PWP(-2)	0.021558	0.077555	0.046820
	(0.01863)	(0.05342)	(0.05216)
	[1.15730]	[1.45179]	[0.89769]
PWP(-3)	0.037634	0.018568	0.049306
	(0.01847)	(0.05297)	(0.05172)
	[2.03743]	[0.35052]	[0.95334]
PWP(-4)	0.029730	0.007302	-0.010424
	(0.01817)	(0.05210)	(0.05087)
	[1.63645]	[0.14014]	[-0.20493]
PWP(-5)	0.028290	0.042732	-0.073884
	(0.01816)	(0.05208)	(0.05085)
	[1.55783]	[0.82052]	[-1.45308]
PWP(-6)	0.034802	0.011375	-0.062190
	(0.01817)	(0.05211)	(0.05087)
	[1.91536]	[0.21830]	[-1.22242]
PWP(-7)	0.012721	0.029734	-0.051829
	(0.01823)	(0.05228)	(0.05104)
	[0.69780]	[0.56874]	[-1.01539]
PWP(-8)	0.006732	0.146698	-0.002072
	(0.01808)	(0.05185)	(0.05062)
	[0.37234]	[2.82936]	[-0.04093]
PWP(-9)	-0.004135	-0.036141	-0.086816
	(0.01829)	(0.05245)	(0.05121)
	[-0.22609]	[-0.68901]	[-1.69521]
PWP(-10)	0.025327	0.031798	-0.162142
	(0.01801)	(0.05164)	(0.05042)
	[1.40652]	[0.61575]	[-3.21591]
PWP(-11)	0.031673	0.007797	-0.083847
	(0.01822)	(0.05225)	(0.05101)
	[1.73846]	[0.14923]	[-1.64367]
PWP(-12)	0.004114	0.034109	-0.015274

	(0.01834)	(0.05258)	(0.05134)
	[0.22437]	[0.64869]	[-0.29752]
PWP(-13)	0.009815	0.099809	0.036584
	(0.01816)	(0.05209)	(0.05085)
	[0.54042]	[1.91626]	[0.71942]
PWP(-14)	0.011015	-0.004047	-0.061195
	(0.01815)	(0.05204)	(0.05081)
	[0.60700]	[-0.07776]	[-1.20442]
PWP(-15)	-0.007217	-0.088355	-0.019784
	(0.01804)	(0.05173)	(0.05051)
	[-0.40005]	[-1.70788]	[-0.39169]
PWP(-16)	0.024583	0.064895	-0.009121
	(0.01808)	(0.05186)	(0.05063)
	[1.35956]	[1.25147]	[-0.18016]
PWP(-17)	0.008003	0.127921	-0.027909
	(0.01800)	(0.05161)	(0.05039)
	[0.44474]	[2.47865]	[-0.55389]
NWP(-1)	0.001825	0.015472	0.001972
	(0.01937)	(0.05554)	(0.05423)
	[0.09421]	[0.27856]	[0.03637]
NWP(-2)	-0.018179	-0.042082	-0.054367
	(0.01935)	(0.05548)	(0.05417)
	[-0.93971]	[-0.75852]	[-1.00370]
NWP(-3)	0.020978	0.053478	0.020269
	(0.01927)	(0.05527)	(0.05396)
	[1.08849]	[0.96758]	[0.37562]
NWP(-4)	0.014610	-0.067737	-0.018343
	(0.01925)	(0.05520)	(0.05390)
	[0.75901]	[-1.22704]	[-0.34033]
NWP(-5)	0.012805	-0.100025	-0.004557
	(0.01925)	(0.05522)	(0.05391)
	[0.66502]	[-1.81144]	[-0.08453]
NWP(-6)	0.030539	-0.025653	0.011175
	(0.01928)	(0.05530)	(0.05399)
	[1.58366]	[-0.46385]	[0.20697]
NWP(-7)	0.037839	0.089797	0.053460
	(0.01919)	(0.05504)	(0.05373)
	[1.97174]	[1.63163]	[0.99493]
NWP(-8)	0.028938	-0.178453	0.011023
	(0.01870)	(0.05362)	(0.05236)
	[1.54760]	[-3.32781]	[0.21054]
NWP(-9)	0.059365	-0.019102	-0.001928
	(0.01890)	(0.05420)	(0.05292)
	[3.14083]	[-0.35241]	[-0.03644]
NWP(-10)	0.042760	-0.000834	0.065996
	(0.01905)	(0.05462)	(0.05333)
	[2.24507]	[-0.01527]	[1.23754]

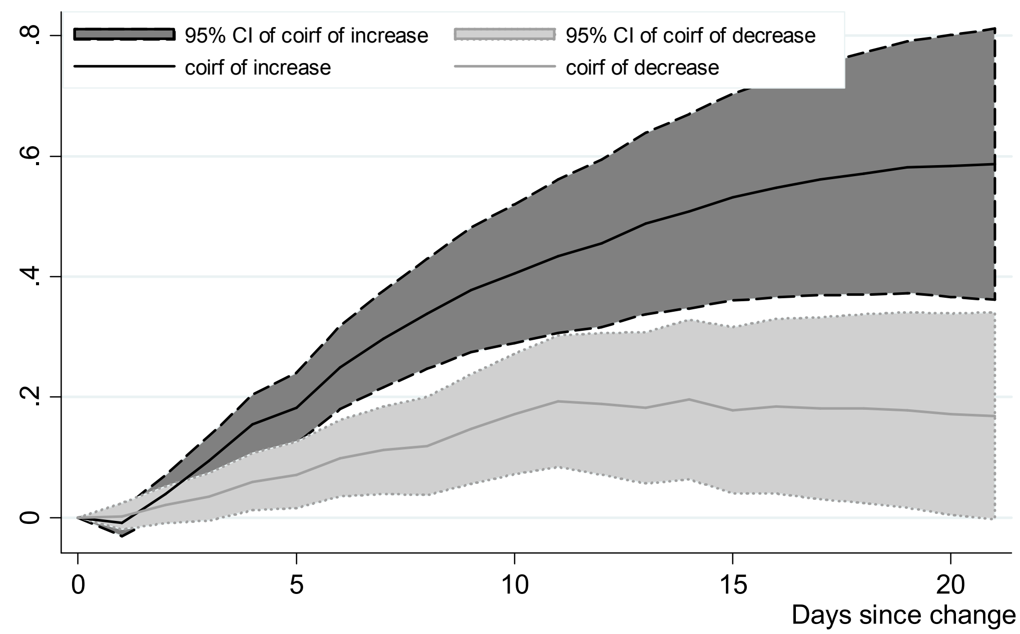
NWP(-11)	0.034215	-0.027213	0.067738
	(0.01891)	(0.05422)	(0.05293)
	[1.80982]	[-0.50192]	[1.27967]
NWP(-12)	0.007432	0.021215	0.076385
	(0.01892)	(0.05425)	(0.05297)
	[0.39283]	[0.39103]	[1.44207]
NWP(-13)	-0.005927	-0.028863	0.016252
	(0.01890)	(0.05420)	(0.05291)
	[-0.31363]	[-0.53255]	[0.30714]
NWP(-14)	0.001485	0.005063	0.069986
	(0.01888)	(0.05416)	(0.05288)
	[0.07863]	[0.09348]	[1.32360]
NWP(-15)	0.003594	-0.090524	-0.026641
	(0.01880)	(0.05392)	(0.05264)
	[0.19117]	[-1.67883]	[-0.50606]
NWP(-16)	-0.013926	-0.029412	0.020167
	(0.01870)	(0.05364)	(0.05237)
	[-0.74462]	[-0.54835]	[0.38511]
NWP(-17)	0.007889	-0.078124	0.025355
	(0.01872)	(0.05370)	(0.05243)
	[0.42131]	[-1.45489]	[0.48364]
RD(-1)	-0.000732	-0.000850	0.002151
	(0.00272)	(0.00780)	(0.00761)
	[-0.26928]	[-0.10904]	[0.28254]
R-squared	0.225694	0.098225	0.085281
Adj. R-squared	0.134283	-0.008234	-0.022706
Sum sq. resids	47.68168	392.1572	373.8102
S.E. equation	0.332226	0.952770	0.930216
F-statistic	2.469000	0.922652	0.789734
Log likelihood	-125.9221	-635.8441	-624.2488
Akaike AIC	0.735215	2.842331	2.794416
Schwarz SC	1.184530	3.291646	3.243731
Mean dependent	0.059653	0.673927	-0.586724
S.D. dependent	0.357064	0.948872	0.919832

Determinant resid covariance (dof adj.)	0.068040
Determinant resid covariance	0.048382
Log likelihood	-1327.369
Akaike information criterion	6.129623
Schwarz criterion	7.477568

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	-.009219	-.031117	.01268	.001911	-.019848	.023671
2	.039202	.007688	.070716	.021357	-.009449	.052162
3	.094431	.053594	.135268	.034364	-.005152	.073881
4	.154612	.104418	.204806	.059624	.012035	.107213
5	.181824	.123171	.240478	.070975	.015904	.126045
6	.248893	.179678	.318109	.098442	.035085	.1618
7	.296856	.216617	.377096	.111771	.039133	.18441
8	.338141	.246714	.429569	.118842	.037204	.20048
9	.378043	.274662	.481424	.14687	.055917	.237823
10	.405063	.289869	.520257	.171928	.071955	.271901
11	.433815	.306433	.561197	.19309	.083874	.302307
12	.455404	.3162	.594609	.188679	.070835	.306523
13	.488087	.337734	.638439	.182148	.056521	.307774
14	.508568	.347213	.669922	.196021	.063415	.328627
15	.532011	.360634	.703388	.178153	.040119	.316188
16	.547104	.365283	.728925	.184879	.039721	.330038
17	.560969	.369411	.752527	.181434	.030367	.332501
18	.57081	.370001	.771618	.180819	.024002	.337635
19	.581464	.372103	.790825	.178403	.016177	.340629
20	.583659	.366099	.80122	.171495	.00418	.33881
21	.586512	.361387	.811638	.168934	-.002944	.340811

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



S4 - Gasoline

B6: GASOLINE SEGMENTS

Gasoline 1: 03/01/2000 to 16/03/2003

Vector Autoregression Estimates

Sample (adjusted): 1/25/2000 3/16/2003
Included observations: 792 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	0.157506	0.017934	-0.053704
	(0.03632)	(0.07292)	(0.06845)
	[4.33691]	[0.24595]	[-0.78458]
DGP(-2)	0.008104	0.071506	0.060560
	(0.03660)	(0.07347)	(0.06897)
	[0.22145]	[0.97320]	[0.87803]
DGP(-3)	0.029029	-0.011763	-0.039069
	(0.03650)	(0.07329)	(0.06880)
	[0.79528]	[-0.16051]	[-0.56790]
DGP(-4)	0.010075	0.048116	-0.003362
	(0.03641)	(0.07310)	(0.06863)
	[0.27670]	[0.65818]	[-0.04899]
DGP(-5)	0.104587	-0.052265	0.059978
	(0.03641)	(0.07310)	(0.06862)
	[2.87239]	[-0.71494]	[0.87400]
DGP(-6)	0.022845	-0.026283	0.065352
	(0.03666)	(0.07360)	(0.06909)
	[0.62320]	[-0.35712]	[0.94592]
DGP(-7)	0.007267	0.123758	-0.005189
	(0.03655)	(0.07339)	(0.06889)
	[0.19881]	[1.68632]	[-0.07532]
DGP(-8)	-0.009259	-0.077896	-0.068610
	(0.03658)	(0.07345)	(0.06895)
	[-0.25308]	[-1.06053]	[-0.99507]
DGP(-9)	-0.028805	-0.078913	-0.022841
	(0.03658)	(0.07345)	(0.06895)
	[-0.78734]	[-1.07435]	[-0.33127]
DGP(-10)	0.029135	0.082438	0.052118
	(0.03646)	(0.07320)	(0.06872)
	[0.79907]	[1.12614]	[0.75842]
DGP(-11)	-0.020737	-0.110000	-0.113571
	(0.03616)	(0.07260)	(0.06815)
	[-0.57350]	[-1.51520]	[-1.66651]
DGP(-12)	0.022171	-0.018721	-0.016617
	(0.03605)	(0.07239)	(0.06795)
	[0.61493]	[-0.25863]	[-0.24455]

DGP(-13)	0.058236	0.115322	0.074289
	(0.03597)	(0.07222)	(0.06780)
	[1.61886]	[1.59671]	[1.09571]
DGP(-14)	0.081619	-0.014276	-0.052471
	(0.03603)	(0.07234)	(0.06791)
	[2.26533]	[-0.19735]	[-0.77270]
DGP(-15)	0.087380	-0.033421	0.061263
	(0.03533)	(0.07092)	(0.06658)
	[2.47359]	[-0.47123]	[0.92016]
PSP(-1)	-0.013576	0.104784	0.020467
	(0.01911)	(0.03838)	(0.03602)
	[-0.71024]	[2.73046]	[0.56814]
PSP(-2)	0.036871	0.011138	-0.094136
	(0.01920)	(0.03855)	(0.03618)
	[1.92048]	[0.28896]	[-2.60156]
PSP(-3)	0.015961	0.090494	-0.033858
	(0.01928)	(0.03871)	(0.03634)
	[0.82784]	[2.33771]	[-0.93172]
PSP(-4)	0.051055	0.037366	-0.050269
	(0.01935)	(0.03886)	(0.03648)
	[2.63789]	[0.96160]	[-1.37809]
PSP(-5)	0.015658	0.007069	0.035812
	(0.01943)	(0.03900)	(0.03661)
	[0.80603]	[0.18126]	[0.97812]
PSP(-6)	0.059919	0.004481	-0.045176
	(0.01939)	(0.03893)	(0.03654)
	[3.09029]	[0.11511]	[-1.23621]
PSP(-7)	0.022277	0.010532	-0.039943
	(0.01943)	(0.03901)	(0.03662)
	[1.14666]	[0.27002]	[-1.09087]
PSP(-8)	0.018960	0.022271	-0.025846
	(0.01942)	(0.03899)	(0.03660)
	[0.97629]	[0.57118]	[-0.70614]
PSP(-9)	0.006526	0.090932	-0.016102
	(0.01939)	(0.03893)	(0.03654)
	[0.33656]	[2.33588]	[-0.44063]
PSP(-10)	-7.80E-05	0.036837	-0.036908
	(0.01944)	(0.03902)	(0.03663)
	[-0.00401]	[0.94404]	[-1.00760]
PSP(-11)	0.013350	0.063733	0.003357
	(0.01943)	(0.03900)	(0.03661)
	[0.68719]	[1.63406]	[0.09168]
PSP(-12)	0.014424	0.038750	-0.036454
	(0.01945)	(0.03906)	(0.03666)
	[0.74147]	[0.99213]	[-0.99426]
PSP(-13)	0.001297	0.003212	-0.073156
	(0.01942)	(0.03899)	(0.03660)

	[0.06679]	[0.08237]	[-1.99869]
PSP(-14)	-0.026190	0.018039	-0.030098
	(0.01944)	(0.03902)	(0.03663)
	[-1.34745]	[0.46225]	[-0.82162]
PSP(-15)	0.002861	0.015939	0.014846
	(0.01930)	(0.03875)	(0.03637)
	[0.14822]	[0.41136]	[0.40817]
NSP(-1)	-0.000782	-0.079665	0.071316
	(0.02083)	(0.04182)	(0.03926)
	[-0.03754]	[-1.90504]	[1.81671]
NSP(-2)	-0.007966	-0.034911	0.104864
	(0.02093)	(0.04202)	(0.03945)
	[-0.38058]	[-0.83075]	[2.65825]
NSP(-3)	0.038856	-0.027127	0.064241
	(0.02099)	(0.04215)	(0.03957)
	[1.85074]	[-0.64354]	[1.62350]
NSP(-4)	0.031168	-0.044289	0.011825
	(0.02107)	(0.04230)	(0.03970)
	[1.47954]	[-1.04712]	[0.29784]
NSP(-5)	0.047978	-0.011055	0.050873
	(0.02106)	(0.04228)	(0.03969)
	[2.27830]	[-0.26146]	[1.28177]
NSP(-6)	-0.022861	-0.010955	0.077681
	(0.02114)	(0.04244)	(0.03984)
	[-1.08140]	[-0.25810]	[1.94970]
NSP(-7)	0.014732	-0.060508	-0.063403
	(0.02120)	(0.04257)	(0.03996)
	[0.69487]	[-1.42148]	[-1.58672]
NSP(-8)	0.021992	0.011714	0.077880
	(0.02120)	(0.04256)	(0.03995)
	[1.03740]	[0.27523]	[1.94924]
NSP(-9)	0.039837	0.019484	0.022298
	(0.02119)	(0.04255)	(0.03994)
	[1.87966]	[0.45790]	[0.55823]
NSP(-10)	0.001097	0.033250	-0.012846
	(0.02125)	(0.04267)	(0.04006)
	[0.05161]	[0.77924]	[-0.32071]
NSP(-11)	0.001718	-0.053373	0.039490
	(0.02120)	(0.04256)	(0.03996)
	[0.08102]	[-1.25395]	[0.98834]
NSP(-12)	0.031639	-0.053452	0.021007
	(0.02119)	(0.04255)	(0.03994)
	[1.49301]	[-1.25631]	[0.52596]
NSP(-13)	0.020956	-0.072464	-0.001815
	(0.02114)	(0.04244)	(0.03984)
	[0.99135]	[-1.70738]	[-0.04555]

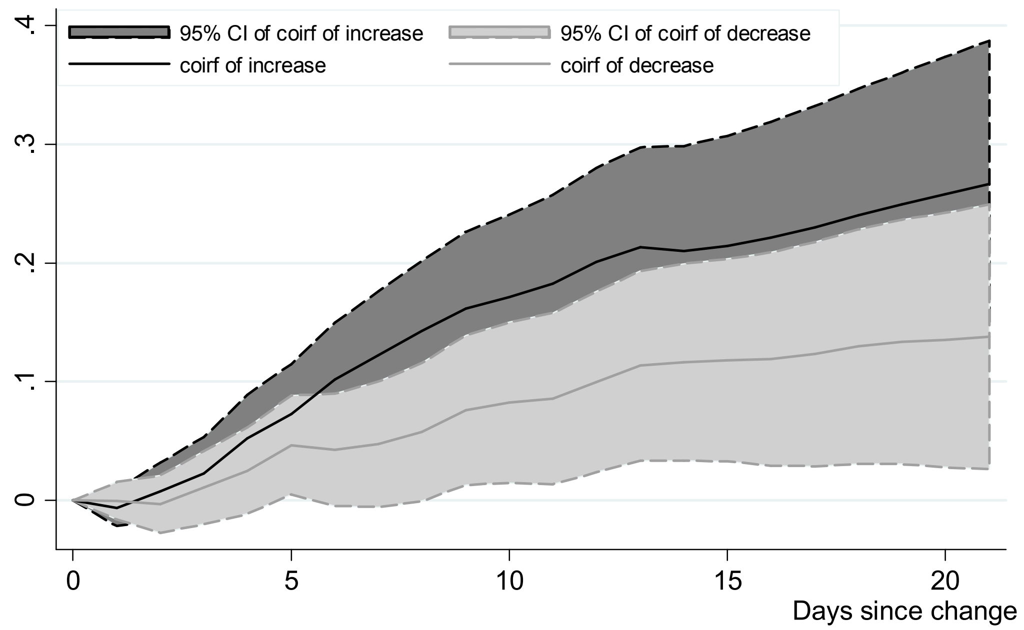
NSP(-14)	-0.009284	-0.001239	0.070011
	(0.02104)	(0.04224)	(0.03965)
	[-0.44132]	[-0.02933]	[1.76573]
NSP(-15)	-0.005087	0.034383	0.007807
	(0.02072)	(0.04161)	(0.03906)
	[-0.24548]	[0.82638]	[0.19990]
RG(-1)	-0.009179	-0.007446	-0.008002
	(0.00348)	(0.00699)	(0.00656)
	[-2.63542]	[-1.06486]	[-1.21907]
R-squared	0.246514	0.018323	0.078907
Adj. R-squared	0.201063	-0.040893	0.023345
Sum sq. resids	38.61933	155.6745	137.1819
S.E. equation	0.227527	0.456814	0.428824
F-statistic	5.423671	0.309424	1.420166
Log likelihood	72.44086	-479.5888	-429.5107
Akaike AIC	-0.066770	1.327244	1.200785
Schwarz SC	0.204732	1.598747	1.472287
Mean dependent	0.009005	0.244952	-0.238229
S.D. dependent	0.254552	0.447751	0.433919

Determinant resid covariance (dof adj.)	0.001827
Determinant resid covariance	0.001527
Log likelihood	-803.5194
Akaike information criterion	2.377574
Schwarz criterion	3.192081

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	-.00611	-.02163	.00941	-.000312	-.016126	.015502
2	.007824	-.016155	.031802	-.003131	-.02735	.021087
3	.022801	-.007854	.053457	.010764	-.019986	.041513
4	.052464	.015839	.089089	.025109	-.011375	.061592
5	.072857	.030747	.114968	.046613	.004868	.088357
6	.101872	.053938	.149806	.042634	-.004622	.08989
7	.122283	.068551	.176014	.047232	-.005617	.100081
8	.142754	.08343	.202078	.057489	-.000619	.115598
9	.161567	.096881	.226253	.076132	.013038	.139225
10	.171214	.101542	.240886	.082423	.014734	.150113
11	.182915	.108294	.257535	.085737	.013566	.157909
12	.200698	.1213	.280097	.099791	.023558	.176024
13	.213584	.129599	.297569	.113545	.033715	.193375
14	.210184	.121744	.298625	.116515	.03367	.199359
15	.214477	.12181	.307144	.118193	.03287	.203515
16	.221302	.123651	.318952	.119074	.029185	.208962
17	.229876	.127612	.332139	.123281	.028857	.217704
18	.240141	.133343	.34694	.12963	.030887	.228372
19	.249173	.137862	.360484	.133545	.030569	.236521
20	.257928	.142017	.373839	.135181	.027951	.242411
21	.266845	.146525	.387165	.137894	.02634	.249449

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



G1

Gasoline 2: 16/3/2003 to 24/8/2005 (G2)

Vector Autoregression Estimates

Sample (adjusted): 4/07/2003 8/24/2005
Included observations: 601 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.042472	0.436496	0.247691
	(0.04211)	(0.17915)	(0.17002)
	[-1.00871]	[2.43650]	[1.45685]
DGP(-2)	0.226686	-0.365494	-0.170883
	(0.04225)	(0.17976)	(0.17059)
	[5.36556]	[-2.03328]	[-1.00169]
DGP(-3)	0.074677	-0.193464	-0.410143
	(0.04337)	(0.18454)	(0.17513)
	[1.72178]	[-1.04837]	[-2.34190]
DGP(-4)	-0.022927	0.181511	0.180939
	(0.04370)	(0.18592)	(0.17645)
	[-0.52469]	[0.97628]	[1.02546]
DGP(-5)	0.217671	0.448492	0.229460
	(0.04373)	(0.18606)	(0.17658)
	[4.97753]	[2.41042]	[1.29946]
DGP(-6)	-0.041553	-0.190757	-0.356102
	(0.04387)	(0.18667)	(0.17716)
	[-0.94708]	[-1.02187]	[-2.01006]

DGP(-7)	-0.077477	-0.008829	-0.097519
	(0.04406)	(0.18745)	(0.17790)
	[-1.75853]	[-0.04710]	[-0.54817]
DGP(-8)	0.012993	0.004001	0.279763
	(0.04411)	(0.18769)	(0.17813)
	[0.29454]	[0.02132]	[1.57059]
DGP(-9)	0.021959	0.286923	0.209860
	(0.04408)	(0.18753)	(0.17798)
	[0.49820]	[1.52997]	[1.17914]
DGP(-10)	0.146039	0.262062	0.149297
	(0.04371)	(0.18596)	(0.17649)
	[3.34128]	[1.40920]	[0.84594]
DGP(-11)	0.014567	-0.084994	0.047201
	(0.04331)	(0.18427)	(0.17488)
	[0.33633]	[-0.46124]	[0.26990]
DGP(-12)	-0.008850	0.017429	-0.015020
	(0.04318)	(0.18373)	(0.17437)
	[-0.20493]	[0.09486]	[-0.08614]
DGP(-13)	-0.045255	-0.110037	-0.107982
	(0.04286)	(0.18234)	(0.17305)
	[-1.05598]	[-0.60347]	[-0.62400]
DGP(-14)	0.039094	-0.396425	-0.469852
	(0.04091)	(0.17407)	(0.16520)
	[0.95554]	[-2.27735]	[-2.84411]
DGP(-15)	0.130468	-0.285732	-0.140021
	(0.04083)	(0.17372)	(0.16487)
	[3.19535]	[-1.64474]	[-0.84928]
PSP(-1)	0.005199	0.070115	0.010253
	(0.01104)	(0.04698)	(0.04459)
	[0.47086]	[1.49234]	[0.22994]
PSP(-2)	0.007529	0.055132	0.001477
	(0.01101)	(0.04683)	(0.04444)
	[0.68403]	[1.17731]	[0.03324]
PSP(-3)	0.042246	0.057858	-0.084247
	(0.01097)	(0.04669)	(0.04431)
	[3.84987]	[1.23923]	[-1.90132]
PSP(-4)	0.024568	0.010359	-0.197462
	(0.01118)	(0.04757)	(0.04514)
	[2.19751]	[0.21779]	[-4.37415]
PSP(-5)	0.015556	0.018284	-0.050782
	(0.01144)	(0.04868)	(0.04620)
	[1.35968]	[0.37561]	[-1.09923]
PSP(-6)	-0.002033	0.100422	-0.077377
	(0.01135)	(0.04828)	(0.04581)
	[-0.17922]	[2.08019]	[-1.68890]
PSP(-7)	0.020907	0.020203	0.018064

	(0.01142)	(0.04861)	(0.04613)
	[1.82994]	[0.41561]	[0.39158]
PSP(-8)	0.011293	-0.007257	-0.047640
	(0.01133)	(0.04822)	(0.04577)
	[0.99633]	[-0.15048]	[-1.04094]
PSP(-9)	0.017036	0.034263	-0.044078
	(0.01140)	(0.04852)	(0.04604)
	[1.49403]	[0.70621]	[-0.95731]
PSP(-10)	0.032752	0.032907	0.100564
	(0.01137)	(0.04838)	(0.04591)
	[2.88057]	[0.68024]	[2.19041]
PSP(-11)	0.010340	-0.057441	-0.158884
	(0.01150)	(0.04891)	(0.04642)
	[0.89938]	[-1.17433]	[-3.42267]
PSP(-12)	0.002894	-0.019977	-0.044731
	(0.01158)	(0.04927)	(0.04676)
	[0.24990]	[-0.40543]	[-0.95652]
PSP(-13)	0.005596	0.052347	0.006826
	(0.01144)	(0.04869)	(0.04621)
	[0.48901]	[1.07514]	[0.14773]
PSP(-14)	0.002562	0.051464	-0.060220
	(0.01131)	(0.04812)	(0.04567)
	[0.22648]	[1.06940]	[-1.31856]
PSP(-15)	0.008015	0.037183	-0.023447
	(0.01134)	(0.04826)	(0.04580)
	[0.70659]	[0.77044]	[-0.51192]
NSP(-1)	-0.002380	-0.013131	0.019062
	(0.01158)	(0.04925)	(0.04674)
	[-0.20559]	[-0.26662]	[0.40783]
NSP(-2)	0.017187	-0.042761	0.031542
	(0.01149)	(0.04890)	(0.04640)
	[1.49555]	[-0.87453]	[0.67971]
NSP(-3)	-0.002120	-0.077713	0.033022
	(0.01151)	(0.04896)	(0.04647)
	[-0.18420]	[-1.58725]	[0.71067]
NSP(-4)	0.029492	-0.065119	0.057063
	(0.01154)	(0.04911)	(0.04661)
	[2.55510]	[-1.32597]	[1.22433]
NSP(-5)	0.014072	0.011068	0.011837
	(0.01162)	(0.04946)	(0.04694)
	[1.21063]	[0.22379]	[0.25219]
NSP(-6)	0.051835	-0.003640	0.039781
	(0.01158)	(0.04929)	(0.04678)
	[4.47449]	[-0.07384]	[0.85043]
NSP(-7)	0.027174	-0.033184	-0.027114
	(0.01177)	(0.05008)	(0.04753)
	[2.30854]	[-0.66258]	[-0.57045]

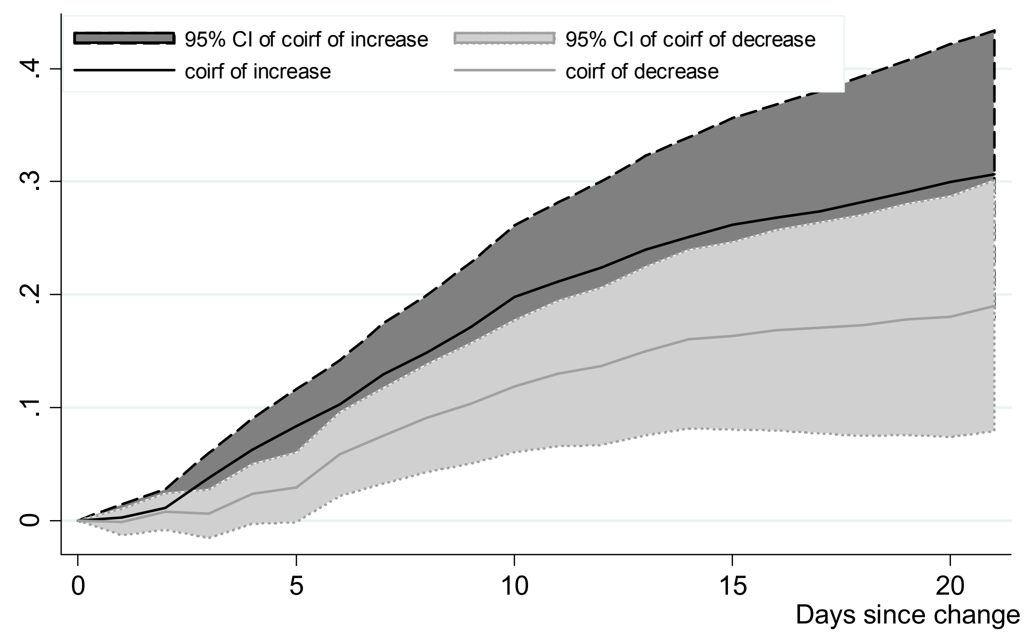
NSP(-8)	0.017489	-0.057724	0.055400
	(0.01177)	(0.05006)	(0.04751)
	[1.48643]	[-1.15309]	[1.16611]
NSP(-9)	0.008229	-0.046341	-0.028647
	(0.01182)	(0.05028)	(0.04772)
	[0.69637]	[-0.92169]	[-0.60036]
NSP(-10)	0.016747	-0.035834	-0.096677
	(0.01167)	(0.04963)	(0.04710)
	[1.43562]	[-0.72200]	[-2.05247]
NSP(-11)	0.011213	0.006577	0.071756
	(0.01167)	(0.04964)	(0.04711)
	[0.96106]	[0.13249]	[1.52313]
NSP(-12)	0.001718	-0.002241	-0.046303
	(0.01145)	(0.04872)	(0.04624)
	[0.15003]	[-0.04599]	[-1.00143]
NSP(-13)	0.022124	-0.075694	0.035976
	(0.01135)	(0.04827)	(0.04581)
	[1.95009]	[-1.56809]	[0.78531]
NSP(-14)	0.013003	-0.068895	0.032937
	(0.01130)	(0.04809)	(0.04564)
	[1.15049]	[-1.43270]	[0.72172]
NSP(-15)	-0.005287	-0.054785	0.023839
	(0.01130)	(0.04810)	(0.04565)
	[-0.46771]	[-1.13901]	[0.52224]
RG(-1)	-0.007195	-0.001580	-0.014218
	(0.00313)	(0.01333)	(0.01265)
	[-2.29636]	[-0.11852]	[-1.12383]
R-squared	0.467916	0.050952	0.149882
Adj. R-squared	0.424775	-0.025998	0.080953
Sum sq. resids	12.68638	229.6603	206.8479
S.E. equation	0.151190	0.643275	0.610491
F-statistic	10.84599	0.662140	2.174451
Log likelihood	306.5668	-563.7029	-532.2654
Akaike AIC	-0.867111	2.028962	1.924344
Schwarz SC	-0.530446	2.365626	2.261009
Mean dependent	0.025636	0.431223	-0.370226
S.D. dependent	0.199344	0.635072	0.636811

Determinant resid covariance (dof adj.)	0.002921
Determinant resid covariance	0.002300
Log likelihood	-732.8799
Akaike information criterion	2.898103
Schwarz criterion	3.908096

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.00264	-.009221	.014501	-.001279	-.012996	.010438
2	.011333	-.005242	.027909	.007951	-.008313	.024216
3	.037624	.01543	.059819	.006088	-.015416	.027591
4	.06289	.035238	.090541	.023543	-.002902	.049989
5	.083386	.050548	.116224	.029479	-.001546	.060504
6	.10261	.063284	.141937	.05878	.021695	.095865
7	.129387	.08419	.174584	.075026	.032639	.117412
8	.148612	.0975	.199725	.090681	.042878	.138483
9	.171291	.114135	.228447	.103633	.050316	.15695
10	.197929	.134767	.261091	.118764	.060315	.177214
11	.211443	.141349	.281538	.130158	.065705	.194611
12	.22376	.147309	.300211	.136549	.066772	.206326
13	.239913	.157211	.322616	.150026	.075371	.22468
14	.250892	.1623	.339484	.160641	.081502	.23978
15	.261798	.167505	.356092	.163596	.080472	.24672
16	.267837	.167283	.36839	.168394	.079694	.257094
17	.273678	.167419	.379936	.170499	.077075	.263923
18	.282021	.170361	.393681	.172866	.07485	.270882
19	.29044	.173703	.407178	.178109	.075708	.280511
20	.299809	.17798	.421637	.180576	.073899	.287252
21	.30664	.179734	.433545	.1901	.079042	.301159

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



G2

Gasoline 3: 24/8/2005 to 12/5/2008 (G3)

Vector Autoregression Estimates

Sample (adjusted): 9/18/2005 5/12/2008
Included observations: 671 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.099676	0.133123	-0.080108
	(0.03969)	(0.20611)	(0.18457)
	[-2.51126]	[0.64589]	[-0.43402]
DGP(-2)	0.172041	0.132294	0.066691
	(0.03985)	(0.20694)	(0.18531)
	[4.31709]	[0.63930]	[0.35988]
DGP(-3)	0.116758	0.087039	-0.072981
	(0.04039)	(0.20975)	(0.18784)
	[2.89047]	[0.41496]	[-0.38853]
DGP(-4)	0.007372	-0.135207	-0.033806
	(0.04045)	(0.21005)	(0.18810)
	[0.18224]	[-0.64369]	[-0.17972]
DGP(-5)	0.272466	0.006092	-0.010367
	(0.04001)	(0.20776)	(0.18605)
	[6.80991]	[0.02932]	[-0.05572]
DGP(-6)	0.014210	-0.021244	0.300926
	(0.04122)	(0.21406)	(0.19169)
	[0.34470]	[-0.09924]	[1.56982]
DGP(-7)	0.036384	-0.155920	-0.001576
	(0.04111)	(0.21349)	(0.19118)
	[0.88498]	[-0.73035]	[-0.00824]
DGP(-8)	0.025072	0.193404	-0.112716
	(0.04080)	(0.21186)	(0.18972)
	[0.61450]	[0.91289]	[-0.59411]
DGP(-9)	0.089285	-0.022527	-0.344224
	(0.04051)	(0.21034)	(0.18836)
	[2.20425]	[-0.10710]	[-1.82749]
DGP(-10)	-0.002115	-0.283696	-0.156272
	(0.03627)	(0.18834)	(0.16866)
	[-0.05830]	[-1.50630]	[-0.92655]
DGP(-11)	-0.060283	-0.135097	-0.126884
	(0.03479)	(0.18066)	(0.16179)
	[-1.73269]	[-0.74779]	[-0.78427]
DGP(-12)	-0.061946	0.273424	0.498545
	(0.03393)	(0.17619)	(0.15778)
	[-1.82570]	[1.55190]	[3.15978]

DGP(-13)	-0.022320	0.075255	-0.038708
	(0.03363)	(0.17461)	(0.15637)
	[-0.66378]	[0.43099]	[-0.24754]
DGP(-14)	0.011694	0.248287	0.276460
	(0.03248)	(0.16866)	(0.15104)
	[0.36003]	[1.47210]	[1.83038]
DGP(-15)	0.076555	-0.094311	-0.238682
	(0.03196)	(0.16596)	(0.14862)
	[2.39537]	[-0.56829]	[-1.60604]
PSP(-1)	0.016002	0.036024	0.029412
	(0.00858)	(0.04457)	(0.03992)
	[1.86416]	[0.80819]	[0.73685]
PSP(-2)	0.037271	0.029442	-0.004115
	(0.00854)	(0.04432)	(0.03969)
	[4.36680]	[0.66429]	[-0.10368]
PSP(-3)	0.029434	0.034538	-0.067626
	(0.00864)	(0.04486)	(0.04017)
	[3.40726]	[0.76996]	[-1.68347]
PSP(-4)	0.020224	0.074971	0.016299
	(0.00873)	(0.04533)	(0.04059)
	[2.31678]	[1.65391]	[0.40153]
PSP(-5)	0.028785	0.046117	-0.078209
	(0.00897)	(0.04656)	(0.04169)
	[3.21050]	[0.99055]	[-1.87586]
PSP(-6)	0.011096	0.019710	-0.019603
	(0.00909)	(0.04718)	(0.04225)
	[1.22136]	[0.41778]	[-0.46400]
PSP(-7)	0.013215	0.047489	-0.080859
	(0.00906)	(0.04703)	(0.04212)
	[1.45898]	[1.00968]	[-1.91976]
PSP(-8)	0.019171	0.035563	-0.057048
	(0.00910)	(0.04724)	(0.04230)
	[2.10743]	[0.75287]	[-1.34862]
PSP(-9)	0.006435	-0.005107	-0.047694
	(0.00911)	(0.04730)	(0.04236)
	[0.70651]	[-0.10797]	[-1.12606]
PSP(-10)	0.012262	-0.010512	-0.052102
	(0.00911)	(0.04733)	(0.04239)
	[1.34528]	[-0.22209]	[-1.22922]
PSP(-11)	-0.015591	-0.005406	-0.001613
	(0.00897)	(0.04657)	(0.04170)
	[-1.73858]	[-0.11608]	[-0.03868]
PSP(-12)	-0.014103	0.092397	0.012910
	(0.00884)	(0.04592)	(0.04113)
	[-1.59469]	[2.01197]	[0.31391]
PSP(-13)	-0.005044	0.071354	-0.017301
	(0.00875)	(0.04544)	(0.04069)

	[-0.57639]	[1.57038]	[-0.42519]
PSP(-14)	0.019678	0.057336	0.035837
	(0.00871)	(0.04523)	(0.04051)
	[2.25914]	[1.26762]	[0.88476]
PSP(-15)	-0.001108	0.071450	0.028058
	(0.00869)	(0.04513)	(0.04041)
	[-0.12755]	[1.58332]	[0.69429]
NSP(-1)	-0.008120	-0.001380	0.035879
	(0.00950)	(0.04930)	(0.04415)
	[-0.85524]	[-0.02798]	[0.81260]
NSP(-2)	0.003444	-0.021435	0.013658
	(0.00944)	(0.04904)	(0.04391)
	[0.36466]	[-0.43711]	[0.31103]
NSP(-3)	0.013932	-0.052104	0.032048
	(0.00941)	(0.04885)	(0.04374)
	[1.48107]	[-1.06669]	[0.73264]
NSP(-4)	0.026243	-0.041157	0.088798
	(0.00927)	(0.04816)	(0.04312)
	[2.82984]	[-0.85468]	[2.05914]
NSP(-5)	0.024446	-0.066807	-0.026112
	(0.00936)	(0.04861)	(0.04353)
	[2.61158]	[-1.37444]	[-0.59988]
NSP(-6)	0.030917	0.019286	0.064808
	(0.00937)	(0.04868)	(0.04359)
	[3.29812]	[0.39620]	[1.48672]
NSP(-7)	0.021223	-0.062226	0.054041
	(0.00937)	(0.04864)	(0.04356)
	[2.26550]	[-1.27923]	[1.24058]
NSP(-8)	0.007691	-0.026691	0.061332
	(0.00944)	(0.04901)	(0.04389)
	[0.81487]	[-0.54462]	[1.39750]
NSP(-9)	0.007565	0.004842	0.120432
	(0.00938)	(0.04869)	(0.04360)
	[0.80688]	[0.09946]	[2.76229]
NSP(-10)	0.004410	0.041566	0.042395
	(0.00944)	(0.04904)	(0.04392)
	[0.46691]	[0.84752]	[0.96528]
NSP(-11)	0.009648	-0.096278	-0.013668
	(0.00935)	(0.04856)	(0.04348)
	[1.03178]	[-1.98285]	[-0.31435]
NSP(-12)	0.009197	-0.028948	0.004422
	(0.00934)	(0.04848)	(0.04341)
	[0.98523]	[-0.59717]	[0.10186]
NSP(-13)	0.011265	-0.017754	0.028191
	(0.00917)	(0.04759)	(0.04262)
	[1.22905]	[-0.37304]	[0.66143]

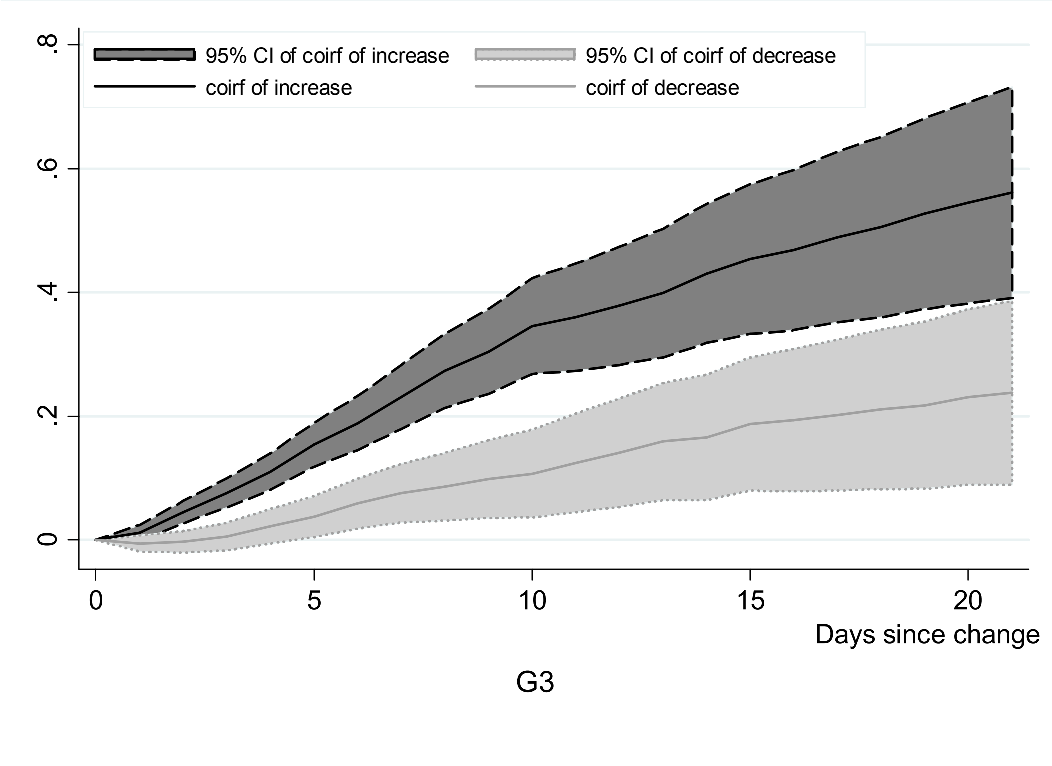
NSP(-14)	-0.006117	-0.067535	0.045571
	(0.00913)	(0.04740)	(0.04245)
	[-0.67009]	[-1.42478]	[1.07358]
NSP(-15)	0.016208	0.049000	0.078057
	(0.00907)	(0.04708)	(0.04216)
	[1.78759]	[1.04070]	[1.85126]
RG(-1)	-0.002804	-0.003837	-0.000301
	(0.00223)	(0.01159)	(0.01038)
	[-1.25623]	[-0.33112]	[-0.02903]
R-squared	0.541456	0.048936	0.098189
Adj. R-squared	0.508441	-0.019541	0.033258
Sum sq. resids	19.76424	532.9257	427.3789
S.E. equation	0.177828	0.923407	0.826926
F-statistic	16.40020	0.714638	1.512217
Log likelihood	230.4945	-874.8129	-800.7643
Akaike AIC	-0.549909	2.744599	2.523888
Schwarz SC	-0.240813	3.053695	2.832984
Mean dependent	0.023374	0.619933	-0.556111
S.D. dependent	0.253637	0.914515	0.841030

Determinant resid covariance (dof adj.)	0.014923
Determinant resid covariance	0.012059
Log likelihood	-1374.111
Akaike information criterion	4.507038
Schwarz criterion	5.434325

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

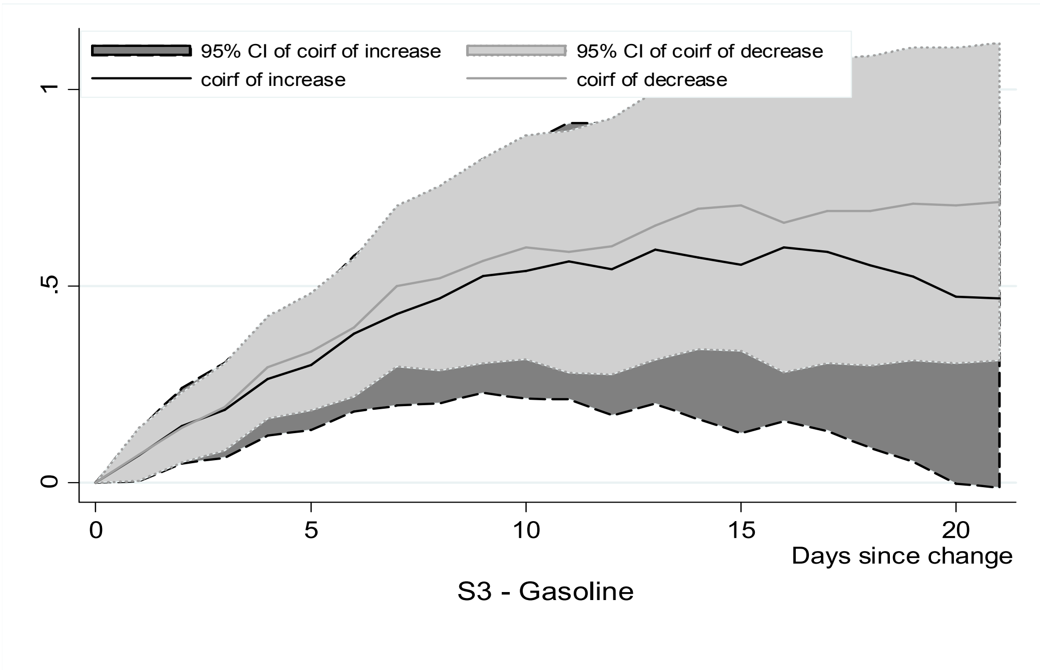
step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.011437	-.001678	.024552	-.005833	-.018739	.007072
2	.044882	.026877	.062887	-.003003	-.020304	.014298
3	.076199	.052452	.099945	.00542	-.017013	.027853
4	.110274	.080754	.139794	.022193	-.00576	.050145
5	.153905	.118325	.189484	.037739	.004566	.070911
6	.188906	.14518	.232633	.058791	.018356	.099227
7	.23092	.179455	.282385	.075549	.028227	.122871
8	.272976	.213064	.332889	.085951	.031124	.140778
9	.304635	.23618	.37309	.098538	.03568	.161396
10	.34573	.268249	.423211	.107303	.03622	.178386
11	.359775	.273016	.446535	.124597	.044846	.204348
12	.378247	.282762	.473732	.14098	.053444	.228516
13	.39888	.294807	.502954	.159008	.064301	.253715
14	.430854	.318512	.543196	.165762	.064479	.267044
15	.45372	.332785	.574655	.187305	.079626	.294984
16	.468414	.33893	.597899	.193651	.078333	.308969
17	.489524	.351755	.627293	.202035	.079987	.324083
18	.505802	.359762	.651843	.211257	.082484	.34003
19	.527382	.373117	.681646	.217833	.082522	.353143
20	.544826	.382295	.707357	.231181	.089376	.372986
21	.561596	.390819	.732373	.2379	.089403	.386397

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



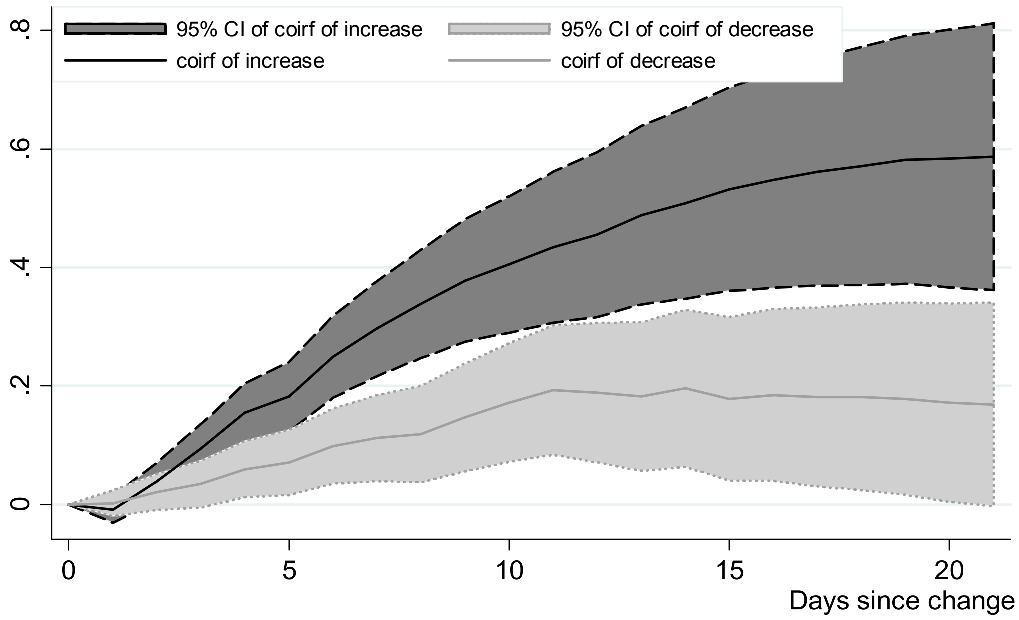
Gasoline 4: 12/5/2008 to 5/1/2009 (G4)

See Segment 3



Gasoline 5: 5/1/2009 to 31/12/2010 (G5)

See S4



S4 - Gasoline

B7: HARMONISED SEGMENTS

Segment 1: 03/01/2000 to 14/03/2001

Diesel

Vector Autoregression Estimates

Sample (adjusted): 1/27/2000 3/14/2001
Included observations: 286 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.096230	0.086277	0.058143
	(0.06605)	(0.07103)	(0.07194)
	[1.45683]	[1.21464]	[0.80827]
DDP(-2)	-0.103573	0.039146	-0.076947
	(0.06667)	(0.07170)	(0.07261)
	[-1.55346]	[0.54600]	[-1.05974]
DDP(-3)	-0.007460	-0.016692	-0.077978
	(0.06746)	(0.07254)	(0.07346)
	[-0.11059]	[-0.23012]	[-1.06149]
DDP(-4)	0.012400	0.085614	0.056444
	(0.06930)	(0.07452)	(0.07547)
	[0.17892]	[1.14881]	[0.74787]
DDP(-5)	0.027606	-0.052400	-0.041698
	(0.07039)	(0.07569)	(0.07665)
	[0.39221]	[-0.69230]	[-0.54398]
DDP(-6)	0.068473	0.027466	0.273119
	(0.09641)	(0.10367)	(0.10499)
	[0.71026]	[0.26494]	[2.60142]
DDP(-7)	0.090578	-0.086486	-0.120434
	(0.09716)	(0.10448)	(0.10581)
	[0.93222]	[-0.82775]	[-1.13816]
DDP(-8)	-0.040713	0.092672	-0.005064

	(0.09675)	(0.10404)	(0.10537)
	[-0.42079]	[0.89072]	[-0.04806]
DDP(-9)	0.041520	-0.115924	-0.153022
	(0.09608)	(0.10332)	(0.10464)
	[0.43213]	[-1.12198]	[-1.46241]
DDP(-10)	0.043483	0.012816	-0.159686
	(0.09518)	(0.10235)	(0.10365)
	[0.45687]	[0.12522]	[-1.54062]
DDP(-11)	-0.086639	-0.105105	-0.055182
	(0.09576)	(0.10297)	(0.10428)
	[-0.90477]	[-1.02072]	[-0.52916]
DDP(-12)	0.023035	0.111572	-0.012644
	(0.09469)	(0.10182)	(0.10312)
	[0.24327]	[1.09573]	[-0.12261]
DDP(-13)	-0.005004	0.023707	-0.081740
	(0.09435)	(0.10146)	(0.10275)
	[-0.05304]	[0.23367]	[-0.79553]
DDP(-14)	0.060924	0.015477	0.086057
	(0.09393)	(0.10100)	(0.10229)
	[0.64863]	[0.15323]	[0.84131]
DDP(-15)	0.043874	0.030117	-0.111839
	(0.09328)	(0.10030)	(0.10158)
	[0.47036]	[0.30025]	[-1.10097]
DDP(-16)	0.025452	-0.000287	0.204675
	(0.09276)	(0.09975)	(0.10102)
	[0.27438]	[-0.00287]	[2.02601]
DDP(-17)	0.051021	-0.287684	-0.041672
	(0.09175)	(0.09866)	(0.09991)
	[0.55611]	[-2.91596]	[-0.41708]
PWP(-1)	-0.015930	-0.059047	0.007155
	(0.06656)	(0.07158)	(0.07249)
	[-0.23932]	[-0.82491]	[0.09870]
PWP(-2)	-0.110305	0.138801	-0.038583
	(0.06628)	(0.07128)	(0.07218)
	[-1.66417]	[1.94738]	[-0.53451]
PWP(-3)	0.082433	0.103114	-0.106538
	(0.06740)	(0.07247)	(0.07340)
	[1.22309]	[1.42275]	[-1.45151]
PWP(-4)	-0.067438	0.108419	-0.091222
	(0.06693)	(0.07198)	(0.07289)
	[-1.00753]	[1.50631]	[-1.25145]
PWP(-5)	-0.030674	0.005568	-0.037782
	(0.06744)	(0.07252)	(0.07345)
	[-0.45481]	[0.07677]	[-0.51440]
PWP(-6)	0.156995	0.054184	-0.100255
	(0.06636)	(0.07136)	(0.07227)
	[2.36573]	[0.75928]	[-1.38721]

PWP(-7)	0.016825	0.041657	0.052296
	(0.06744)	(0.07252)	(0.07344)
	[0.24950]	[0.57446]	[0.71210]
PWP(-8)	0.096917	-0.007387	0.085875
	(0.06746)	(0.07254)	(0.07346)
	[1.43672]	[-0.10184]	[1.16895]
PWP(-9)	0.052489	-0.035181	-0.112373
	(0.06766)	(0.07276)	(0.07368)
	[0.77577]	[-0.48354]	[-1.52505]
PWP(-10)	-0.044454	-0.033624	-0.062770
	(0.06786)	(0.07298)	(0.07390)
	[-0.65506]	[-0.46076]	[-0.84934]
PWP(-11)	0.151332	0.034850	-0.048398
	(0.06797)	(0.07309)	(0.07402)
	[2.22657]	[0.47684]	[-0.65387]
PWP(-12)	0.030170	0.071619	-0.120094
	(0.06867)	(0.07384)	(0.07478)
	[0.43938]	[0.96993]	[-1.60597]
PWP(-13)	-0.052541	0.057021	-0.030688
	(0.06921)	(0.07442)	(0.07537)
	[-0.75916]	[0.76617]	[-0.40716]
PWP(-14)	-0.034921	-0.016824	-0.078789
	(0.06872)	(0.07390)	(0.07484)
	[-0.50815]	[-0.22767]	[-1.05277]
PWP(-15)	0.035623	-0.059922	-0.099529
	(0.06888)	(0.07406)	(0.07501)
	[0.51721]	[-0.80905]	[-1.32692]
PWP(-16)	0.038044	0.083235	0.143088
	(0.06868)	(0.07386)	(0.07480)
	[0.55392]	[1.12699]	[1.91303]
PWP(-17)	-0.028106	0.019350	-0.008232
	(0.06875)	(0.07393)	(0.07487)
	[-0.40883]	[0.26175]	[-0.10996]
NWP(-1)	0.037865	0.135353	0.020534
	(0.06735)	(0.07242)	(0.07335)
	[0.56221]	[1.86889]	[0.27996]
NWP(-2)	0.112917	-0.114525	-0.060972
	(0.06635)	(0.07135)	(0.07226)
	[1.70183]	[-1.60514]	[-0.84381]
NWP(-3)	0.015437	-0.027453	0.023349
	(0.06548)	(0.07042)	(0.07131)
	[0.23574]	[-0.38987]	[0.32742]
NWP(-4)	0.073217	-0.011793	0.067597
	(0.06509)	(0.06999)	(0.07089)
	[1.12485]	[-0.16849]	[0.95361]
NWP(-5)	0.101810	-0.080237	0.003925

	(0.06513)	(0.07004)	(0.07093)
	[1.56310]	[-1.14558]	[0.05533]
NWP(-6)	-0.090910	-0.006141	-0.022557
	(0.06468)	(0.06956)	(0.07044)
	[-1.40543]	[-0.08829]	[-0.32021]
NWP(-7)	0.002785	0.009311	0.083546
	(0.06454)	(0.06940)	(0.07028)
	[0.04315]	[0.13417]	[1.18868]
NWP(-8)	-0.016202	-0.069141	-0.069085
	(0.06433)	(0.06918)	(0.07006)
	[-0.25185]	[-0.99943]	[-0.98606]
NWP(-9)	0.069502	0.022027	0.011673
	(0.06353)	(0.06832)	(0.06919)
	[1.09400]	[0.32243]	[0.16871]
NWP(-10)	-0.015049	0.010696	0.039221
	(0.06362)	(0.06841)	(0.06928)
	[-0.23657]	[0.15635]	[0.56613]
NWP(-11)	-0.043918	-0.046591	0.043180
	(0.06334)	(0.06812)	(0.06898)
	[-0.69331]	[-0.68399]	[0.62594]
NWP(-12)	0.008424	-0.161052	0.096657
	(0.06229)	(0.06698)	(0.06783)
	[0.13524]	[-2.40449]	[1.42494]
NWP(-13)	-0.007524	-0.089275	-0.028179
	(0.06294)	(0.06768)	(0.06854)
	[-0.11954]	[-1.31907]	[-0.41112]
NWP(-14)	0.099073	-0.018497	0.062364
	(0.06303)	(0.06777)	(0.06864)
	[1.57195]	[-0.27293]	[0.90861]
NWP(-15)	-0.037237	0.063044	0.110861
	(0.06308)	(0.06784)	(0.06870)
	[-0.59029]	[0.92937]	[1.61371]
NWP(-16)	-0.083302	0.032859	0.017278
	(0.06311)	(0.06786)	(0.06873)
	[-1.31997]	[0.48419]	[0.25140]
NWP(-17)	-0.012588	-0.075022	-0.054787
	(0.06328)	(0.06805)	(0.06892)
	[-0.19891]	[-1.10245]	[-0.79497]
RD(-1)	-0.034496	-0.015024	-0.029946
	(0.01766)	(0.01899)	(0.01923)
	[-1.95375]	[-0.79130]	[-1.55738]
R-squared	0.194052	0.128150	0.233158
Adj. R-squared	0.018396	-0.061869	0.066026
Sum sq. resids	45.92886	53.10971	54.47123
S.E. equation	0.443032	0.476408	0.482476
F-statistic	1.104729	0.674405	1.395052
Log likelihood	-144.2840	-165.0570	-168.6768
Akaike AIC	1.372615	1.517881	1.543194

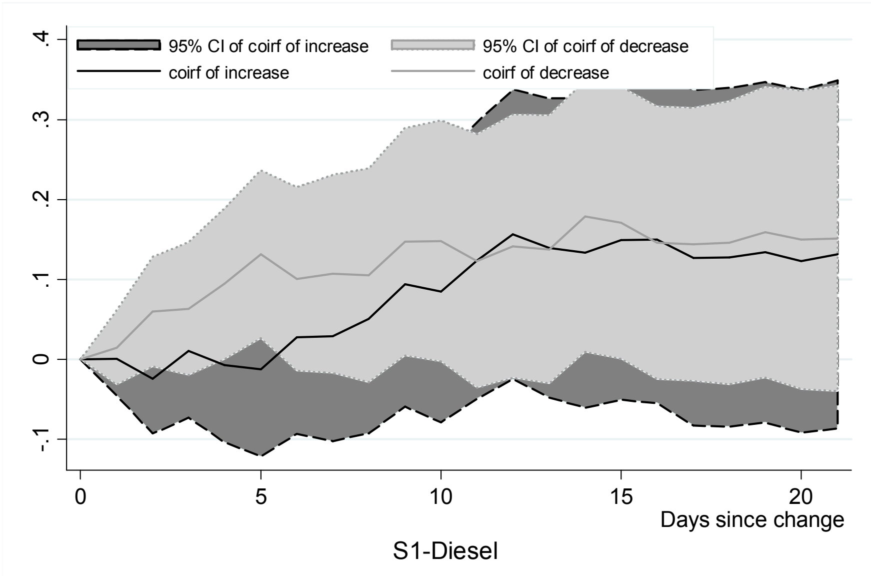
Schwarz SC	2.037341	2.182607	2.207920
Mean dependent	0.009352	0.304941	-0.311429
S.D. dependent	0.447164	0.462321	0.499239

Determinant resid covariance (dof adj.)	0.008208
Determinant resid covariance	0.004495
Log likelihood	-444.5755
Akaike information criterion	4.199829
Schwarz criterion	6.194006

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.000595	-.045168	.046357	.014746	-.031769	.061261
2	-.024306	-.092826	.044214	.059602	-.008972	.128176
3	.010671	-.072977	.094319	.063368	-.019959	.146695
4	-.007295	-.10387	.089281	.094714	.000171	.189258
5	-.012314	-.121436	.096809	.131378	.026183	.236573
6	.027539	-.093061	.14814	.100578	-.014312	.215468
7	.028838	-.102219	.159895	.106915	-.017022	.230852
8	.050365	-.092444	.193174	.10525	-.028525	.239026
9	.094397	-.05923	.248025	.147042	.00466	.289423
10	.084586	-.078715	.247887	.148034	-.002736	.298803
11	.123728	-.049268	.296724	.123224	-.035723	.282172
12	.156375	-.024729	.337478	.141645	-.023223	.306513
13	.139299	-.047762	.32636	.137712	-.030111	.305535
14	.13329	-.06039	.32697	.178926	.009068	.348785
15	.149058	-.050631	.348747	.170894	.000521	.341266
16	.150111	-.054577	.3548	.14591	-.024792	.316611
17	.127071	-.0828	.336942	.143914	-.027154	.314982
18	.127628	-.084309	.339565	.145966	-.031268	.3232
19	.13386	-.079014	.346733	.159324	-.022721	.341369
20	.122775	-.091934	.337485	.149635	-.037145	.336414
21	.13118	-.086306	.348665	.151383	-.039697	.342462

95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp



Gasoline

Vector Autoregression Estimates

Sample (adjusted): 1/25/2000 3/14/2001
Included observations: 288 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	0.134107	0.036172	-0.042934
	(0.06297)	(0.07510)	(0.08024)
	[2.12967]	[0.48163]	[-0.53505]
DGP(-2)	-0.025293	-0.032948	-0.017494
	(0.06300)	(0.07514)	(0.08028)
	[-0.40147]	[-0.43850]	[-0.21792]
DGP(-3)	0.011520	-0.045167	-0.024325
	(0.06244)	(0.07448)	(0.07957)
	[0.18448]	[-0.60646]	[-0.30570]
DGP(-4)	-0.004931	-0.006667	-0.022717
	(0.06195)	(0.07389)	(0.07894)
	[-0.07960]	[-0.09023]	[-0.28778]
DGP(-5)	0.017234	-0.073308	0.067126
	(0.06545)	(0.07806)	(0.08340)
	[0.26333]	[-0.93915]	[0.80490]

DGP(-6)	0.060203	0.085831	0.207552
	(0.07579)	(0.09040)	(0.09658)
	[0.79432]	[0.94950]	[2.14901]
DGP(-7)	-0.045139	0.134895	-0.178122
	(0.07658)	(0.09133)	(0.09758)
	[-0.58947]	[1.47700]	[-1.82544]
DGP(-8)	-0.039031	0.042576	0.038198
	(0.07743)	(0.09234)	(0.09866)
	[-0.50411]	[0.46106]	[0.38716]
DGP(-9)	-0.015977	-0.159502	-0.096626
	(0.07730)	(0.09220)	(0.09850)
	[-0.20668]	[-1.73001]	[-0.98093]
DGP(-10)	-0.008106	0.145760	0.114469
	(0.07735)	(0.09225)	(0.09857)
	[-0.10479]	[1.57998]	[1.16135]
DGP(-11)	-0.005635	-0.222516	-0.213588
	(0.07712)	(0.09198)	(0.09827)
	[-0.07307]	[-2.41913]	[-2.17340]
DGP(-12)	-0.030948	-0.028990	0.110455
	(0.07815)	(0.09321)	(0.09959)
	[-0.39598]	[-0.31100]	[1.10909]
DGP(-13)	0.071689	0.088597	0.144467
	(0.07824)	(0.09331)	(0.09969)
	[0.91633]	[0.94949]	[1.44912]
DGP(-14)	0.068253	-0.026428	-0.143387
	(0.07881)	(0.09399)	(0.10042)
	[0.86608]	[-0.28118]	[-1.42785]
DGP(-15)	0.068247	0.014703	0.106177
	(0.07429)	(0.08860)	(0.09466)
	[0.91870]	[0.16595]	[1.12166]
PSP(-1)	-0.015494	0.173788	0.141219
	(0.05708)	(0.06807)	(0.07273)
	[-0.27145]	[2.55291]	[1.94166]
PSP(-2)	0.008056	0.028201	-0.166601
	(0.05789)	(0.06904)	(0.07377)
	[0.13916]	[0.40846]	[-2.25852]
PSP(-3)	-0.070369	0.261347	0.039672
	(0.05825)	(0.06948)	(0.07423)
	[-1.20802]	[3.76170]	[0.53445]
PSP(-4)	-0.018797	0.038534	-0.007928
	(0.05948)	(0.07094)	(0.07580)
	[-0.31602]	[0.54316]	[-0.10460]
PSP(-5)	0.057572	-0.006982	-0.060430
	(0.05850)	(0.06977)	(0.07454)
	[0.98419]	[-0.10008]	[-0.81070]
PSP(-6)	0.060482	-0.101260	-0.048234

	(0.05823)	(0.06945)	(0.07420)
	[1.03870]	[-1.45805]	[-0.65005]
PSP(-7)	0.042716	0.027319	-0.015468
	(0.05625)	(0.06708)	(0.07167)
	[0.75946]	[0.40724]	[-0.21581]
PSP(-8)	0.004104	-0.058927	0.021011
	(0.05591)	(0.06669)	(0.07125)
	[0.07339]	[-0.88363]	[0.29489]
PSP(-9)	-0.046208	0.271334	0.100273
	(0.05578)	(0.06653)	(0.07108)
	[-0.82837]	[4.07832]	[1.41067]
PSP(-10)	0.005877	0.042511	-0.125351
	(0.05718)	(0.06820)	(0.07286)
	[0.10279]	[0.62335]	[-1.72038]
PSP(-11)	-0.025122	0.078608	0.034886
	(0.05745)	(0.06853)	(0.07321)
	[-0.43725]	[1.14714]	[0.47649]
PSP(-12)	0.068394	-0.115309	-0.065728
	(0.05754)	(0.06863)	(0.07332)
	[1.18858]	[-1.68014]	[-0.89640]
PSP(-13)	0.017424	-0.014095	-0.086450
	(0.05638)	(0.06725)	(0.07185)
	[0.30901]	[-0.20960]	[-1.20322]
PSP(-14)	-0.083436	-0.005696	0.012969
	(0.05659)	(0.06749)	(0.07211)
	[-1.47446]	[-0.08439]	[0.17986]
PSP(-15)	0.013169	0.097076	0.058663
	(0.05646)	(0.06734)	(0.07194)
	[0.23324]	[1.44164]	[0.81540]
NSP(-1)	-0.039795	-0.001428	0.108932
	(0.05344)	(0.06374)	(0.06810)
	[-0.74466]	[-0.02241]	[1.59963]
NSP(-2)	-0.023831	-0.058474	0.141918
	(0.05354)	(0.06386)	(0.06822)
	[-0.44511]	[-0.91574]	[2.08021]
NSP(-3)	0.041960	-0.055961	0.078049
	(0.05399)	(0.06439)	(0.06879)
	[0.77725]	[-0.86912]	[1.13457]
NSP(-4)	0.013951	-0.046700	0.066526
	(0.05410)	(0.06452)	(0.06893)
	[0.25789]	[-0.72382]	[0.96509]
NSP(-5)	0.069595	0.130091	0.190429
	(0.05374)	(0.06410)	(0.06849)
	[1.29493]	[2.02949]	[2.78058]
NSP(-6)	-0.065319	0.047551	0.088786
	(0.05409)	(0.06452)	(0.06893)
	[-1.20751]	[0.73703]	[1.28805]

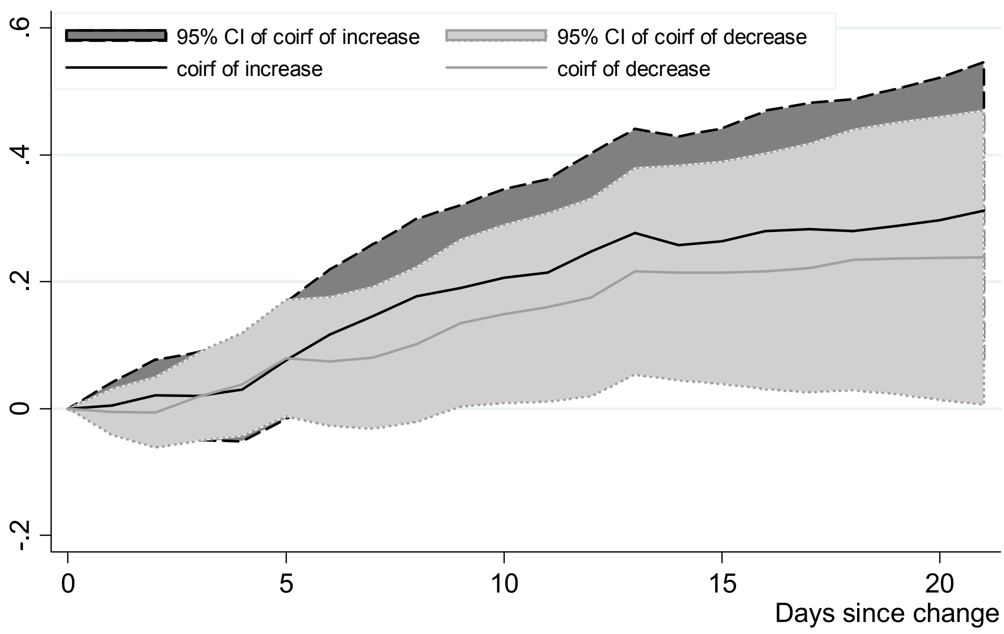
NSP(-7)	-0.015382	0.005549	-0.043038
	(0.05415)	(0.06459)	(0.06901)
	[-0.28403]	[0.08591]	[-0.62367]
NSP(-8)	0.024987	-0.034933	0.028953
	(0.05419)	(0.06464)	(0.06906)
	[0.46107]	[-0.54046]	[0.41925]
NSP(-9)	0.055199	-0.039259	-0.053172
	(0.05330)	(0.06356)	(0.06791)
	[1.03571]	[-0.61762]	[-0.78294]
NSP(-10)	-0.017912	-0.009113	0.004619
	(0.05320)	(0.06345)	(0.06779)
	[-0.33670]	[-0.14362]	[0.06814]
NSP(-11)	-0.023694	-0.114296	0.092389
	(0.05303)	(0.06325)	(0.06757)
	[-0.44682]	[-1.80712]	[1.36722]
NSP(-12)	0.020160	0.006145	0.047747
	(0.05357)	(0.06389)	(0.06826)
	[0.37634]	[0.09618]	[0.69948]
NSP(-13)	0.068755	-0.067185	-0.017028
	(0.05309)	(0.06332)	(0.06766)
	[1.29497]	[-1.06096]	[-0.25169]
NSP(-14)	-0.056974	0.001516	0.018994
	(0.05268)	(0.06283)	(0.06713)
	[-1.08150]	[0.02412]	[0.28295]
NSP(-15)	-0.025474	0.031415	-7.62E-05
	(0.05081)	(0.06060)	(0.06475)
	[-0.50132]	[0.51836]	[-0.00118]
RG(-1)	-0.035810	0.005585	0.014553
	(0.01153)	(0.01375)	(0.01469)
	[-3.10684]	[0.40626]	[0.99086]
R-squared	0.252935	0.160254	0.146977
Adj. R-squared	0.114018	0.004103	-0.011643
Sum sq. resids	27.93583	39.73884	45.36143
S.E. equation	0.339761	0.405228	0.432948
F-statistic	1.820762	1.026277	0.926599
Log likelihood	-72.69502	-123.4434	-142.4993
Akaike AIC	0.824271	1.176690	1.309023
Schwarz SC	1.409327	1.761746	1.894079
Mean dependent	0.006350	0.241343	-0.238423
S.D. dependent	0.360961	0.406062	0.430449

Determinant resid covariance (dof adj.)	0.003264
Determinant resid covariance	0.001937
Log likelihood	-326.4278
Akaike information criterion	3.225193
Schwarz criterion	4.980362

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.00444	-.031942	.040823	-.005377	-.041867	.031114
2	.021154	-.034324	.076632	-.006069	-.061777	.049638
3	.019327	-.050236	.088891	.018727	-.051142	.088597
4	.030126	-.051527	.111779	.038059	-.043428	.119547
5	.076079	-.016499	.168656	.079507	-.012607	.171621
6	.116016	.013226	.218806	.074458	-.02734	.176256
7	.146203	.03313	.259275	.080177	-.032145	.192498
8	.17693	.054483	.299378	.101138	-.021139	.223414
9	.18977	.058651	.32089	.134819	.003006	.266632
10	.206209	.066805	.345613	.149179	.008438	.289919
11	.214216	.066755	.361678	.159429	.01068	.308179
12	.247381	.091647	.403115	.17527	.0191	.331439
13	.277209	.113584	.440834	.216407	.053319	.379496
14	.257377	.085992	.428762	.213925	.044309	.383541
15	.263314	.084525	.442103	.213995	.038622	.389368
16	.279962	.090435	.469489	.216314	.030264	.402365
17	.282624	.083652	.481595	.221603	.025429	.417777
18	.279747	.071831	.487664	.234289	.028797	.439781
19	.287607	.070972	.504242	.236756	.022322	.45119
20	.296621	.071515	.521727	.236993	.013636	.46035
21	.312135	.078483	.545787	.23801	.005821	.470198

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



S1- Gasoline

Segment 2: 15/03/2001 to 12/05/2008:

Diesel

Vector Autoregression Estimates

Sample (adjusted): 4/10/2001 5/12/2008
Included observations: 1788 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.083005	-0.116495	0.068296
	(0.02398)	(0.10457)	(0.09785)
	[-3.46130]	[-1.11405]	[0.69794]
DDP(-2)	0.071874	0.039260	-0.034407
	(0.02401)	(0.10469)	(0.09797)
	[2.99354]	[0.37500]	[-0.35119]
DDP(-3)	0.099620	-0.054265	-0.387471
	(0.02394)	(0.10438)	(0.09768)
	[4.16159]	[-0.51987]	[-3.96677]
DDP(-4)	0.048924	0.054069	0.014098
	(0.02414)	(0.10526)	(0.09850)
	[2.02683]	[0.51369]	[0.14314]
DDP(-5)	0.287172	-0.035207	-0.014998
	(0.02415)	(0.10532)	(0.09856)
	[11.8895]	[-0.33428]	[-0.15218]
DDP(-6)	-0.002532	0.028746	-0.056132
	(0.02513)	(0.10956)	(0.10253)
	[-0.10079]	[0.26237]	[-0.54749]
DDP(-7)	0.022833	0.174878	0.141054
	(0.02508)	(0.10937)	(0.10235)
	[0.91033]	[1.59898]	[1.37822]
DDP(-8)	0.031591	-0.019359	0.190530
	(0.02497)	(0.10886)	(0.10187)
	[1.26540]	[-0.17783]	[1.87033]
DDP(-9)	0.007099	-0.074965	-0.110170
	(0.02500)	(0.10902)	(0.10202)
	[0.28395]	[-0.68762]	[-1.07988]
DDP(-10)	0.097846	0.070051	0.049733
	(0.02501)	(0.10904)	(0.10204)
	[3.91283]	[0.64242]	[0.48739]
DDP(-11)	-0.039921	0.087295	0.245275
	(0.02495)	(0.10880)	(0.10181)
	[-1.60000]	[0.80236]	[2.40911]
DDP(-12)	-0.024954	-0.032280	-0.030106
	(0.02494)	(0.10875)	(0.10176)

	[-1.00060]	[-0.29683]	[-0.29584]
DDP(-13)	-0.032251	0.030952	-0.144994
	(0.02392)	(0.10432)	(0.09762)
	[-1.34813]	[0.29671]	[-1.48532]
DDP(-14)	0.018672	0.131032	-0.237111
	(0.02382)	(0.10388)	(0.09721)
	[0.78379]	[1.26141]	[-2.43925]
DDP(-15)	0.102623	-0.056280	-0.129735
	(0.02363)	(0.10304)	(0.09642)
	[4.34288]	[-0.54619]	[-1.34548]
DDP(-16)	0.011395	0.134949	0.242526
	(0.02323)	(0.10128)	(0.09477)
	[0.49063]	[1.33249]	[2.55904]
DDP(-17)	-0.043517	-0.066016	0.111043
	(0.02310)	(0.10072)	(0.09425)
	[-1.88403]	[-0.65545]	[1.17817]
PWP(-1)	0.008821	0.009500	-0.030515
	(0.00605)	(0.02640)	(0.02470)
	[1.45700]	[0.35985]	[-1.23519]
PWP(-2)	-0.013229	0.082668	-0.078845
	(0.00610)	(0.02659)	(0.02489)
	[-2.16921]	[3.10855]	[-3.16825]
PWP(-3)	0.023769	0.006880	-0.031381
	(0.00622)	(0.02711)	(0.02537)
	[3.82282]	[0.25375]	[-1.23688]
PWP(-4)	0.032737	0.029848	-0.058490
	(0.00623)	(0.02718)	(0.02543)
	[5.25205]	[1.09816]	[-2.29965]
PWP(-5)	0.017814	-0.018404	-0.057044
	(0.00631)	(0.02752)	(0.02576)
	[2.82217]	[-0.66865]	[-2.21469]
PWP(-6)	0.020718	0.040729	-0.020343
	(0.00636)	(0.02774)	(0.02596)
	[3.25613]	[1.46800]	[-0.78354]
PWP(-7)	0.028917	0.097150	-0.016478
	(0.00638)	(0.02780)	(0.02602)
	[4.53522]	[3.49420]	[-0.63332]
PWP(-8)	0.003418	0.047306	-0.028498
	(0.00644)	(0.02810)	(0.02629)
	[0.53045]	[1.68353]	[-1.08379]
PWP(-9)	0.007145	-0.009389	-0.072716
	(0.00646)	(0.02816)	(0.02635)
	[1.10628]	[-0.33339]	[-2.75930]
PWP(-10)	0.018552	0.006228	0.007215
	(0.00647)	(0.02822)	(0.02641)
	[2.86644]	[0.22069]	[0.27321]

PWP(-11)	0.007636	0.012511	-0.026949
	(0.00644)	(0.02807)	(0.02627)
	[1.18621]	[0.44570]	[-1.02591]
PWP(-12)	0.005764	-0.011953	-0.060891
	(0.00643)	(0.02803)	(0.02623)
	[0.89664]	[-0.42645]	[-2.32146]
PWP(-13)	0.001664	0.137270	0.015539
	(0.00642)	(0.02797)	(0.02618)
	[0.25941]	[4.90712]	[0.59360]
PWP(-14)	-0.010139	0.077760	-0.014987
	(0.00646)	(0.02817)	(0.02636)
	[-1.56962]	[2.76057]	[-0.56859]
PWP(-15)	0.013079	0.017980	-0.004116
	(0.00647)	(0.02819)	(0.02638)
	[2.02286]	[0.63776]	[-0.15602]
PWP(-16)	0.018252	0.051802	-0.008868
	(0.00644)	(0.02809)	(0.02629)
	[2.83326]	[1.84411]	[-0.33737]
PWP(-17)	-0.003543	0.049309	-0.025186
	(0.00642)	(0.02797)	(0.02618)
	[-0.55232]	[1.76270]	[-0.96214]
NWP(-1)	-0.007543	-0.052319	-0.000278
	(0.00647)	(0.02821)	(0.02640)
	[-1.16615]	[-1.85482]	[-0.01051]
NWP(-2)	0.008885	-0.040838	0.060479
	(0.00647)	(0.02819)	(0.02638)
	[1.37426]	[-1.44859]	[2.29251]
NWP(-3)	0.008431	0.016524	0.054570
	(0.00649)	(0.02830)	(0.02648)
	[1.29895]	[0.58383]	[2.06044]
NWP(-4)	0.015494	0.015295	0.030613
	(0.00650)	(0.02834)	(0.02652)
	[2.38398]	[0.53971]	[1.15437]
NWP(-5)	0.028441	-0.080126	-0.001167
	(0.00651)	(0.02838)	(0.02656)
	[4.37006]	[-2.82346]	[-0.04393]
NWP(-6)	0.019358	-0.031627	0.002938
	(0.00655)	(0.02857)	(0.02673)
	[2.95456]	[-1.10701]	[0.10988]
NWP(-7)	0.021941	-0.068371	0.030016
	(0.00660)	(0.02877)	(0.02692)
	[3.32571]	[-2.37662]	[1.11499]
NWP(-8)	0.015019	0.007293	0.027990
	(0.00663)	(0.02890)	(0.02704)
	[2.26623]	[0.25235]	[1.03503]
NWP(-9)	0.009435	0.038635	0.124659
	(0.00660)	(0.02880)	(0.02695)

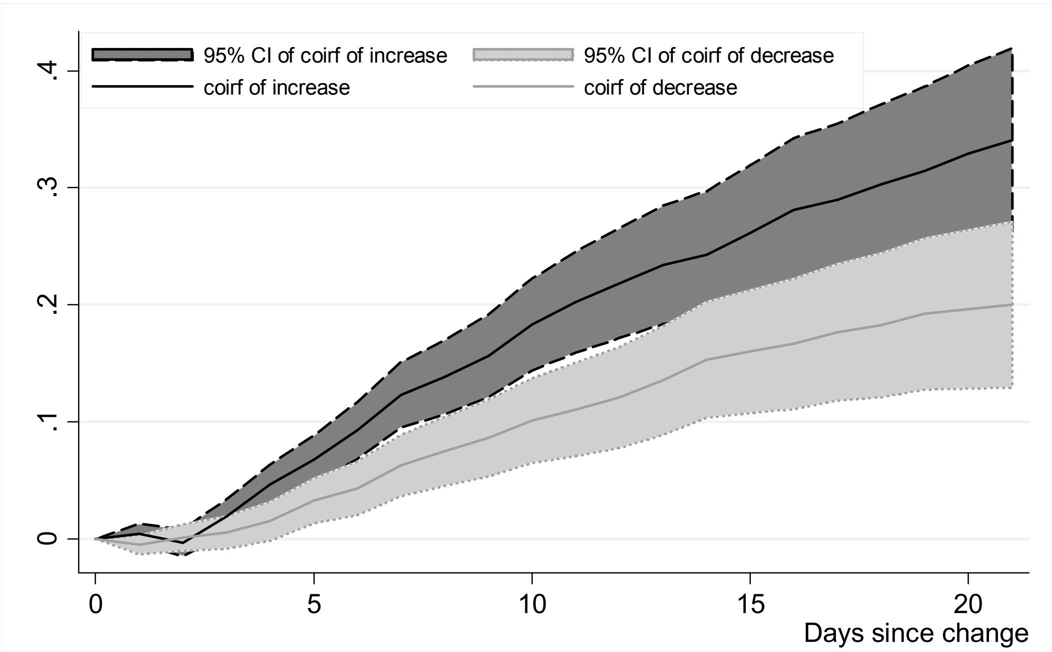
	[1.42866]	[1.34167]	[4.62610]
NWP(-10)	0.012289	-0.010283	-0.035108
	(0.00665)	(0.02898)	(0.02712)
	[1.84936]	[-0.35488]	[-1.29472]
NWP(-11)	0.009193	-0.034779	0.029918
	(0.00664)	(0.02896)	(0.02710)
	[1.38429]	[-1.20105]	[1.10410]
NWP(-12)	0.003266	0.025688	0.011454
	(0.00665)	(0.02900)	(0.02714)
	[0.49108]	[0.88580]	[0.42209]
NWP(-13)	0.009281	-0.064933	-0.019065
	(0.00664)	(0.02893)	(0.02707)
	[1.39879]	[-2.24432]	[-0.70416]
NWP(-14)	0.016497	0.000541	0.022152
	(0.00662)	(0.02885)	(0.02699)
	[2.49389]	[0.01875]	[0.82068]
NWP(-15)	-0.003233	-0.015718	0.001414
	(0.00660)	(0.02877)	(0.02692)
	[-0.49004]	[-0.54640]	[0.05251]
NWP(-16)	-0.002163	-0.030913	0.017615
	(0.00654)	(0.02850)	(0.02667)
	[-0.33098]	[-1.08456]	[0.66044]
NWP(-17)	0.006431	-0.053506	0.012257
	(0.00653)	(0.02849)	(0.02666)
	[0.98433]	[-1.87816]	[0.45978]
RD(-1)	-0.004027	-0.001382	-0.004869
	(0.00151)	(0.00659)	(0.00617)
	[-2.66442]	[-0.20965]	[-0.78953]
R-squared	0.377744	0.098283	0.097890
Adj. R-squared	0.359463	0.071793	0.071388
Sum sq. resids	57.06336	1085.016	950.1328
S.E. equation	0.181303	0.790575	0.739805
F-statistic	20.66367	3.710130	3.693690
Log likelihood	542.4914	-2090.506	-1971.830
Akaike AIC	-0.548648	2.396539	2.263791
Schwarz SC	-0.389017	2.556170	2.423423
Mean dependent	0.029533	0.491153	-0.419242
S.D. dependent	0.226533	0.820579	0.767715

Determinant resid covariance (dof adj.)	0.009339
Determinant resid covariance	0.008548
Log likelihood	-3353.876
Akaike information criterion	3.926036
Schwarz criterion	4.404929

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.004617	-.003757	.012992	-.005017	-.013327	.003293
2	-.003307	-.014768	.008154	.001003	-.010264	.01227
3	.019374	.004905	.033843	.005663	-.008363	.019688
4	.046208	.028781	.063635	.015142	-.001625	.031909
5	.067955	.047605	.088305	.032643	.013237	.052048
6	.092884	.068486	.117283	.043299	.02028	.066318
7	.123214	.095209	.151218	.062773	.036569	.088978
8	.138239	.106517	.16996	.074718	.045135	.104302
9	.156453	.120977	.191929	.086194	.053268	.11912
10	.183236	.144036	.222436	.101038	.064837	.13724
11	.20219	.15888	.245499	.110671	.070743	.150598
12	.218481	.171493	.265469	.120895	.077609	.164181
13	.234186	.183577	.284795	.135353	.088764	.181942
14	.243037	.188867	.297206	.153219	.103522	.202917
15	.261538	.203827	.319248	.160287	.107586	.212988
16	.281017	.219534	.3425	.166607	.110832	.222383
17	.290122	.22522	.355023	.17681	.118282	.235337
18	.302905	.234483	.371326	.182747	.120978	.244517
19	.314481	.24257	.386391	.192382	.12748	.257283
20	.329419	.254138	.4047	.196268	.12835	.264187
21	.340582	.261867	.419298	.200324	.129374	.271275

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



S2 Diesel

Gasoline

Vector Autoregression Estimates

Sample (adjusted): 4/08/2001 5/12/2008
Included observations: 1790 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.022409	0.041805	-0.137765
	(0.02377)	(0.10859)	(0.09688)
	[-0.94285]	[0.38497]	[-1.42204]
DGP(-2)	0.122864	-0.039670	0.063996
	(0.02370)	(0.10828)	(0.09659)
	[5.18475]	[-0.36638]	[0.66252]
DGP(-3)	0.075996	0.038224	-0.245558
	(0.02386)	(0.10904)	(0.09727)
	[3.18456]	[0.35056]	[-2.52440]
DGP(-4)	0.011214	-0.047592	0.003410
	(0.02392)	(0.10928)	(0.09749)
	[0.46887]	[-0.43551]	[0.03498]
DGP(-5)	0.238456	0.123107	0.253501
	(0.02387)	(0.10907)	(0.09730)
	[9.98975]	[1.12875]	[2.60537]
DGP(-6)	-0.016486	-0.046805	-0.080600
	(0.02451)	(0.11198)	(0.09990)
	[-0.67268]	[-0.41797]	[-0.80680]
DGP(-7)	0.027351	-0.091945	-0.067557
	(0.02445)	(0.11173)	(0.09968)
	[1.11846]	[-0.82289]	[-0.67774]
DGP(-8)	0.016902	-0.026812	0.129067
	(0.02440)	(0.11147)	(0.09945)
	[0.69280]	[-0.24053]	[1.29787]
DGP(-9)	0.025476	0.003320	0.068612
	(0.02436)	(0.11131)	(0.09930)
	[1.04581]	[0.02982]	[0.69097]
DGP(-10)	0.049843	-0.063281	-0.118839
	(0.02426)	(0.11083)	(0.09887)
	[2.05486]	[-0.57097]	[-1.20193]
DGP(-11)	-0.040299	-0.055047	-0.050073
	(0.02347)	(0.10725)	(0.09568)
	[-1.71691]	[-0.51328]	[-0.52336]
DGP(-12)	-0.040485	0.276322	0.213752
	(0.02341)	(0.10696)	(0.09542)
	[-1.72951]	[2.58351]	[2.24017]
DGP(-13)	-0.028908	0.082789	0.000271
	(0.02327)	(0.10633)	(0.09486)
	[-1.24223]	[0.77863]	[0.00285]

DGP(-14)	0.051811	0.080000	0.013238
	(0.02265)	(0.10349)	(0.09233)
	[2.28742]	[0.77301]	[0.14338]
DGP(-15)	0.088297	-0.169297	-0.172739
	(0.02241)	(0.10239)	(0.09135)
	[3.94002]	[-1.65338]	[-1.89098]
PSP(-1)	0.024843	0.154439	0.034049
	(0.00569)	(0.02602)	(0.02321)
	[4.36226]	[5.93529]	[1.46679]
PSP(-2)	0.051036	0.042921	-0.051844
	(0.00576)	(0.02631)	(0.02347)
	[8.86337]	[1.63139]	[-2.20884]
PSP(-3)	0.039050	0.037307	-0.107655
	(0.00589)	(0.02692)	(0.02402)
	[6.62728]	[1.38571]	[-4.48216]
PSP(-4)	0.012595	0.054365	-0.063033
	(0.00600)	(0.02743)	(0.02447)
	[2.09811]	[1.98213]	[-2.57607]
PSP(-5)	0.023379	0.026522	-0.055843
	(0.00614)	(0.02804)	(0.02502)
	[3.80911]	[0.94574]	[-2.23212]
PSP(-6)	0.009624	0.018376	-0.032146
	(0.00617)	(0.02821)	(0.02517)
	[1.55864]	[0.65133]	[-1.27716]
PSP(-7)	0.007988	0.014653	-0.036685
	(0.00617)	(0.02818)	(0.02514)
	[1.29507]	[0.51993]	[-1.45907]
PSP(-8)	0.012927	0.021355	-0.047214
	(0.00615)	(0.02810)	(0.02507)
	[2.10166]	[0.75983]	[-1.88310]
PSP(-9)	0.016511	0.003335	-0.053185
	(0.00615)	(0.02810)	(0.02507)
	[2.68441]	[0.11868]	[-2.12130]
PSP(-10)	0.019589	0.000188	0.031033
	(0.00617)	(0.02819)	(0.02515)
	[3.17536]	[0.00667]	[1.23412]
PSP(-11)	-0.006245	-0.007439	-0.026823
	(0.00617)	(0.02821)	(0.02516)
	[-1.01151]	[-0.26371]	[-1.06588]
PSP(-12)	-0.010912	0.089243	-0.012290
	(0.00615)	(0.02810)	(0.02506)
	[-1.77464]	[3.17638]	[-0.49033]
PSP(-13)	-0.002152	0.078120	-0.009326
	(0.00615)	(0.02812)	(0.02509)
	[-0.34969]	[2.77822]	[-0.37178]
PSP(-14)	0.018613	0.056870	0.009017
	(0.00614)	(0.02807)	(0.02504)

	[3.03018]	[2.02633]	[0.36013]
PSP(-15)	0.000398	0.053122	0.017392
	(0.00614)	(0.02803)	(0.02501)
	[0.06481]	[1.89496]	[0.69544]
NSP(-1)	-0.005745	-0.028569	0.012384
	(0.00643)	(0.02938)	(0.02621)
	[-0.89333]	[-0.97235]	[0.47246]
NSP(-2)	0.001686	-0.005678	0.058836
	(0.00642)	(0.02935)	(0.02619)
	[0.26238]	[-0.19342]	[2.24671]
NSP(-3)	0.012853	-0.023455	0.069174
	(0.00644)	(0.02940)	(0.02623)
	[1.99728]	[-0.79767]	[2.63702]
NSP(-4)	0.036675	-0.029424	0.056553
	(0.00645)	(0.02948)	(0.02630)
	[5.68472]	[-0.99816]	[2.15048]
NSP(-5)	0.023138	-0.027233	0.004039
	(0.00653)	(0.02985)	(0.02663)
	[3.54108]	[-0.91219]	[0.15164]
NSP(-6)	0.033091	0.042548	0.049982
	(0.00655)	(0.02992)	(0.02669)
	[5.05376]	[1.42218]	[1.87267]
NSP(-7)	0.019815	-0.046965	0.006807
	(0.00660)	(0.03014)	(0.02689)
	[3.00425]	[-1.55843]	[0.25321]
NSP(-8)	0.017761	-0.035487	0.061475
	(0.00663)	(0.03028)	(0.02701)
	[2.68044]	[-1.17212]	[2.27604]
NSP(-9)	0.009772	-0.004984	0.058235
	(0.00666)	(0.03045)	(0.02716)
	[1.46641]	[-0.16370]	[2.14383]
NSP(-10)	0.003411	0.024240	-0.000863
	(0.00667)	(0.03047)	(0.02718)
	[0.51146]	[0.79556]	[-0.03175]
NSP(-11)	0.011930	-0.034389	0.003386
	(0.00664)	(0.03036)	(0.02708)
	[1.79562]	[-1.13281]	[0.12501]
NSP(-12)	0.013420	-0.023017	-0.016423
	(0.00661)	(0.03022)	(0.02696)
	[2.02887]	[-0.76161]	[-0.60915]
NSP(-13)	0.012754	-0.029710	0.031488
	(0.00653)	(0.02984)	(0.02662)
	[1.95308]	[-0.99575]	[1.18296]
NSP(-14)	0.001886	-0.053211	0.043821
	(0.00652)	(0.02978)	(0.02657)
	[0.28945]	[-1.78693]	[1.64953]

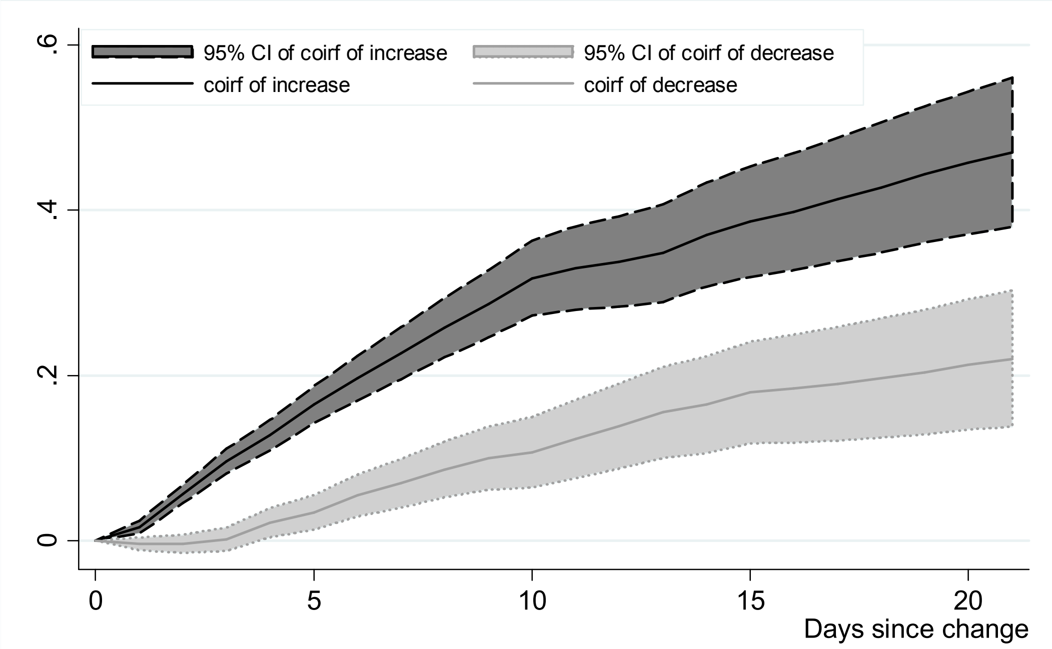
NSP(-15)	0.015377	0.020984	0.042550
	(0.00648)	(0.02962)	(0.02643)
	[2.37204]	[0.70844]	[1.61022]
RG(-1)	-0.001963	0.008037	-0.007170
	(0.00132)	(0.00603)	(0.00538)
	[-1.48729]	[1.33286]	[-1.33283]
R-squared	0.462288	0.062272	0.117078
Adj. R-squared	0.448413	0.038076	0.094296
Sum sq. resids	49.91014	1041.965	829.2802
S.E. equation	0.169169	0.772953	0.689568
F-statistic	33.31932	2.573636	5.139083
Log likelihood	663.9733	-2055.609	-1851.275
Akaike AIC	-0.690473	2.348166	2.119861
Schwarz SC	-0.549390	2.489250	2.260944
Mean dependent	0.023217	0.461724	-0.415127
S.D. dependent	0.227779	0.788103	0.724576

Determinant resid covariance (dof adj.)	0.006864
Determinant resid covariance	0.006349
Log likelihood	-3091.441
Akaike information criterion	3.608314
Schwarz criterion	4.031564

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.016245	.008406	.024084	-.004024	-.011799	.003752
2	.056482	.045209	.067754	-.003881	-.014826	.007064
3	.096256	.081359	.111153	.001661	-.012588	.015909
4	.12767	.109105	.146235	.02173	.004043	.039417
5	.16467	.142371	.186968	.0341	.013046	.055153
6	.196622	.169661	.223582	.054553	.029155	.079951
7	.226871	.195449	.258294	.069394	.039847	.098941
8	.258067	.221982	.294152	.086222	.052349	.120095
9	.286734	.24595	.327518	.099812	.061504	.138119
10	.317757	.272219	.363294	.106989	.064255	.149724
11	.330177	.279756	.380597	.122819	.075405	.170233
12	.337877	.283016	.392738	.138771	.087174	.190367
13	.348122	.289076	.407169	.155219	.09992	.210517
14	.370541	.307541	.433541	.164549	.105999	.223098
15	.386338	.319403	.453274	.179309	.117673	.240946
16	.398373	.327339	.469406	.184134	.118718	.249551
17	.413185	.338298	.488072	.18983	.120997	.258664
18	.427594	.348869	.506319	.196991	.124756	.269227
19	.443464	.360918	.526009	.20391	.128319	.279501
20	.457532	.371106	.543958	.213303	.134327	.292279
21	.47005	.37971	.56039	.220252	.137744	.302759

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```



S2 - Gasoline

Segment 3: 13/05/2008 to 05/01/2009

Diesel

Vector Autoregression Estimates

Sample (adjusted): 6/09/2008 1/05/2009
Included observations: 147 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	0.027581	0.111450	0.063375
	(0.10911)	(0.38595)	(0.40227)
	[0.25277]	[0.28877]	[0.15754]
DDP(-2)	-0.028800	0.654992	0.861492
	(0.10847)	(0.38367)	(0.39989)
	[-0.26552]	[1.70718]	[2.15432]
DDP(-3)	-0.030224	0.380133	0.212426
	(0.10965)	(0.38787)	(0.40427)
	[-0.27563]	[0.98005]	[0.52546]
DDP(-4)	-0.053025	0.045325	0.607830
	(0.10766)	(0.38080)	(0.39690)
	[-0.49254]	[0.11903]	[1.53144]

DDP(-5)	0.308618	0.645771	0.314962
	(0.10839)	(0.38340)	(0.39961)
	[2.84727]	[1.68433]	[0.78817]
DDP(-6)	-0.092762	0.426649	0.180596
	(0.11371)	(0.40221)	(0.41921)
	[-0.81579]	[1.06077]	[0.43080]
DDP(-7)	0.154835	-0.384355	-0.030499
	(0.11348)	(0.40139)	(0.41836)
	[1.36446]	[-0.95756]	[-0.07290]
DDP(-8)	-0.022603	-0.328373	-0.030479
	(0.11429)	(0.40428)	(0.42137)
	[-0.19776]	[-0.81224]	[-0.07233]
DDP(-9)	-0.084340	0.375215	0.082832
	(0.11212)	(0.39658)	(0.41334)
	[-0.75226]	[0.94614]	[0.20039]
DDP(-10)	0.011128	-0.572271	0.270418
	(0.11254)	(0.39808)	(0.41492)
	[0.09888]	[-1.43756]	[0.65174]
DDP(-11)	-0.119867	-0.043255	0.149074
	(0.11409)	(0.40357)	(0.42063)
	[-1.05061]	[-0.10718]	[0.35440]
DDP(-12)	-0.109990	-0.205712	-0.382582
	(0.11343)	(0.40124)	(0.41821)
	[-0.96963]	[-0.51269]	[-0.91482]
DDP(-13)	-0.063825	0.117008	0.331298
	(0.10269)	(0.36325)	(0.37861)
	[-0.62151]	[0.32212]	[0.87505]
DDP(-14)	-0.050091	0.236076	0.287241
	(0.10294)	(0.36411)	(0.37950)
	[-0.48662]	[0.64837]	[0.75689]
DDP(-15)	0.296865	-0.255117	-0.262785
	(0.10236)	(0.36207)	(0.37737)
	[2.90023]	[-0.70462]	[-0.69635]
DDP(-16)	-0.064631	-0.003345	0.097226
	(0.10301)	(0.36437)	(0.37978)
	[-0.62742]	[-0.00918]	[0.25601]
DDP(-17)	-0.072989	0.408600	0.274585
	(0.10112)	(0.35769)	(0.37281)
	[-0.72180]	[1.14234]	[0.73653]
PWP(-1)	0.015201	0.059464	-0.158136
	(0.02679)	(0.09478)	(0.09879)
	[0.56730]	[0.62739]	[-1.60078]
PWP(-2)	0.040142	0.080899	-0.045812
	(0.02689)	(0.09512)	(0.09914)
	[1.49279]	[0.85052]	[-0.46210]
PWP(-3)	0.033369	0.000595	-0.121916
	(0.02673)	(0.09454)	(0.09854)

	[1.24846]	[0.00629]	[-1.23723]
PWP(-4)	0.042990	-0.002068	-0.085132
	(0.02669)	(0.09440)	(0.09839)
	[1.61089]	[-0.02190]	[-0.86525]
PWP(-5)	0.015862	-0.049783	-0.282073
	(0.02681)	(0.09482)	(0.09883)
	[0.59171]	[-0.52502]	[-2.85412]
PWP(-6)	0.051899	-0.012591	-0.082582
	(0.02717)	(0.09612)	(0.10018)
	[1.90998]	[-0.13100]	[-0.82434]
PWP(-7)	0.039036	-0.102725	-0.163268
	(0.02730)	(0.09658)	(0.10066)
	[1.42970]	[-1.06366]	[-1.62196]
PWP(-8)	0.034824	-0.189454	-0.355189
	(0.02763)	(0.09774)	(0.10187)
	[1.26032]	[-1.93843]	[-3.48675]
PWP(-9)	0.036431	-0.022230	-0.042464
	(0.02902)	(0.10265)	(0.10699)
	[1.25542]	[-0.21657]	[-0.39691]
PWP(-10)	0.027986	-0.023366	-0.124089
	(0.02875)	(0.10170)	(0.10600)
	[0.97338]	[-0.22976]	[-1.17066]
PWP(-11)	0.020445	0.057742	0.026812
	(0.02852)	(0.10088)	(0.10515)
	[0.71687]	[0.57237]	[0.25500]
PWP(-12)	0.041060	-0.161162	-0.182276
	(0.02826)	(0.09995)	(0.10418)
	[1.45310]	[-1.61241]	[-1.74967]
PWP(-13)	0.029996	-0.107469	-0.199549
	(0.02747)	(0.09715)	(0.10126)
	[1.09214]	[-1.10621]	[-1.97070]
PWP(-14)	0.018507	0.146747	-0.149596
	(0.02756)	(0.09748)	(0.10160)
	[0.67158]	[1.50542]	[-1.47240]
PWP(-15)	-0.006261	-0.016382	0.026641
	(0.02711)	(0.09591)	(0.09996)
	[-0.23091]	[-0.17081]	[0.26652]
PWP(-16)	0.019572	-0.114600	-0.251892
	(0.02702)	(0.09558)	(0.09962)
	[0.72435]	[-1.19903]	[-2.52858]
PWP(-17)	0.027750	-0.020423	-0.078879
	(0.02781)	(0.09835)	(0.10251)
	[0.99802]	[-0.20765]	[-0.76946]
NWP(-1)	0.054328	-0.024090	-0.086770
	(0.02992)	(0.10583)	(0.11031)
	[1.81579]	[-0.22762]	[-0.78661]

NWP(-2)	-0.003381	-0.019818	-0.125700
	(0.02929)	(0.10359)	(0.10797)
	[-0.11544]	[-0.19131]	[-1.16420]
NWP(-3)	0.031629	-0.239393	-0.126334
	(0.02905)	(0.10275)	(0.10710)
	[1.08884]	[-2.32984]	[-1.17964]
NWP(-4)	0.039937	-0.081065	0.010133
	(0.02955)	(0.10453)	(0.10894)
	[1.35150]	[-0.77555]	[0.09301]
NWP(-5)	0.057245	-0.060950	0.145520
	(0.02940)	(0.10398)	(0.10838)
	[1.94733]	[-0.58616]	[1.34270]
NWP(-6)	0.033503	0.038734	-0.037766
	(0.02930)	(0.10363)	(0.10801)
	[1.14360]	[0.37378]	[-0.34966]
NWP(-7)	0.063766	-0.020564	-0.082586
	(0.02884)	(0.10200)	(0.10631)
	[2.21138]	[-0.20162]	[-0.77685]
NWP(-8)	0.037166	0.139384	-0.018112
	(0.02932)	(0.10371)	(0.10810)
	[1.26759]	[1.34396]	[-0.16755]
NWP(-9)	0.040320	-0.118002	-0.134546
	(0.02951)	(0.10437)	(0.10878)
	[1.36649]	[-1.13061]	[-1.23683]
NWP(-10)	0.018226	-0.154250	-0.091350
	(0.02926)	(0.10349)	(0.10787)
	[0.62294]	[-1.49043]	[-0.84685]
NWP(-11)	-0.002133	-0.158563	-0.268006
	(0.02929)	(0.10360)	(0.10798)
	[-0.07282]	[-1.53052]	[-2.48196]
NWP(-12)	0.005066	-0.119308	-0.095060
	(0.03025)	(0.10700)	(0.11153)
	[0.16747]	[-1.11498]	[-0.85234]
NWP(-13)	0.004279	0.013241	0.000824
	(0.02910)	(0.10293)	(0.10728)
	[0.14706]	[0.12865]	[0.00769]
NWP(-14)	0.037521	-0.019939	0.064480
	(0.02868)	(0.10143)	(0.10572)
	[1.30847]	[-0.19658]	[0.60992]
NWP(-15)	0.053407	-0.082937	0.021563
	(0.02845)	(0.10064)	(0.10490)
	[1.87711]	[-0.82410]	[0.20557]
NWP(-16)	-0.033412	0.059563	0.065761
	(0.02825)	(0.09994)	(0.10416)
	[-1.18260]	[0.59601]	[0.63133]
NWP(-17)	0.037773	-0.212816	-0.144658
	(0.02797)	(0.09893)	(0.10311)

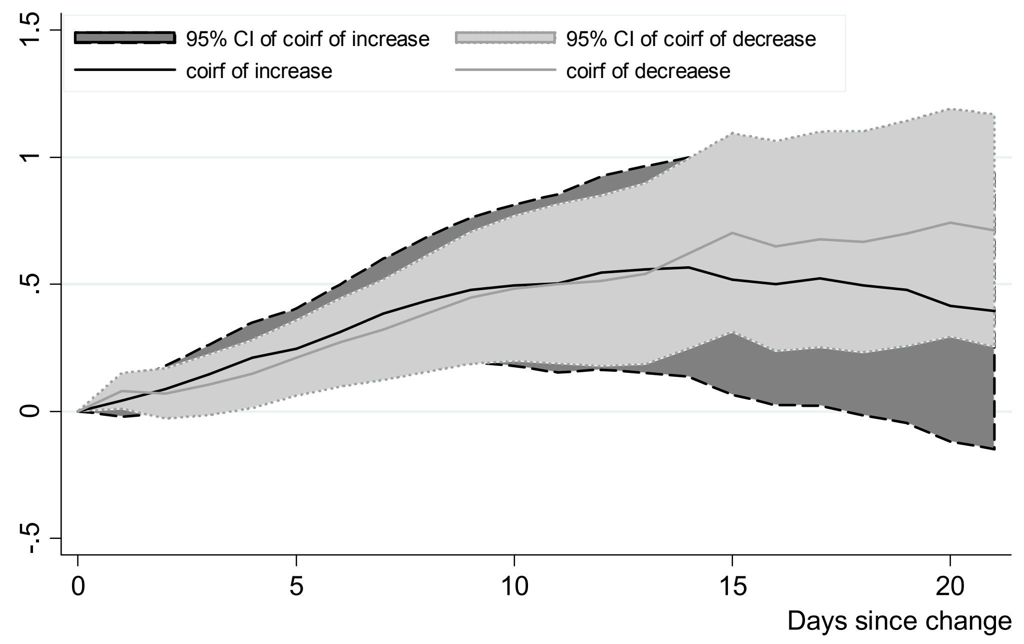
	[1.35057]	[-2.15118]	[-1.40291]
RD(-1)	0.026679	-0.060299	-0.160461
	(0.01825)	(0.06455)	(0.06728)
	[1.46187]	[-0.93410]	[-2.38490]
R-squared	0.611841	0.288464	0.351950
Adj. R-squared	0.403461	-0.093518	0.004050
Sum sq. resids	25.28601	316.3739	343.6930
S.E. equation	0.515915	1.824898	1.902057
F-statistic	2.936180	0.755178	1.011641
Log likelihood	-79.21064	-264.9211	-271.0087
Akaike AIC	1.785179	4.311852	4.394676
Schwarz SC	2.843019	5.369692	5.452516
Mean dependent	-0.316456	0.812012	-1.515924
S.D. dependent	0.667973	1.745121	1.905920

Determinant resid covariance (dof adj.)	2.884792
Determinant resid covariance	0.778634
Log likelihood	-607.3611
Akaike information criterion	10.38587
Schwarz criterion	13.55939

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.041398	-.021056	.103853	.080425	.010035	.150815
2	.086139	-.006095	.178374	.070118	-.028871	.169106
3	.146038	.030035	.26204	.104127	-.015415	.223668
4	.211608	.07314	.350076	.147484	.012815	.282153
5	.245296	.08698	.403613	.209696	.061139	.358252
6	.310963	.123228	.498698	.27073	.096694	.444767
7	.383713	.167129	.600296	.321148	.123057	.519239
8	.434494	.183301	.685688	.384148	.155213	.613082
9	.47702	.191613	.762427	.446873	.186539	.707207
10	.496394	.178937	.81385	.483284	.196795	.769772
11	.503366	.152356	.854376	.501425	.186995	.815856
12	.544664	.163846	.925483	.513422	.177006	.849839
13	.557271	.149782	.964761	.541535	.184768	.898303
14	.566513	.134912	.998114	.621215	.24652	.995911
15	.519283	.065209	.973357	.703335	.312235	1.09443
16	.501641	.022919	.980363	.650043	.236587	1.0635
17	.522169	.022727	1.02161	.675993	.250987	1.101
18	.496115	-.016339	1.00857	.667047	.231606	1.10249
19	.47653	-.047552	1.00061	.699717	.256148	1.14329
20	.413795	-.119212	.946802	.741746	.292877	1.19061
21	.393378	-.149524	.93628	.711167	.253006	1.16933

95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp



S3 - Diesel

Gasoline

Vector Autoregression Estimates

Sample (adjusted): 6/05/2008 1/05/2009
Included observations: 149 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.107710	-0.289738	-0.312270
	(0.10273)	(0.29794)	(0.34440)
	[-1.04846]	[-0.97246]	[-0.90670]
DGP(-2)	-0.031938	0.044597	-0.686681
	(0.10528)	(0.30534)	(0.35295)
	[-0.30336]	[0.14606]	[-1.94554]
DGP(-3)	-0.030405	0.491072	0.486366
	(0.09974)	(0.28927)	(0.33438)
	[-0.30484]	[1.69763]	[1.45455]
DGP(-4)	-0.122482	0.012498	0.052455
	(0.10076)	(0.29222)	(0.33779)
	[-1.21561]	[0.04277]	[0.15529]

DGP(-5)	0.180556	0.217784	-0.360711
	(0.09980)	(0.28945)	(0.33458)
	[1.80914]	[0.75242]	[-1.07810]
DGP(-6)	0.043774	0.038296	-0.246228
	(0.10004)	(0.29015)	(0.33539)
	[0.43755]	[0.13199]	[-0.73415]
DGP(-7)	0.035050	0.211871	0.475412
	(0.09790)	(0.28394)	(0.32822)
	[0.35800]	[0.74617]	[1.44846]
DGP(-8)	-0.111649	-0.643110	-0.599320
	(0.09806)	(0.28440)	(0.32874)
	[-1.13858]	[-2.26132]	[-1.82307]
DGP(-9)	-0.154201	0.205692	-0.323937
	(0.09995)	(0.28986)	(0.33506)
	[-1.54285]	[0.70962]	[-0.96680]
DGP(-10)	0.137362	-0.216188	0.154353
	(0.10044)	(0.29130)	(0.33673)
	[1.36758]	[-0.74214]	[0.45839]
DGP(-11)	-0.187618	0.105980	0.038026
	(0.09574)	(0.27766)	(0.32096)
	[-1.95968]	[0.38169]	[0.11848]
DGP(-12)	-0.101453	0.232114	0.179853
	(0.09706)	(0.28149)	(0.32538)
	[-1.04529]	[0.82459]	[0.55274]
DGP(-13)	-0.065709	-0.249595	-0.060972
	(0.09757)	(0.28297)	(0.32710)
	[-0.67345]	[-0.88205]	[-0.18640]
DGP(-14)	0.036333	-0.007543	-0.119155
	(0.09501)	(0.27553)	(0.31850)
	[0.38243]	[-0.02738]	[-0.37411]
DGP(-15)	0.145586	0.191682	0.149619
	(0.09340)	(0.27088)	(0.31312)
	[1.55874]	[0.70763]	[0.47784]
PSP(-1)	0.038062	0.142900	-0.201139
	(0.03810)	(0.11050)	(0.12773)
	[0.99899]	[1.29321]	[-1.57471]
PSP(-2)	0.072775	-0.111318	0.016453
	(0.03865)	(0.11210)	(0.12958)
	[1.88275]	[-0.99300]	[0.12697]
PSP(-3)	0.031475	-0.089027	-0.136782
	(0.03938)	(0.11422)	(0.13203)
	[0.79917]	[-0.77941]	[-1.03596]
PSP(-4)	0.073347	0.042233	0.011049
	(0.03892)	(0.11288)	(0.13048)
	[1.88447]	[0.37414]	[0.08468]
PSP(-5)	0.063526	-0.040535	0.037156
	(0.03921)	(0.11373)	(0.13146)

	[1.61997]	[-0.35641]	[0.28263]
PSP(-6)	0.074280	0.122528	0.061159
	(0.03936)	(0.11417)	(0.13197)
	[1.88697]	[1.07324]	[0.46344]
PSP(-7)	0.035159	-0.125694	-0.153083
	(0.03903)	(0.11320)	(0.13086)
	[0.90075]	[-1.11034]	[-1.16986]
PSP(-8)	0.056657	-0.013377	-0.099157
	(0.03892)	(0.11287)	(0.13047)
	[1.45579]	[-0.11852]	[-0.75999]
PSP(-9)	0.081808	-0.070612	-0.060494
	(0.03869)	(0.11220)	(0.12970)
	[2.11462]	[-0.62934]	[-0.46643]
PSP(-10)	0.050935	0.059358	0.107896
	(0.03912)	(0.11345)	(0.13114)
	[1.30208]	[0.52320]	[0.82274]
PSP(-11)	0.075229	0.139721	0.000592
	(0.03878)	(0.11246)	(0.13000)
	[1.94009]	[1.24242]	[0.00455]
PSP(-12)	0.016351	0.058907	0.169289
	(0.03719)	(0.10785)	(0.12466)
	[0.43970]	[0.54621]	[1.35796]
PSP(-13)	0.065220	-0.005777	-0.120673
	(0.03761)	(0.10908)	(0.12609)
	[1.73405]	[-0.05296]	[-0.95704]
PSP(-14)	0.011544	0.263428	0.079783
	(0.03713)	(0.10770)	(0.12449)
	[0.31085]	[2.44597]	[0.64086]
PSP(-15)	0.029068	-0.007285	0.095216
	(0.03810)	(0.11049)	(0.12772)
	[0.76302]	[-0.06594]	[0.74553]
NSP(-1)	0.051300	-0.012543	0.105300
	(0.03233)	(0.09376)	(0.10838)
	[1.58689]	[-0.13378]	[0.97161]
NSP(-2)	0.051290	-0.121777	0.040617
	(0.03227)	(0.09358)	(0.10818)
	[1.58949]	[-1.30125]	[0.37547]
NSP(-3)	0.037371	0.032422	-0.107669
	(0.03228)	(0.09362)	(0.10822)
	[1.15766]	[0.34630]	[-0.99490]
NSP(-4)	0.099522	-0.209273	0.032165
	(0.03244)	(0.09408)	(0.10875)
	[3.06804]	[-2.22447]	[0.29577]
NSP(-5)	0.057572	-0.035097	-0.021259
	(0.03423)	(0.09928)	(0.11476)
	[1.68179]	[-0.35350]	[-0.18524]

NSP(-6)	0.073864	-0.058249	-0.045622
	(0.03439)	(0.09974)	(0.11529)
	[2.14783]	[-0.58401]	[-0.39572]
NSP(-7)	0.102785	-0.085609	-0.010825
	(0.03499)	(0.10149)	(0.11732)
	[2.93723]	[-0.84352]	[-0.09227]
NSP(-8)	0.055624	0.045838	0.169225
	(0.03574)	(0.10366)	(0.11982)
	[1.55630]	[0.44221]	[1.41233]
NSP(-9)	0.047136	0.008293	0.279571
	(0.03413)	(0.09899)	(0.11443)
	[1.38099]	[0.08378]	[2.44323]
NSP(-10)	0.056165	0.053171	0.129119
	(0.03369)	(0.09771)	(0.11294)
	[1.66715]	[0.54420]	[1.14325]
NSP(-11)	0.001721	-0.052468	0.193693
	(0.03358)	(0.09738)	(0.11257)
	[0.05126]	[-0.53879]	[1.72071]
NSP(-12)	0.005348	-0.096310	-0.028855
	(0.03382)	(0.09808)	(0.11337)
	[0.15814]	[-0.98194]	[-0.25451]
NSP(-13)	0.079220	0.119242	0.130342
	(0.03220)	(0.09339)	(0.10796)
	[2.46002]	[1.27675]	[1.20734]
NSP(-14)	0.019855	-0.093880	0.194638
	(0.03278)	(0.09507)	(0.10990)
	[0.60567]	[-0.98745]	[1.77108]
NSP(-15)	-0.001454	0.086010	0.088336
	(0.03265)	(0.09470)	(0.10947)
	[-0.04453]	[0.90824]	[0.80697]
RG(-1)	0.033920	-0.072137	-0.024348
	(0.01910)	(0.05540)	(0.06404)
	[1.77569]	[-1.30208]	[-0.38020]
R-squared	0.521820	0.272038	0.306618
Adj. R-squared	0.312906	-0.046004	0.003685
Sum sq. resids	26.31752	221.3622	295.7800
S.E. equation	0.505480	1.465997	1.694594
F-statistic	2.497775	0.855352	1.012163
Log likelihood	-82.26034	-240.9130	-262.5042
Akaike AIC	1.721615	3.851181	4.140996
Schwarz SC	2.649008	4.778573	5.068389
Mean dependent	-0.298496	0.752024	-1.289990
S.D. dependent	0.609812	1.433397	1.697725

Determinant resid covariance (dof adj.)	1.403717
Determinant resid covariance	0.463695
Log likelihood	-577.0102
Akaike information criterion	9.597452
Schwarz criterion	12.37963

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.069857	.004367	.135347	.072147	.005295	.138999
2	.145045	.049528	.240562	.140688	.051239	.230137
3	.185024	.064347	.305701	.193253	.082261	.304245
4	.263984	.120474	.407494	.293253	.163039	.423468
5	.299678	.133768	.465588	.333095	.18398	.48221
6	.379123	.181225	.577021	.394651	.218908	.570395
7	.428886	.196363	.661409	.499933	.295673	.704194
8	.469622	.20272	.736525	.520597	.28573	.755464
9	.525912	.228481	.823342	.564042	.303193	.824891
10	.538437	.21373	.863143	.598395	.313422	.883369
11	.563547	.212378	.914716	.587232	.279159	.895305
12	.543074	.171545	.914603	.601103	.275512	.926694
13	.592362	.200651	.984073	.653975	.312767	.995183
14	.573034	.162234	.983834	.697116	.339591	1.05464
15	.553922	.12604	.981805	.705951	.335781	1.07612
16	.599006	.156727	1.04128	.660663	.28039	1.04093
17	.587866	.132303	1.04343	.691416	.304037	1.07879
18	.552425	.088439	1.01641	.691392	.297741	1.08504
19	.524769	.0545	.995039	.70906	.310885	1.10723
20	.473378	-.001636	.948391	.7052	.303624	1.10678
21	.468272	-.012171	.948716	.714253	.310872	1.11763

```
95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp
```

Segment 4: 06/01/2009 to 31/12/2010

Diesel

Vector Autoregression Estimates

Sample (adjusted): 2/01/2009 12/30/2010
Included observations: 484 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DDP	PWP	NWP
DDP(-1)	-0.109681	-0.047977	0.025273
	(0.04842)	(0.13885)	(0.13556)
	[-2.26535]	[-0.34552]	[0.18643]
DDP(-2)	0.020872	-0.048606	-0.015619
	(0.04867)	(0.13957)	(0.13627)
	[0.42886]	[-0.34826]	[-0.11462]
DDP(-3)	0.057909	-0.321822	0.082493
	(0.04840)	(0.13881)	(0.13552)
	[1.19643]	[-2.31847]	[0.60871]
DDP(-4)	0.041208	0.042320	0.068318
	(0.04882)	(0.14000)	(0.13669)
	[0.84412]	[0.30228]	[0.49981]
DDP(-5)	0.186926	-0.125378	-0.102446
	(0.04873)	(0.13974)	(0.13644)
	[3.83611]	[-0.89720]	[-0.75087]
DDP(-6)	0.020200	0.000146	-0.040792
	(0.04940)	(0.14168)	(0.13833)
	[0.40888]	[0.00103]	[-0.29488]
DDP(-7)	-0.023324	0.003696	-0.199785
	(0.04884)	(0.14007)	(0.13675)
	[-0.47756]	[0.02639]	[-1.46093]
DDP(-8)	0.006924	-0.027879	-0.014232
	(0.04844)	(0.13892)	(0.13563)
	[0.14294]	[-0.20069]	[-0.10494]
DDP(-9)	0.035637	0.104008	0.001466
	(0.04808)	(0.13789)	(0.13463)
	[0.74117]	[0.75427]	[0.01089]
DDP(-10)	0.065360	0.149765	-0.064630
	(0.04808)	(0.13789)	(0.13463)
	[1.35933]	[1.08610]	[-0.48006]
DDP(-11)	0.013469	-0.101074	-0.169420
	(0.04817)	(0.13815)	(0.13488)
	[0.27959]	[-0.73161]	[-1.25606]
DDP(-12)	-0.008607	-0.323515	-0.104199
	(0.04806)	(0.13782)	(0.13455)
	[-0.17911]	[-2.34745]	[-0.77441]

DDP(-13)	-0.029390	0.032574	-0.055221
	(0.04743)	(0.13603)	(0.13281)
	[-0.61959]	[0.23946]	[-0.41579]
DDP(-14)	0.041327	0.039242	-0.072684
	(0.04729)	(0.13563)	(0.13242)
	[0.87381]	[0.28932]	[-0.54888]
DDP(-15)	0.097648	-0.143245	-0.119432
	(0.04719)	(0.13534)	(0.13214)
	[2.06911]	[-1.05838]	[-0.90383]
DDP(-16)	0.039619	-0.000247	-0.004076
	(0.04726)	(0.13552)	(0.13232)
	[0.83837]	[-0.00182]	[-0.03081]
DDP(-17)	0.007681	0.054345	0.023403
	(0.04703)	(0.13488)	(0.13169)
	[0.16331]	[0.40291]	[0.17772]
PWP(-1)	0.008162	-0.014683	0.038087
	(0.01867)	(0.05353)	(0.05226)
	[0.43728]	[-0.27427]	[0.72873]
PWP(-2)	0.021558	0.077555	0.046820
	(0.01863)	(0.05342)	(0.05216)
	[1.15730]	[1.45179]	[0.89769]
PWP(-3)	0.037634	0.018568	0.049306
	(0.01847)	(0.05297)	(0.05172)
	[2.03743]	[0.35052]	[0.95334]
PWP(-4)	0.029730	0.007302	-0.010424
	(0.01817)	(0.05210)	(0.05087)
	[1.63645]	[0.14014]	[-0.20493]
PWP(-5)	0.028290	0.042732	-0.073884
	(0.01816)	(0.05208)	(0.05085)
	[1.55783]	[0.82052]	[-1.45308]
PWP(-6)	0.034802	0.011375	-0.062190
	(0.01817)	(0.05211)	(0.05087)
	[1.91536]	[0.21830]	[-1.22242]
PWP(-7)	0.012721	0.029734	-0.051829
	(0.01823)	(0.05228)	(0.05104)
	[0.69780]	[0.56874]	[-1.01539]
PWP(-8)	0.006732	0.146698	-0.002072
	(0.01808)	(0.05185)	(0.05062)
	[0.37234]	[2.82936]	[-0.04093]
PWP(-9)	-0.004135	-0.036141	-0.086816
	(0.01829)	(0.05245)	(0.05121)
	[-0.22609]	[-0.68901]	[-1.69521]
PWP(-10)	0.025327	0.031798	-0.162142
	(0.01801)	(0.05164)	(0.05042)
	[1.40652]	[0.61575]	[-3.21591]
PWP(-11)	0.031673	0.007797	-0.083847
	(0.01822)	(0.05225)	(0.05101)

	[1.73846]	[0.14923]	[-1.64367]
PWP(-12)	0.004114	0.034109	-0.015274
	(0.01834)	(0.05258)	(0.05134)
	[0.22437]	[0.64869]	[-0.29752]
PWP(-13)	0.009815	0.099809	0.036584
	(0.01816)	(0.05209)	(0.05085)
	[0.54042]	[1.91626]	[0.71942]
PWP(-14)	0.011015	-0.004047	-0.061195
	(0.01815)	(0.05204)	(0.05081)
	[0.60700]	[-0.07776]	[-1.20442]
PWP(-15)	-0.007217	-0.088355	-0.019784
	(0.01804)	(0.05173)	(0.05051)
	[-0.40005]	[-1.70788]	[-0.39169]
PWP(-16)	0.024583	0.064895	-0.009121
	(0.01808)	(0.05186)	(0.05063)
	[1.35956]	[1.25147]	[-0.18016]
PWP(-17)	0.008003	0.127921	-0.027909
	(0.01800)	(0.05161)	(0.05039)
	[0.44474]	[2.47865]	[-0.55389]
NWP(-1)	0.001825	0.015472	0.001972
	(0.01937)	(0.05554)	(0.05423)
	[0.09421]	[0.27856]	[0.03637]
NWP(-2)	-0.018179	-0.042082	-0.054367
	(0.01935)	(0.05548)	(0.05417)
	[-0.93971]	[-0.75852]	[-1.00370]
NWP(-3)	0.020978	0.053478	0.020269
	(0.01927)	(0.05527)	(0.05396)
	[1.08849]	[0.96758]	[0.37562]
NWP(-4)	0.014610	-0.067737	-0.018343
	(0.01925)	(0.05520)	(0.05390)
	[0.75901]	[-1.22704]	[-0.34033]
NWP(-5)	0.012805	-0.100025	-0.004557
	(0.01925)	(0.05522)	(0.05391)
	[0.66502]	[-1.81144]	[-0.08453]
NWP(-6)	0.030539	-0.025653	0.011175
	(0.01928)	(0.05530)	(0.05399)
	[1.58366]	[-0.46385]	[0.20697]
NWP(-7)	0.037839	0.089797	0.053460
	(0.01919)	(0.05504)	(0.05373)
	[1.97174]	[1.63163]	[0.99493]
NWP(-8)	0.028938	-0.178453	0.011023
	(0.01870)	(0.05362)	(0.05236)
	[1.54760]	[-3.32781]	[0.21054]
NWP(-9)	0.059365	-0.019102	-0.001928
	(0.01890)	(0.05420)	(0.05292)
	[3.14083]	[-0.35241]	[-0.03644]

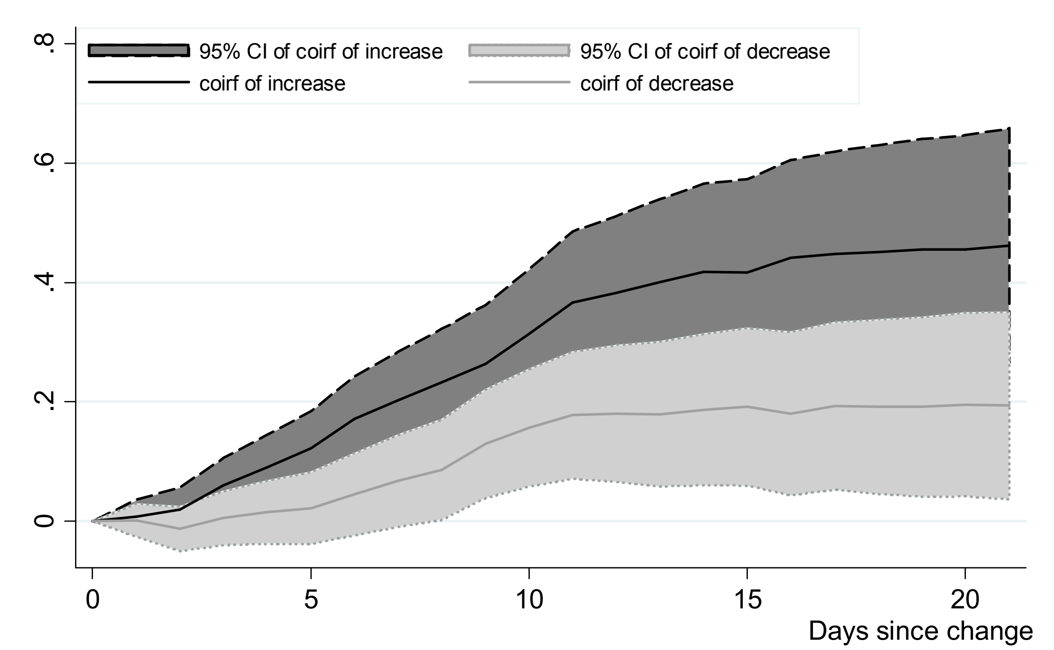
NWP(-10)	0.042760	-0.000834	0.065996
	(0.01905)	(0.05462)	(0.05333)
	[2.24507]	[-0.01527]	[1.23754]
NWP(-11)	0.034215	-0.027213	0.067738
	(0.01891)	(0.05422)	(0.05293)
	[1.80982]	[-0.50192]	[1.27967]
NWP(-12)	0.007432	0.021215	0.076385
	(0.01892)	(0.05425)	(0.05297)
	[0.39283]	[0.39103]	[1.44207]
NWP(-13)	-0.005927	-0.028863	0.016252
	(0.01890)	(0.05420)	(0.05291)
	[-0.31363]	[-0.53255]	[0.30714]
NWP(-14)	0.001485	0.005063	0.069986
	(0.01888)	(0.05416)	(0.05288)
	[0.07863]	[0.09348]	[1.32360]
NWP(-15)	0.003594	-0.090524	-0.026641
	(0.01880)	(0.05392)	(0.05264)
	[0.19117]	[-1.67883]	[-0.50606]
NWP(-16)	-0.013926	-0.029412	0.020167
	(0.01870)	(0.05364)	(0.05237)
	[-0.74462]	[-0.54835]	[0.38511]
NWP(-17)	0.007889	-0.078124	0.025355
	(0.01872)	(0.05370)	(0.05243)
	[0.42131]	[-1.45489]	[0.48364]
RD(-1)	-0.000732	-0.000850	0.002151
	(0.00272)	(0.00780)	(0.00761)
	[-0.26928]	[-0.10904]	[0.28254]
R-squared	0.225694	0.098225	0.085281
Adj. R-squared	0.134283	-0.008234	-0.022706
Sum sq. resids	47.68168	392.1572	373.8102
S.E. equation	0.332226	0.952770	0.930216
F-statistic	2.469000	0.922652	0.789734
Log likelihood	-125.9221	-635.8441	-624.2488
Akaike AIC	0.735215	2.842331	2.794416
Schwarz SC	1.184530	3.291646	3.243731
Mean dependent	0.059653	0.673927	-0.586724
S.D. dependent	0.357064	0.948872	0.919832

Determinant resid covariance (dof adj.)	0.068040
Determinant resid covariance	0.048382
Log likelihood	-1327.369
Akaike information criterion	6.129623
Schwarz criterion	7.477568

```
. irf ctable (diesel pwp ddp coirf, ci) (diesel nwp ddp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.008072	-.019848	.035992	.001421	-.0265	.029341
2	.019372	-.018178	.056922	-.012788	-.050113	.024537
3	.060196	.014306	.106087	.005019	-.040294	.050332
4	.090613	.036613	.144612	.015139	-.037797	.068074
5	.122014	.060094	.183935	.022067	-.038122	.082255
6	.171141	.099295	.242986	.045097	-.023998	.114192
7	.202785	.121804	.283766	.067448	-.009638	.144533
8	.232299	.14247	.322128	.086209	.002047	.170371
9	.263358	.164248	.362468	.129747	.038564	.220931
10	.313627	.205195	.422059	.156334	.057776	.254892
11	.366723	.24762	.485825	.177546	.070744	.284348
12	.382179	.252724	.511634	.180499	.065805	.295193
13	.400876	.261912	.539841	.17944	.058158	.300723
14	.417506	.269561	.565451	.186778	.059934	.313623
15	.417187	.260946	.573428	.191644	.059459	.32383
16	.441138	.276988	.605287	.18031	.043398	.317223
17	.447832	.276187	.619476	.193292	.052805	.333778
18	.451643	.272897	.63039	.191893	.045698	.338088
19	.455404	.270193	.640615	.191464	.041007	.341921
20	.455654	.264623	.646684	.195606	.04161	.349602
21	.462084	.265695	.658473	.193634	.036591	.350677

```
95% lower and upper bounds reported
(1) irfname = diesel, impulse = pwp, and response = ddp
(2) irfname = diesel, impulse = nwp, and response = ddp
```



S4 - Diesel

Gasoline

Vector Autoregression Estimates

Sample (adjusted): 1/28/2009 12/30/2010
Included observations: 486 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DGP	PSP	NSP
DGP(-1)	-0.002543	0.029698	0.025412
	(0.04774)	(0.15583)	(0.15745)
	[-0.05326]	[0.19058]	[0.16139]
DGP(-2)	0.101268	0.101853	-0.019816
	(0.04769)	(0.15569)	(0.15732)
	[2.12330]	[0.65418]	[-0.12596]
DGP(-3)	0.032106	-0.309994	-0.033263
	(0.04812)	(0.15710)	(0.15873)
	[0.66716]	[-1.97324]	[-0.20955]
DGP(-4)	-0.076103	-0.133982	-0.000461
	(0.04830)	(0.15767)	(0.15931)
	[-1.57566]	[-0.84976]	[-0.00290]
DGP(-5)	0.159734	0.131060	0.213875
	(0.04831)	(0.15769)	(0.15933)
	[3.30673]	[0.83111]	[1.34231]
DGP(-6)	0.066945	0.059472	0.034831
	(0.04843)	(0.15811)	(0.15976)
	[1.38219]	[0.37614]	[0.21803]
DGP(-7)	-0.006695	0.077676	-0.070561
	(0.04838)	(0.15795)	(0.15959)
	[-0.13838]	[0.49178]	[-0.44213]
DGP(-8)	0.051048	0.056293	-0.274961
	(0.04830)	(0.15768)	(0.15932)
	[1.05688]	[0.35702]	[-1.72588]
DGP(-9)	-0.016729	-0.158711	0.202924
	(0.04857)	(0.15857)	(0.16022)
	[-0.34440]	[-1.00088]	[1.26652]
DGP(-10)	0.044045	-0.063686	-0.173929
	(0.04761)	(0.15542)	(0.15704)
	[0.92512]	[-0.40977]	[-1.10756]
DGP(-11)	0.004564	-0.111825	-0.206146
	(0.04693)	(0.15319)	(0.15478)
	[0.09726]	[-0.72998]	[-1.33183]
DGP(-12)	0.014519	-0.286373	-0.014616
	(0.04681)	(0.15281)	(0.15440)
	[0.31017]	[-1.87401]	[-0.09466]
DGP(-13)	-0.012672	0.240933	0.346554
	(0.04655)	(0.15197)	(0.15355)
	[-0.27219]	[1.58537]	[2.25688]

DGP(-14)	0.006392	0.010292	-0.053668
	(0.04586)	(0.14972)	(0.15128)
	[0.13936]	[0.06874]	[-0.35476]
DGP(-15)	0.049702	0.025230	-0.314576
	(0.04508)	(0.14717)	(0.14870)
	[1.10250]	[0.17144]	[-2.11555]
PSP(-1)	-0.012621	0.176888	0.028416
	(0.01598)	(0.05217)	(0.05271)
	[-0.78979]	[3.39074]	[0.53909]
PSP(-2)	0.051734	-0.006337	-0.026673
	(0.01592)	(0.05198)	(0.05252)
	[3.24890]	[-0.12190]	[-0.50783]
PSP(-3)	0.053640	0.084280	0.057919
	(0.01607)	(0.05246)	(0.05300)
	[3.33822]	[1.60671]	[1.09279]
PSP(-4)	0.046864	0.040833	-0.052271
	(0.01622)	(0.05294)	(0.05349)
	[2.88982]	[0.77132]	[-0.97720]
PSP(-5)	0.003994	0.028309	0.014387
	(0.01641)	(0.05356)	(0.05411)
	[0.24343]	[0.52860]	[0.26587]
PSP(-6)	0.056267	0.002917	-0.023321
	(0.01638)	(0.05347)	(0.05403)
	[3.43501]	[0.05456]	[-0.43162]
PSP(-7)	0.022798	0.075116	-0.017019
	(0.01649)	(0.05382)	(0.05438)
	[1.38277]	[1.39564]	[-0.31296]
PSP(-8)	0.021487	0.011389	-0.078618
	(0.01648)	(0.05381)	(0.05437)
	[1.30358]	[0.21165]	[-1.44602]
PSP(-9)	0.000388	0.060728	0.028582
	(0.01647)	(0.05376)	(0.05432)
	[0.02356]	[1.12970]	[0.52621]
PSP(-10)	-0.002881	0.032374	-0.146800
	(0.01645)	(0.05371)	(0.05427)
	[-0.17509]	[0.60275]	[-2.70499]
PSP(-11)	-0.004271	0.016165	-0.020876
	(0.01664)	(0.05433)	(0.05490)
	[-0.25662]	[0.29754]	[-0.38029]
PSP(-12)	0.006835	-0.017362	-0.087226
	(0.01653)	(0.05397)	(0.05453)
	[0.41340]	[-0.32170]	[-1.59953]
PSP(-13)	0.020581	0.113517	0.067157
	(0.01649)	(0.05383)	(0.05439)
	[1.24818]	[2.10891]	[1.23479]
PSP(-14)	-0.001111	-0.032892	-0.073337

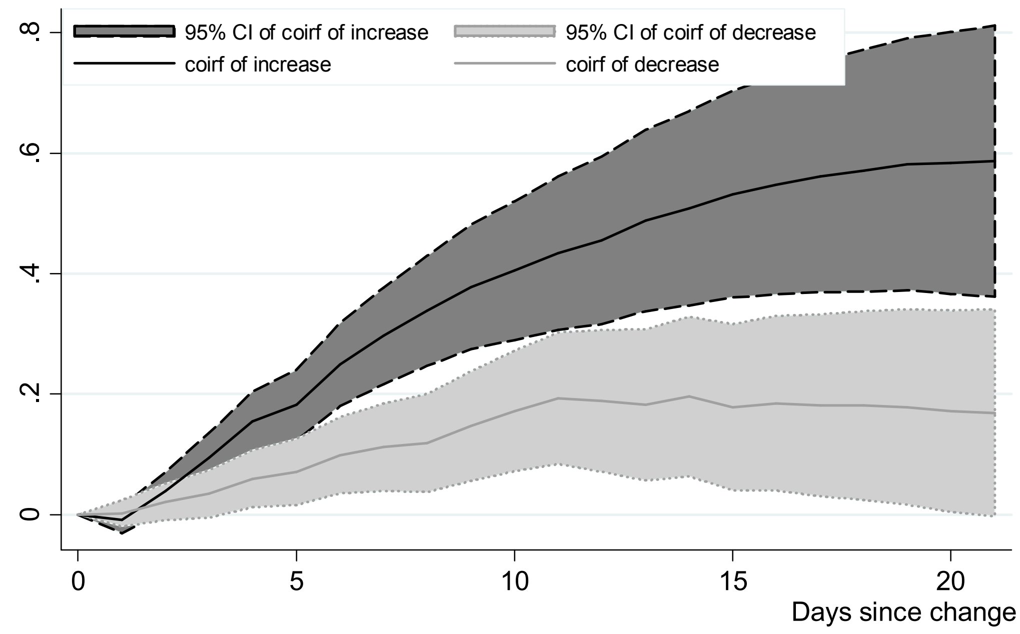
	(0.01649)	(0.05384)	(0.05440)
	[-0.06737]	[-0.61090]	[-1.34804]
PSP(-15)	0.018128	0.052179	-0.053240
	(0.01643)	(0.05363)	(0.05419)
	[1.10337]	[0.97288]	[-0.98243]
NSP(-1)	0.002604	0.040482	0.149725
	(0.01590)	(0.05189)	(0.05243)
	[0.16383]	[0.78015]	[2.85572]
NSP(-2)	0.026619	-0.099571	0.007797
	(0.01601)	(0.05226)	(0.05281)
	[1.66274]	[-1.90524]	[0.14765]
NSP(-3)	0.010274	0.022359	0.042735
	(0.01605)	(0.05241)	(0.05296)
	[0.63995]	[0.42662]	[0.80700]
NSP(-4)	0.031416	-0.068538	-0.088517
	(0.01592)	(0.05196)	(0.05250)
	[1.97384]	[-1.31910]	[-1.68607]
NSP(-5)	0.009301	3.12E-05	-0.015038
	(0.01601)	(0.05226)	(0.05280)
	[0.58102]	[0.00060]	[-0.28480]
NSP(-6)	0.041017	-0.071890	-0.023723
	(0.01571)	(0.05127)	(0.05180)
	[2.61165]	[-1.40217]	[-0.45795]
NSP(-7)	0.009290	-0.032346	0.076854
	(0.01582)	(0.05163)	(0.05217)
	[0.58737]	[-0.62648]	[1.47319]
NSP(-8)	0.015874	-0.071095	0.085811
	(0.01562)	(0.05100)	(0.05153)
	[1.01608]	[-1.39398]	[1.66518]
NSP(-9)	0.036282	-0.091672	-0.027429
	(0.01571)	(0.05130)	(0.05183)
	[2.30898]	[-1.78709]	[-0.52921]
NSP(-10)	0.039755	0.042484	0.110803
	(0.01578)	(0.05152)	(0.05206)
	[2.51878]	[0.82453]	[2.12833]
NSP(-11)	0.029498	-0.040451	0.028076
	(0.01596)	(0.05210)	(0.05265)
	[1.84815]	[-0.77636]	[0.53330]
NSP(-12)	-0.011513	0.031100	0.135228
	(0.01586)	(0.05178)	(0.05232)
	[-0.72591]	[0.60066]	[2.58486]
NSP(-13)	-0.002108	-0.093996	-0.058972
	(0.01600)	(0.05224)	(0.05278)
	[-0.13173]	[-1.79943]	[-1.11732]
NSP(-14)	0.013073	0.059368	0.030482
	(0.01581)	(0.05163)	(0.05216)
	[0.82665]	[1.14994]	[0.58435]

NSP(-15)	-0.010399	-0.068296	0.002912
	(0.01571)	(0.05129)	(0.05182)
	[-0.66192]	[-1.33169]	[0.05619]
RG(-1)	-0.001329	0.001017	0.000499
	(0.00213)	(0.00695)	(0.00702)
	[-0.62414]	[0.14638]	[0.07111]
R-squared	0.365126	0.086149	0.109246
Adj. R-squared	0.300196	-0.007314	0.018146
Sum sq. resids	29.15192	310.6649	317.1655
S.E. equation	0.257399	0.840272	0.849017
F-statistic	5.623354	0.921749	1.199192
Log likelihood	-5.877960	-580.8631	-585.8954
Akaike AIC	0.213490	2.579684	2.600392
Schwarz SC	0.609715	2.975909	2.996618
Mean dependent	0.079982	0.606182	-0.507799
S.D. dependent	0.307694	0.837216	0.856827
Determinant resid covariance (dof adj.)		0.027795	
Determinant resid covariance		0.020626	
Log likelihood		-1125.680	
Akaike information criterion		5.200328	
Schwarz criterion		6.389004	

```
. irf ctable (gas psp dgp coirf, ci) (gas nsp dgp coirf, ci)
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	-.009219	-.031117	.01268	.001911	-.019848	.023671
2	.039202	.007688	.070716	.021357	-.009449	.052162
3	.094431	.053594	.135268	.034364	-.005152	.073881
4	.154612	.104418	.204806	.059624	.012035	.107213
5	.181824	.123171	.240478	.070975	.015904	.126045
6	.248893	.179678	.318109	.098442	.035085	.1618
7	.296856	.216617	.377096	.111771	.039133	.18441
8	.338141	.246714	.429569	.118842	.037204	.20048
9	.378043	.274662	.481424	.14687	.055917	.237823
10	.405063	.289869	.520257	.171928	.071955	.271901
11	.433815	.306433	.561197	.19309	.083874	.302307
12	.455404	.3162	.594609	.188679	.070835	.306523
13	.488087	.337734	.638439	.182148	.056521	.307774
14	.508568	.347213	.669922	.196021	.063415	.328627
15	.532011	.360634	.703388	.178153	.040119	.316188
16	.547104	.365283	.728925	.184879	.039721	.330038
17	.560969	.369411	.752527	.181434	.030367	.332501
18	.57081	.370001	.771618	.180819	.024002	.337635
19	.581464	.372103	.790825	.178403	.016177	.340629
20	.583659	.366099	.80122	.171495	.00418	.33881
21	.586512	.361387	.811638	.168934	-.002944	.340811

95% lower and upper bounds reported
(1) irfname = gas, impulse = psp, and response = dgp
(2) irfname = gas, impulse = nsp, and response = dgp


95% CI of coirf of increase
95% CI of coirf of decrease
coirf of increase
coirf of decrease
0
.2
.4
.6
.8
0
5
10
15
20
Days since change

S4 - Gasoline

APPENDIX C: Price Stickiness in a Competitive Petroleum Retail Market

NOMENCLATURE:

P= RETAIL DIESEL PRICE

DP= FIRST DIFFERENCE OF D

DG= FIRST DIFFERENCE OF RETAIL G

DS= FIRST DIFFERENCE OF S

DW= FIRST DIFFERENCE OF W

G= RETAIL GASOLINE PRICE

NS= NEGATIVE CHANGE IN S

NW= NEGATIVE CHANGE IN W

PS= POSITIVE CHANGE IN S

NS= NEGATIVE CHANGE IN W

SP= WHOLESALE GASOLINE PRICE

WP= WHOLESALE DIESEL PRICE

C1 – ALL STATIONS DIESEL

UNIT ROOT TEST ON W

Null Hypothesis: W has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.750648	0.9931
Test critical values:	1% level	-3.448062	
	5% level	-2.869241	
	10% level	-2.570940	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(W)
Method: Least Squares

Sample (adjusted): 2/01/2008 31/12/2008
Included observations: 365 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
W(-1)	0.002997	0.003992	0.750648	0.4534
C	-0.540358	0.518207	-1.042746	0.2978

R-squared	0.001550	Mean dependent var	-0.164023
Adjusted R-squared	-0.001201	S.D. dependent var	2.503319
S.E. of regression	2.504822	Akaike info criterion	4.679777
Sum squared resid	2277.510	Schwarz criterion	4.701146
Log likelihood	-852.0593	Hannan-Quinn criter.	4.688269
F-statistic	0.563472	Durbin-Watson stat	1.870845
Prob(F-statistic)	0.453351		

UNIT ROOT TEST ON P

Null Hypothesis: P has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.147472	0.9978
Test critical values:	1% level	-3.448262	
	5% level	-2.869329	
	10% level	-2.570987	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(P)

Method: Least Squares

Sample (adjusted): 6/01/2008 31/12/2008
Included observations: 361 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
P(-1)	0.003598	0.003136	1.147472	0.2520
D(P(-1))	-0.212243	0.052804	-4.019467	0.0001
D(P(-2))	0.038157	0.052964	0.720433	0.4717
D(P(-3))	0.197362	0.052989	3.724599	0.0002
D(P(-4))	0.156750	0.052770	2.970433	0.0032
C	-0.656343	0.475897	-1.379169	0.1687

R-squared	0.091204	Mean dependent var	-0.158155
Adjusted R-squared	0.078404	S.D. dependent var	1.950252
S.E. of regression	1.872238	Akaike info criterion	4.108627
Sum squared resid	1244.372	Schwarz criterion	4.173262
Log likelihood	-735.6071	Hannan-Quinn criter.	4.134324
F-statistic	7.125334	Durbin-Watson stat	2.015188
Prob(F-statistic)	0.000002		

COINTEGRATION TEST

Sample (adjusted): 6/01/2008 31/12/2008
Included observations: 361 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: P W
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.124781	48.79789	20.26184	0.0000
At most 1	0.001892	0.683552	9.164546	0.9840

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.124781	48.11434	15.89210	0.0000
At most 1	0.001892	0.683552	9.164546	0.9840

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

P	W	C
-0.161076	0.176265	1.173228
-0.008582	0.016572	0.136946

Unrestricted Adjustment Coefficients (alpha):

D(P)	0.637574	-0.012825
D(W)	0.052615	-0.107465

1 Cointegrating Equation(s):	Log likelihood	-1536.560

Normalized cointegrating coefficients (standard error in parentheses)

P	W	C
1.000000	-1.094298	-7.283711
	(0.02893)	(3.81263)

Adjustment coefficients (standard error in parentheses)

D(P)	-0.102698
	(0.01472)
D(W)	-0.008475
	(0.02125)

CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1/01/2008 31/12/2008
Included observations: 350

Dependent variable: DP

Excluded	Chi-sq	df	Prob.
PW	31.98435	15	0.0065
NW	42.32857	15	0.0002
All	64.22044	30	0.0003

Dependent variable: PW

Excluded	Chi-sq	df	Prob.
DP	21.41381	15	0.1241
NW	19.55136	15	0.1898
All	42.26670	30	0.0679

Dependent variable: NW

Excluded	Chi-sq	df	Prob.
DP	26.12194	15	0.0368
PW	22.30967	15	0.0999
All	55.95813	30	0.0028

LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DP PW NW
Exogenous variables:

Sample: 1/01/2008 31/12/2008
Included observations: 350

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-2058.098	NA	27.06820	11.81199	11.91119*	11.85148
2	-2046.874	22.06402	26.72655	11.79928	11.99769	11.87825
3	-2023.369	45.80151	24.60119	11.71639	12.01400	11.83485
4	-2002.643	40.02944	23.00795	11.64939	12.04621	11.80734
5	-1997.297	10.23360	23.49522	11.67027	12.16629	11.86770
6	-1977.541	37.48158	22.09705	11.60880	12.20403	11.84572
7	-1940.411	69.80284	18.81899*	11.44806*	12.14249	11.72447*
8	-1932.539	14.66563	18.94466	11.45451	12.24814	11.77040
9	-1929.229	6.108680	19.57618	11.48702	12.37986	11.84240
10	-1922.462	12.37324	19.83443	11.49979	12.49183	11.89465
11	-1916.756	10.33587	20.21981	11.51861	12.60985	11.95296
12	-1909.133	13.67909	20.38975	11.52647	12.71692	12.00031
13	-1895.440	24.33435*	19.86209	11.49966	12.78931	12.01298
14	-1889.455	10.53259	20.22143	11.51689	12.90574	12.06970
15	-1882.517	12.09236	20.47760	11.52867	13.01673	12.12097

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 31/12/2008
Included observations: 357 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DP	PW	NW
DP(-1)	-0.296361	0.136840	-0.127736
	(0.05590)	(0.05097)	(0.04622)
	[-5.30204]	[2.68460]	[-2.76362]
DP(-2)	0.019895	0.019703	0.005651
	(0.05933)	(0.05411)	(0.04906)
	[0.33533]	[0.36416]	[0.11518]
DP(-3)	0.152493	-0.010261	0.030479
	(0.05887)	(0.05368)	(0.04868)
	[2.59032]	[-0.19113]	[0.62610]
DP(-4)	0.139519	0.025027	0.179986

	(0.05906)	(0.05386)	(0.04884)
	[2.36219]	[0.46465]	[3.68522]
DP(-5)	0.048862	0.084150	0.069560
	(0.06021)	(0.05490)	(0.04979)
	[0.81156]	[1.53267]	[1.39720]
DP(-6)	0.029281	-0.025435	0.060432
	(0.05836)	(0.05322)	(0.04826)
	[0.50174]	[-0.47793]	[1.25229]
DP(-7)	0.164689	0.046773	-0.067007
	(0.05974)	(0.05448)	(0.04940)
	[2.75677]	[0.85856]	[-1.35645]
DP(-8)	0.105263	0.040033	-0.037335
	(0.05979)	(0.05452)	(0.04944)
	[1.76062]	[0.73426]	[-0.75517]
PW(-1)	0.006344	0.064496	-0.025832
	(0.06427)	(0.05861)	(0.05315)
	[0.09871]	[1.10042]	[-0.48605]
PW(-2)	-0.049481	0.066065	0.010172
	(0.06233)	(0.05684)	(0.05154)
	[-0.79380]	[1.16221]	[0.19735]
PW(-3)	0.107350	0.039205	-0.037977
	(0.06190)	(0.05644)	(0.05118)
	[1.73438]	[0.69460]	[-0.74201]
PW(-4)	0.006132	0.001866	-0.088065
	(0.06184)	(0.05639)	(0.05113)
	[0.09917]	[0.03310]	[-1.72224]
PW(-5)	0.073671	-0.060949	-0.018116
	(0.06167)	(0.05623)	(0.05099)
	[1.19470]	[-1.08386]	[-0.35528]
PW(-6)	0.146543	0.054930	-0.031500
	(0.06152)	(0.05610)	(0.05087)
	[2.38219]	[0.97919]	[-0.61925]
PW(-7)	-0.059117	0.052772	-0.161060
	(0.06183)	(0.05638)	(0.05113)
	[-0.95611]	[0.93594]	[-3.15016]
PW(-8)	-0.064794	0.027808	-0.051108
	(0.06177)	(0.05633)	(0.05108)
	[-1.04888]	[0.49364]	[-1.00053]
NW(-1)	0.167172	-0.057186	0.131340
	(0.06977)	(0.06363)	(0.05769)
	[2.39597]	[-0.89878]	[2.27647]
NW(-2)	0.058378	-0.099415	-0.036105
	(0.06724)	(0.06132)	(0.05560)
	[0.86816]	[-1.62122]	[-0.64933]
NW(-3)	0.055242	-0.118786	0.045329
	(0.06631)	(0.06047)	(0.05483)
	[0.83308]	[-1.96438]	[0.82668]

NW(-4)	0.030382	0.045685	0.056522
	(0.06684)	(0.06095)	(0.05527)
	[0.45455]	[0.74953]	[1.02267]
NW(-5)	-0.087428	-0.019358	-0.029892
	(0.06546)	(0.05970)	(0.05413)
	[-1.33556]	[-0.32428]	[-0.55222]
NW(-6)	-0.014490	-0.060568	0.042084
	(0.06540)	(0.05964)	(0.05408)
	[-0.22158]	[-1.01564]	[0.77825]
NW(-7)	-0.012332	-0.179453	0.266422
	(0.06567)	(0.05988)	(0.05430)
	[-0.18780]	[-2.99679]	[4.90656]
NW(-8)	0.114650	-0.053692	0.096249
	(0.06923)	(0.06313)	(0.05725)
	[1.65600]	[-0.85043]	[1.68125]
R-squared	0.227790	0.066715	0.174340
Adj. R-squared	0.174454	0.002254	0.117313
Sum sq. resids	1051.490	874.4139	718.9749
S.E. equation	1.776971	1.620453	1.469382
F-statistic	4.270855	1.034962	3.057121
Log likelihood	-699.3817	-666.4646	-631.5272
Akaike AIC	4.052558	3.868149	3.672421
Schwarz SC	4.313246	4.128837	3.933110
Mean dependent	-0.165058	0.701603	-0.861600
S.D. dependent	1.955734	1.622282	1.563980

Determinant resid covariance (dof adj.)	15.22167
Determinant resid covariance	12.35351
Log likelihood	-1968.422
Akaike information criterion	11.43093
Schwarz criterion	12.21300

C2 – ALL STATIONS GASOLINE

UNIT ROOT TEST ON S

Null Hypothesis: S has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.231453	0.9983
Test critical values:	1% level	-3.448062	
	5% level	-2.869241	
	10% level	-2.570940	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(S)
Method: Least Squares

Sample (adjusted): 2/01/2008 31/12/2008
Included observations: 365 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
S(-1)	0.004303	0.003494	1.231453	0.2190
C	-0.572166	0.341355	-1.676161	0.0946

R-squared	0.004160	Mean dependent var	-0.169697
Adjusted R-squared	0.001417	S.D. dependent var	1.883830
S.E. of regression	1.882495	Akaike info criterion	4.108538
Sum squared resid	1286.395	Schwarz criterion	4.129907
Log likelihood	-747.8082	Hannan-Quinn criter.	4.117030
F-statistic	1.516476	Durbin-Watson stat	1.823663
Prob(F-statistic)	0.218951		

UNIT ROOT TEST ON G

Null Hypothesis: G has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.993421	1.0000
Test critical values:	1% level	-3.448111	
	5% level	-2.869263	
	10% level	-2.570952	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(G)

Method: Least Squares

Sample (adjusted): 3/01/2008 31/12/2008
Included observations: 364 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G(-1)	0.008320	0.002779	2.993421	0.0029
D(G(-1))	-0.179077	0.052374	-3.419175	0.0007
C	-1.221079	0.345379	-3.535473	0.0005

R-squared	0.046787	Mean dependent var	-0.188861
Adjusted R-squared	0.041506	S.D. dependent var	1.586675
S.E. of regression	1.553398	Akaike info criterion	3.726974
Sum squared resid	871.1091	Schwarz criterion	3.759093
Log likelihood	-675.3093	Hannan-Quinn criter.	3.739740
F-statistic	8.859503	Durbin-Watson stat	1.985373
Prob(F-statistic)	0.000175		

COINTEGRATION TEST

Sample (adjusted): 10/01/2008 31/12/2008
Included observations: 357 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: G S
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.064151	25.26479	20.26184	0.0094
At most 1	0.004459	1.595268	9.164546	0.8560

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.064151	23.66952	15.89210	0.0025
At most 1	0.004459	1.595268	9.164546	0.8560

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

G	S	C
-0.227024	0.257975	2.742206

0.056268	-0.048016	-3.240202

Unrestricted Adjustment Coefficients (alpha):

D(G)	0.356049	0.027437
D(S)	-0.062165	0.121338

1 Cointegrating Equation(s): Log likelihood -1349.926

Normalized cointegrating coefficients (standard error in parentheses)

G	S	C
1.000000	-1.136334	-12.07894
	(0.03730)	(3.78053)

Adjustment coefficients (standard error in parentheses)

D(G)	-0.080832
	(0.01749)
D(S)	0.014113
	(0.02256)

CAUSALITY

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1/01/2008 31/12/2008
Included observations: 357

Dependent variable: DP

Excluded	Chi-sq	df	Prob.
PW	13.44340	8	0.0975
NW	18.07859	8	0.0206
All	31.58668	16	0.0113

Dependent variable: PW

Excluded	Chi-sq	df	Prob.
DP	15.53305	8	0.0496
NW	30.01539	8	0.0002
All	43.78704	16	0.0002

Dependent variable: NW

Excluded	Chi-sq	df	Prob.
DP	23.65469	8	0.0026
PW	20.15668	8	0.0098
All	48.59173	16	0.0000

LAG LENGTH

VAR Lag Order Selection Criteria
Endogenous variables: DP PW NW
Exogenous variables:

Sample: 1/01/2008 31/12/2008
Included observations: 350

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-2058.098	NA	27.06820	11.81199	11.91119*	11.85148
2	-2046.874	22.06402	26.72655	11.79928	11.99769	11.87825
3	-2023.369	45.80151	24.60119	11.71639	12.01400	11.83485
4	-2002.643	40.02944	23.00795	11.64939	12.04621	11.80734
5	-1997.297	10.23360	23.49522	11.67027	12.16629	11.86770
6	-1977.541	37.48158	22.09705	11.60880	12.20403	11.84572
7	-1940.411	69.80284	18.81899*	11.44806*	12.14249	11.72447*
8	-1932.539	14.66563	18.94466	11.45451	12.24814	11.77040
9	-1929.229	6.108680	19.57618	11.48702	12.37986	11.84240
10	-1922.462	12.37324	19.83443	11.49979	12.49183	11.89465
11	-1916.756	10.33587	20.21981	11.51861	12.60985	11.95296
12	-1909.133	13.67909	20.38975	11.52647	12.71692	12.00031
13	-1895.440	24.33435*	19.86209	11.49966	12.78931	12.01298
14	-1889.455	10.53259	20.22143	11.51689	12.90574	12.06970
15	-1882.517	12.09236	20.47760	11.52867	13.01673	12.12097

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 31/12/2008
Included observations: 357 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DP	PW	NW
DP(-1)	-0.296361	0.136840	-0.127736
	(0.05590)	(0.05097)	(0.04622)
	[-5.30204]	[2.68460]	[-2.76362]
DP(-2)	0.019895	0.019703	0.005651
	(0.05933)	(0.05411)	(0.04906)
	[0.33533]	[0.36416]	[0.11518]
DP(-3)	0.152493	-0.010261	0.030479
	(0.05887)	(0.05368)	(0.04868)
	[2.59032]	[-0.19113]	[0.62610]
DP(-4)	0.139519	0.025027	0.179986

	(0.05906)	(0.05386)	(0.04884)
	[2.36219]	[0.46465]	[3.68522]
DP(-5)	0.048862	0.084150	0.069560
	(0.06021)	(0.05490)	(0.04979)
	[0.81156]	[1.53267]	[1.39720]
DP(-6)	0.029281	-0.025435	0.060432
	(0.05836)	(0.05322)	(0.04826)
	[0.50174]	[-0.47793]	[1.25229]
DP(-7)	0.164689	0.046773	-0.067007
	(0.05974)	(0.05448)	(0.04940)
	[2.75677]	[0.85856]	[-1.35645]
DP(-8)	0.105263	0.040033	-0.037335
	(0.05979)	(0.05452)	(0.04944)
	[1.76062]	[0.73426]	[-0.75517]
PW(-1)	0.006344	0.064496	-0.025832
	(0.06427)	(0.05861)	(0.05315)
	[0.09871]	[1.10042]	[-0.48605]
PW(-2)	-0.049481	0.066065	0.010172
	(0.06233)	(0.05684)	(0.05154)
	[-0.79380]	[1.16221]	[0.19735]
PW(-3)	0.107350	0.039205	-0.037977
	(0.06190)	(0.05644)	(0.05118)
	[1.73438]	[0.69460]	[-0.74201]
PW(-4)	0.006132	0.001866	-0.088065
	(0.06184)	(0.05639)	(0.05113)
	[0.09917]	[0.03310]	[-1.72224]
PW(-5)	0.073671	-0.060949	-0.018116
	(0.06167)	(0.05623)	(0.05099)
	[1.19470]	[-1.08386]	[-0.35528]
PW(-6)	0.146543	0.054930	-0.031500
	(0.06152)	(0.05610)	(0.05087)
	[2.38219]	[0.97919]	[-0.61925]
PW(-7)	-0.059117	0.052772	-0.161060
	(0.06183)	(0.05638)	(0.05113)
	[-0.95611]	[0.93594]	[-3.15016]
PW(-8)	-0.064794	0.027808	-0.051108
	(0.06177)	(0.05633)	(0.05108)
	[-1.04888]	[0.49364]	[-1.00053]
NW(-1)	0.167172	-0.057186	0.131340
	(0.06977)	(0.06363)	(0.05769)
	[2.39597]	[-0.89878]	[2.27647]
NW(-2)	0.058378	-0.099415	-0.036105
	(0.06724)	(0.06132)	(0.05560)
	[0.86816]	[-1.62122]	[-0.64933]
NW(-3)	0.055242	-0.118786	0.045329
	(0.06631)	(0.06047)	(0.05483)
	[0.83308]	[-1.96438]	[0.82668]

NW(-4)	0.030382	0.045685	0.056522
	(0.06684)	(0.06095)	(0.05527)
	[0.45455]	[0.74953]	[1.02267]
NW(-5)	-0.087428	-0.019358	-0.029892
	(0.06546)	(0.05970)	(0.05413)
	[-1.33556]	[-0.32428]	[-0.55222]
NW(-6)	-0.014490	-0.060568	0.042084
	(0.06540)	(0.05964)	(0.05408)
	[-0.22158]	[-1.01564]	[0.77825]
NW(-7)	-0.012332	-0.179453	0.266422
	(0.06567)	(0.05988)	(0.05430)
	[-0.18780]	[-2.99679]	[4.90656]
NW(-8)	0.114650	-0.053692	0.096249
	(0.06923)	(0.06313)	(0.05725)
	[1.65600]	[-0.85043]	[1.68125]
R-squared	0.227790	0.066715	0.174340
Adj. R-squared	0.174454	0.002254	0.117313
Sum sq. resids	1051.490	874.4139	718.9749
S.E. equation	1.776971	1.620453	1.469382
F-statistic	4.270855	1.034962	3.057121
Log likelihood	-699.3817	-666.4646	-631.5272
Akaike AIC	4.052558	3.868149	3.672421
Schwarz SC	4.313246	4.128837	3.933110
Mean dependent	-0.165058	0.701603	-0.861600
S.D. dependent	1.955734	1.622282	1.563980

Determinant resid covariance (dof adj.)	15.22167
Determinant resid covariance	12.35351
Log likelihood	-1968.422
Akaike information criterion	11.43093
Schwarz criterion	12.21300

C3 – MAJORS DIESEL

UNIT ROOT TEST ON P

Null Hypothesis: P has a unit root
Exogenous: Constant
Lag Length: 14 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.982089	0.9964
Test critical values:	1% level	-3.448835	
	5% level	-2.869581	
	10% level	-2.571122	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(P)
Method: Least Squares

Sample (adjusted): 16/01/2008 30/12/2008
Included observations: 350 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
P(-1)	0.036608	0.037275	0.982089	0.3268
D(P(-1))	-0.951599	0.060492	-15.73106	0.0000
D(P(-2))	-0.869764	0.073981	-11.75663	0.0000
D(P(-3))	-0.791166	0.082765	-9.559130	0.0000
D(P(-4))	-0.725500	0.088534	-8.194559	0.0000
D(P(-5))	-0.670106	0.092181	-7.269434	0.0000
D(P(-6))	-0.621704	0.094218	-6.598553	0.0000
D(P(-7))	-0.576398	0.094799	-6.080224	0.0000
D(P(-8))	-0.549047	0.094124	-5.833205	0.0000
D(P(-9))	-0.519171	0.092166	-5.633000	0.0000
D(P(-10))	-0.499081	0.088717	-5.625566	0.0000
D(P(-11))	-0.483794	0.083576	-5.788647	0.0000
D(P(-12))	-0.479031	0.076131	-6.292218	0.0000
D(P(-13))	-0.476345	0.065224	-7.303240	0.0000
D(P(-14))	-0.485910	0.048216	-10.07773	0.0000
C	-6.844826	5.633563	-1.215008	0.2252

R-squared	0.576243	Mean dependent var	-0.163067
Adjusted R-squared	0.557212	S.D. dependent var	33.27464
S.E. of regression	22.14171	Akaike info criterion	9.077439
Sum squared resid	163745.2	Schwarz criterion	9.253802
Log likelihood	-1572.552	Hannan-Quinn criter.	9.147638
F-statistic	30.27922	Durbin-Watson stat	1.929450
Prob(F-statistic)	0.000000		

COINTEGRATION TEST

Sample (adjusted): 10/01/2008 30/12/2008
Included observations: 356 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: P W
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.088624	33.83752	20.26184	0.0004
At most 1	0.002247	0.800746	9.164546	0.9739

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.088624	33.03677	15.89210	0.0000
At most 1	0.002247	0.800746	9.164546	0.9739

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

P	W	C
-0.096843	0.102455	1.035384
0.012383	-0.007754	-1.826414

Unrestricted Adjustment Coefficients (alpha):

D(P)	6.866366	-0.320630
D(W)	0.257698	0.109832

1 Cointegrating Equation(s): Log likelihood -2447.175

Normalized cointegrating coefficients (standard error in parentheses)

P	W	C
1.000000	-1.057948	-10.69138
	(0.05790)	(7.63215)

Adjustment coefficients (standard error in parentheses)

D(P)	-0.664958
	(0.12116)
D(W)	-0.024956
	(0.01294)

1.4.4 THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 30/12/2008
Included observations: 356 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DP	PW	NW
DP(-1)	-0.862023	0.003237	-0.000678
	(0.05469)	(0.00366)	(0.00340)
	[-15.7629]	[0.88373]	[-0.19947]
DP(-2)	-0.753262	0.006049	0.001765
	(0.07173)	(0.00480)	(0.00446)
	[-10.5014]	[1.25922]	[0.39590]
DP(-3)	-0.634274	-0.000559	0.000597
	(0.08147)	(0.00546)	(0.00506)
	[-7.78495]	[-0.10236]	[0.11796]
DP(-4)	-0.512246	0.005325	-0.002926
	(0.08564)	(0.00574)	(0.00532)
	[-5.98159]	[0.92845]	[-0.54960]
DP(-5)	-0.399973	0.002480	-0.001650
	(0.08514)	(0.00570)	(0.00529)
	[-4.69782]	[0.43499]	[-0.31168]
DP(-6)	-0.306927	-0.004777	-0.003881
	(0.08033)	(0.00538)	(0.00499)
	[-3.82099]	[-0.88788]	[-0.77710]
DP(-7)	-0.202363	-0.003482	-0.000900
	(0.07085)	(0.00474)	(0.00440)
	[-2.85636]	[-0.73389]	[-0.20445]
DP(-8)	-0.111949	-0.001854	-0.000456
	(0.05338)	(0.00357)	(0.00332)
	[-2.09729]	[-0.51848]	[-0.13755]
PW(-1)	-0.777650	0.088440	-0.037835
	(0.85547)	(0.05729)	(0.05318)
	[-0.90904]	[1.54365]	[-0.71143]
PW(-2)	0.969898	0.061990	0.026122
	(0.82384)	(0.05518)	(0.05121)
	[1.17729]	[1.12352]	[0.51005]
PW(-3)	0.252564	0.040965	0.007282
	(0.82422)	(0.05520)	(0.05124)
	[0.30643]	[0.74211]	[0.14211]
PW(-4)	0.685545	0.042084	-0.070131
	(0.81792)	(0.05478)	(0.05085)
	[0.83816]	[0.76826]	[-1.37926]
PW(-5)	0.688219	-0.044543	-0.009905
	(0.81744)	(0.05475)	(0.05082)
	[0.84192]	[-0.81362]	[-0.19491]

PW(-6)	0.053274	0.057220	-0.049358
	(0.81536)	(0.05461)	(0.05069)
	[0.06534]	[1.04785]	[-0.97375]
PW(-7)	-0.727030	0.094988	-0.189566
	(0.81145)	(0.05435)	(0.05044)
	[-0.89596]	[1.74785]	[-3.75789]
PW(-8)	0.684675	0.040831	-0.024921
	(0.83451)	(0.05589)	(0.05188)
	[0.82045]	[0.73057]	[-0.48038]
NW(-1)	1.657997	-0.009812	0.112888
	(0.91698)	(0.06141)	(0.05701)
	[1.80811]	[-0.15977]	[1.98031]
NW(-2)	-0.999094	-0.080618	-0.046678
	(0.85457)	(0.05723)	(0.05313)
	[-1.16912]	[-1.40859]	[-0.87864]
NW(-3)	4.187045	-0.096529	-0.008803
	(0.84278)	(0.05644)	(0.05239)
	[4.96814]	[-1.71019]	[-0.16802]
NW(-4)	-1.028124	0.044770	0.083307
	(0.87664)	(0.05871)	(0.05450)
	[-1.17280]	[0.76255]	[1.52866]
NW(-5)	-0.007673	-0.000345	-0.013889
	(0.87556)	(0.05864)	(0.05443)
	[-0.00876]	[-0.00588]	[-0.25517]
NW(-6)	-0.347841	-0.026416	0.106307
	(0.87142)	(0.05836)	(0.05417)
	[-0.39917]	[-0.45262]	[1.96237]
NW(-7)	-0.430589	-0.202515	0.315933
	(0.87879)	(0.05886)	(0.05463)
	[-0.48998]	[-3.44089]	[5.78301]
NW(-8)	-0.350278	-0.011069	0.081179
	(0.94816)	(0.06350)	(0.05894)
	[-0.36943]	[-0.17432]	[1.37723]
R-squared	0.489248	0.054522	0.123217
Adj. R-squared	0.453864	-0.010978	0.062476
Sum sq. resids	197389.8	885.3713	762.8395
S.E. equation	24.38335	1.633028	1.515820
F-statistic	13.82703	0.832389	2.028567
Log likelihood	-1629.747	-667.3137	-640.7989
Akaike AIC	9.290713	3.883785	3.734825
Schwarz SC	9.551945	4.145016	3.996057
Mean dependent	-0.157485	0.703574	-0.864020
S.D. dependent	32.99461	1.624137	1.565512

Determinant resid covariance (dof adj.)	3328.525
Determinant resid covariance	2699.704
Log likelihood	-2921.786
Akaike information criterion	16.81902
Schwarz criterion	17.60272

C4- MAJORS GASOLINE

UNIT ROOT TEST ON G

Null Hypothesis: G has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.578841	0.9890
Test critical values:	1% level	-3.448466	
	5% level	-2.869419	
	10% level	-2.571035	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(G)
Method: Least Squares

Sample (adjusted): 9/01/2008 30/12/2008
Included observations: 357 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G(-1)	0.001736	0.002998	0.578841	0.5631
D(G(-1))	-0.195512	0.050600	-3.863883	0.0001
D(G(-2))	0.038369	0.051648	0.742894	0.4580
D(G(-3))	0.096364	0.051466	1.872364	0.0620
D(G(-4))	0.148135	0.051305	2.887339	0.0041
D(G(-5))	0.006634	0.051782	0.128120	0.8981
D(G(-6))	0.000333	0.051819	0.006434	0.9949
D(G(-7))	0.351506	0.050601	6.946585	0.0000
C	-0.317306	0.382904	-0.828685	0.4079

R-squared	0.213427	Mean dependent var	-0.186418
Adjusted R-squared	0.195345	S.D. dependent var	1.715004
S.E. of regression	1.538402	Akaike info criterion	3.724253
Sum squared resid	823.6051	Schwarz criterion	3.822011
Log likelihood	-655.7791	Hannan-Quinn criter.	3.763135
F-statistic	11.80321	Durbin-Watson stat	2.059914
Prob(F-statistic)	0.000000		

COINTEGRATION TEST

Sample (adjusted): 10/01/2008 30/12/2008
Included observations: 356 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: G S
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.067014	26.25176	20.26184	0.0066
At most 1	0.004367	1.557898	9.164546	0.8629

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.067014	24.69386	15.89210	0.0016
At most 1	0.004367	1.557898	9.164546	0.8629

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

G	S	C
-0.239352	0.267355	3.586507
0.035738	-0.025683	-2.923587

Unrestricted Adjustment Coefficients (alpha):

D(G)	0.356891	0.036036
D(S)	-0.072836	0.119945

1 Cointegrating Equation(s):	Log likelihood	-1345.672

Normalized cointegrating coefficients (standard error in parentheses)

G	S	C
1.000000	-1.116994	-14.98424
	(0.03456)	(3.50235)

Adjustment coefficients (standard error in parentheses)

D(G)	-0.085422
	(0.01871)
D(S)	0.017433
	(0.02386)

THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 30/12/2008
Included observations: 356 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DG	PS	NS
DG(-1)	-0.242797	0.109527	-0.088553
	(0.05542)	(0.04064)	(0.04644)
	[-4.38138]	[2.69533]	[-1.90686]
DG(-2)	0.024770	0.043950	-0.043311
	(0.05541)	(0.04063)	(0.04643)
	[0.44704]	[1.08172]	[-0.93277]
DG(-3)	0.072082	0.011248	0.012505
	(0.05509)	(0.04039)	(0.04616)
	[1.30853]	[0.27846]	[0.27089]
DG(-4)	0.102855	0.038943	0.115614
	(0.05477)	(0.04016)	(0.04590)
	[1.87791]	[0.96961]	[2.51888]
DG(-5)	0.017845	-0.065275	0.021458
	(0.05419)	(0.03974)	(0.04541)
	[0.32930]	[-1.64265]	[0.47250]
DG(-6)	-0.026345	0.026138	0.050380
	(0.05388)	(0.03951)	(0.04515)
	[-0.48901]	[0.66163]	[1.11587]
DG(-7)	0.325132	0.034355	0.090123
	(0.05385)	(0.03948)	(0.04512)
	[6.03821]	[0.87009]	[1.99725]
DG(-8)	0.039471	0.007121	-0.051477
	(0.05551)	(0.04070)	(0.04651)
	[0.71112]	[0.17496]	[-1.10670]
PS(-1)	0.061616	0.029275	-0.007372
	(0.07820)	(0.05734)	(0.06553)
	[0.78793]	[0.51052]	[-0.11249]
PS(-2)	0.133068	-0.034000	0.084394
	(0.07618)	(0.05586)	(0.06384)
	[1.74677]	[-0.60864]	[1.32197]
PS(-3)	0.023767	0.089973	-0.023831
	(0.07523)	(0.05516)	(0.06304)
	[0.31594]	[1.63107]	[-0.37803]
PS(-4)	-0.150121	0.043071	-0.051213
	(0.07470)	(0.05477)	(0.06260)
	[-2.00979]	[0.78635]	[-0.81815]
PS(-5)	-0.016668	-0.069058	-0.186762
	(0.07514)	(0.05510)	(0.06297)
	[-0.22184]	[-1.25339]	[-2.96608]
PS(-6)	0.240668	0.061098	-0.097206
	(0.07578)	(0.05557)	(0.06350)
	[3.17590]	[1.09951]	[-1.53070]

PS(-7)	-0.064554	0.123944	-0.118846
	(0.07679)	(0.05631)	(0.06435)
	[-0.84065]	[2.20112]	[-1.84683]
PS(-8)	-0.025779	0.123869	-0.076678
	(0.07673)	(0.05626)	(0.06430)
	[-0.33598]	[2.20159]	[-1.19253]
NS(-1)	0.018031	-0.042035	0.188171
	(0.06864)	(0.05033)	(0.05752)
	[0.26271]	[-0.83519]	[3.27156]
NS(-2)	0.089240	-0.053535	0.055240
	(0.06868)	(0.05036)	(0.05755)
	[1.29940]	[-1.06304]	[0.95982]
NS(-3)	0.011452	-0.005787	-0.011448
	(0.06808)	(0.04992)	(0.05705)
	[0.16823]	[-0.11593]	[-0.20067]
NS(-4)	0.146010	-0.076994	0.007302
	(0.06723)	(0.04930)	(0.05634)
	[2.17166]	[-1.56166]	[0.12960]
NS(-5)	0.002538	0.021036	0.011127
	(0.06755)	(0.04953)	(0.05661)
	[0.03757]	[0.42468]	[0.19657]
NS(-6)	-0.086440	-0.123253	0.155753
	(0.06729)	(0.04934)	(0.05639)
	[-1.28460]	[-2.49791]	[2.76211]
NS(-7)	0.015775	-0.119294	0.111572
	(0.06919)	(0.05074)	(0.05798)
	[0.22800]	[-2.35125]	[1.92425]
NS(-8)	0.215216	-0.023687	0.022415
	(0.07000)	(0.05133)	(0.05866)
	[3.07455]	[-0.46147]	[0.38212]
R-squared	0.299827	0.080364	0.152027
Adj. R-squared	0.251321	0.016654	0.093282
Sum sq. resids	732.8721	394.0760	514.6710
S.E. equation	1.485748	1.089484	1.245076
F-statistic	6.181231	1.261409	2.587905
Log likelihood	-633.6653	-523.2292	-570.7524
Akaike AIC	3.694749	3.074321	3.341306
Schwarz SC	3.955980	3.335553	3.602537
Mean dependent	-0.184690	0.506138	-0.679495
S.D. dependent	1.717106	1.098671	1.307554

Determinant resid covariance (dof adj.)	3.501196
Determinant resid covariance	2.839754
Log likelihood	-1701.208
Akaike information criterion	9.961843
Schwarz criterion	10.74554

C5 - IOCs DIESEL

UNIT ROOT TEST ON P

Null Hypothesis: P has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.341444	0.9155
Test critical values:	1% level	-3.452519	
	5% level	-2.871195	
	10% level	-2.571986	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(P)
Method: Least Squares

Sample (adjusted): 4/01/2008 30/12/2008
Included observations: 293 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
P(-1)	-0.002211	0.006474	-0.341444	0.7330
D(P(-1))	-0.402630	0.060456	-6.659829	0.0000
D(P(-2))	-0.192865	0.056367	-3.421616	0.0007
C	0.230195	1.002259	0.229676	0.8185

R-squared	0.140855	Mean dependent var	-0.085214
Adjusted R-squared	0.131936	S.D. dependent var	3.777932
S.E. of regression	3.519897	Akaike info criterion	5.368298
Sum squared resid	3580.616	Schwarz criterion	5.418540
Log likelihood	-782.4557	Hannan-Quinn criter.	5.388421
F-statistic	15.79360	Durbin-Watson stat	1.990011
Prob(F-statistic)	0.000000		

COINTEGRATION TEST

Sample (adjusted): 10/01/2008 24/12/2008
Included observations: 204 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: P W
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.159373	36.59474	20.26184	0.0001
At most 1	0.005762	1.178758	9.164546	0.9266

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.159373	35.41599	15.89210	0.0000
At most 1	0.005762	1.178758	9.164546	0.9266

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

P	W	C
-0.240208	0.253768	3.840023
-0.015614	0.051786	-4.078078

Unrestricted Adjustment Coefficients (alpha):

D(P)	1.277838	-0.041360
D(W)	-0.026021	-0.182072

1 Cointegrating Equation(s): Log likelihood -977.9820

Normalized cointegrating coefficients (standard error in parentheses)

P	W	C
1.000000	-1.056450	-15.98623
	(0.02611)	(3.52228)

Adjustment coefficients (standard error in parentheses)

D(P)	-0.306947
	(0.05243)
D(W)	0.006251
	(0.04215)

THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 24/12/2008
Included observations: 204 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DP	PW	NW
DP(-1)	-0.608152	0.071324	-0.049924
	(0.08064)	(0.04079)	(0.03328)
	[-7.54145]	[1.74837]	[-1.50030]
DP(-2)	-0.336371	-0.003672	-0.036522
	(0.09611)	(0.04862)	(0.03966)
	[-3.49992]	[-0.07552]	[-0.92092]
DP(-3)	-0.209373	-0.000196	0.009126

	(0.09937)	(0.05027)	(0.04100)
	[-2.10696]	[-0.00389]	[0.22257]
DP(-4)	-0.108028	0.109098	0.143398
	(0.09809)	(0.04962)	(0.04048)
	[-1.10131]	[2.19859]	[3.54277]
DP(-5)	-0.020389	0.120237	0.122661
	(0.10137)	(0.05128)	(0.04183)
	[-0.20114]	[2.34474]	[2.93248]
DP(-6)	0.123500	0.015930	0.046086
	(0.10302)	(0.05211)	(0.04251)
	[1.19882]	[0.30566]	[1.08414]
DP(-7)	0.208044	0.069493	0.045773
	(0.10024)	(0.05071)	(0.04136)
	[2.07554]	[1.37048]	[1.10665]
DP(-8)	0.231483	0.074129	0.042168
	(0.07730)	(0.03910)	(0.03190)
	[2.99478]	[1.89579]	[1.32206]
PW(-1)	-0.116335	0.005122	0.015037
	(0.15405)	(0.07793)	(0.06357)
	[-0.75520]	[0.06572]	[0.23656]
PW(-2)	0.047859	0.129245	0.004727
	(0.14569)	(0.07370)	(0.06012)
	[0.32850]	[1.75363]	[0.07863]
PW(-3)	0.197482	-0.062038	-0.085275
	(0.13722)	(0.06942)	(0.05662)
	[1.43918]	[-0.89373]	[-1.50604]
PW(-4)	-0.050085	0.049427	-0.083776
	(0.14022)	(0.07093)	(0.05786)
	[-0.35718]	[0.69680]	[-1.44787]
PW(-5)	0.149253	-0.035624	0.010144
	(0.13767)	(0.06964)	(0.05681)
	[1.08415]	[-0.51153]	[0.17856]
PW(-6)	0.193321	0.000957	-0.051063
	(0.13741)	(0.06951)	(0.05670)
	[1.40690]	[0.01377]	[-0.90058]
PW(-7)	-0.074660	0.065885	-0.200801
	(0.13537)	(0.06848)	(0.05586)
	[-0.55152]	[0.96209]	[-3.59476]
PW(-8)	0.084977	0.082499	-0.010394
	(0.14934)	(0.07555)	(0.06162)
	[0.56902]	[1.09201]	[-0.16866]
NW(-1)	0.264577	0.004962	0.103458
	(0.18777)	(0.09499)	(0.07748)
	[1.40905]	[0.05224]	[1.33527]
NW(-2)	0.136392	-0.128903	-0.011647
	(0.17594)	(0.08900)	(0.07260)
	[0.77522]	[-1.44830]	[-0.16043]

NW(-3)	0.339414	0.057396	0.087678
	(0.17229)	(0.08716)	(0.07109)
	[1.97004]	[0.65855]	[1.23328]
NW(-4)	0.169621	0.070892	0.109736
	(0.17431)	(0.08818)	(0.07193)
	[0.97308]	[0.80394]	[1.52563]
NW(-5)	-0.151111	-0.022053	-0.040335
	(0.17121)	(0.08661)	(0.07065)
	[-0.88259]	[-0.25461]	[-0.57091]
NW(-6)	-0.218048	-0.062658	0.006122
	(0.16307)	(0.08249)	(0.06729)
	[-1.33717]	[-0.75957]	[0.09098]
NW(-7)	0.159783	-0.267022	0.268696
	(0.16039)	(0.08114)	(0.06618)
	[0.99623]	[-3.29102]	[4.05991]
NW(-8)	-0.241711	-0.167068	0.036110
	(0.17929)	(0.09070)	(0.07398)
	[-1.34813]	[-1.84199]	[0.48808]
R-squared	0.329279	0.141099	0.284437
Adj. R-squared	0.243576	0.031351	0.193004
Sum sq. resids	2042.246	522.6305	347.7390
S.E. equation	3.368354	1.703967	1.389922
F-statistic	3.842083	1.285660	3.110875
Log likelihood	-524.4394	-385.4204	-343.8633
Akaike AIC	5.376857	4.013926	3.606503
Schwarz SC	5.767224	4.404293	3.996870
Mean dependent	0.006226	0.788051	-0.877358
S.D. dependent	3.872889	1.731322	1.547229

Determinant resid covariance (dof adj.)	57.30201
Determinant resid covariance	39.36379
Log likelihood	-1243.021
Akaike information criterion	12.89236
Schwarz criterion	14.06346

C6 – IOCs GASOLINE

UNIT ROOT TEST ON G

Null Hypothesis: G has a unit root
Exogenous: Constant
Lag Length: 10 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.464074	0.9853
Test critical values:	1% level	-3.451146	
	5% level	-2.870591	
	10% level	-2.571663	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(G)
Method: Least Squares

Sample (adjusted): 12/01/2008 24/12/2008
Included observations: 312 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G(-1)	0.003605	0.007768	0.464074	0.6429
D(G(-1))	-0.644838	0.058307	-11.05926	0.0000
D(G(-2))	-0.436621	0.067430	-6.475215	0.0000
D(G(-3))	-0.233065	0.067451	-3.455340	0.0006
D(G(-4))	-0.143662	0.066330	-2.165874	0.0311
D(G(-5))	-0.050315	0.066647	-0.754952	0.4509
D(G(-6))	0.146210	0.066534	2.197522	0.0287
D(G(-7))	0.320935	0.066225	4.846125	0.0000
D(G(-8))	0.449995	0.067630	6.653754	0.0000
D(G(-9))	0.302052	0.067992	4.442439	0.0000
D(G(-10))	0.143411	0.058475	2.452522	0.0148
C	-0.764030	1.010414	-0.756155	0.4501

R-squared	0.338710	Mean dependent var	-0.263238
Adjusted R-squared	0.314463	S.D. dependent var	4.434677
S.E. of regression	3.671787	Akaike info criterion	5.476936
Sum squared resid	4044.605	Schwarz criterion	5.620898
Log likelihood	-842.4020	Hannan-Quinn criter.	5.534473
F-statistic	13.96899	Durbin-Watson stat	2.001123
Prob(F-statistic)	0.000000		

COINTEGRATION TEST

Sample (adjusted): 10/01/2008 24/12/2008
Included observations: 320 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: G S
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.094146	33.41262	20.26184	0.0004
At most 1	0.005521	1.771773	9.164546	0.8226

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.094146	31.64085	15.89210	0.0001
At most 1	0.005521	1.771773	9.164546	0.8226

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

G	S	C
-0.195313	0.229424	2.015739
0.079815	-0.076710	-3.542577

Unrestricted Adjustment Coefficients (alpha):

D(G)	1.085459	-0.022556
D(S)	0.114530	0.137084

1 Cointegrating Equation(s): Log likelihood -1498.080

Normalized cointegrating coefficients (standard error in parentheses)

G	S	C
1.000000	-1.174652	-10.32057
	(0.03726)	(3.77068)

Adjustment coefficients (standard error in parentheses)

D(G)	-0.212004
	(0.03793)
D(S)	-0.022369
	(0.02108)

THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 24/12/2008
Included observations: 320 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DG	PS	NS
DG(-1)	-0.603154	-0.003450	-0.062310
	(0.05737)	(0.01765)	(0.02079)
	[-10.5131]	[-0.19551]	[-2.99725]
DG(-2)	-0.357069	0.059527	-0.022379
	(0.06610)	(0.02033)	(0.02395)
	[-5.40229]	[2.92774]	[-0.93437]
DG(-3)	-0.175636	0.045262	-0.020161
	(0.06995)	(0.02152)	(0.02535)
	[-2.51103]	[2.10361]	[-0.79544]
DG(-4)	-0.142749	0.044898	0.035527
	(0.07133)	(0.02194)	(0.02585)
	[-2.00117]	[2.04611]	[1.37447]

DG(-5)	-0.044768	0.032469	0.029237
	(0.07162)	(0.02203)	(0.02595)
	[-0.62503]	[1.47366]	[1.12651]
DG(-6)	0.072545	-0.011245	0.053234
	(0.07066)	(0.02174)	(0.02561)
	[1.02661]	[-0.51730]	[2.07899]
DG(-7)	0.150666	-0.031221	0.052821
	(0.06625)	(0.02038)	(0.02400)
	[2.27437]	[-1.53208]	[2.20045]
DG(-8)	0.198992	-0.033434	-0.001055
	(0.05777)	(0.01777)	(0.02093)
	[3.44446]	[-1.88135]	[-0.05039]
PS(-1)	-0.105498	-0.007749	-0.026453
	(0.19756)	(0.06077)	(0.07159)
	[-0.53402]	[-0.12751]	[-0.36952]
PS(-2)	0.139867	-0.047791	0.013065
	(0.19307)	(0.05939)	(0.06996)
	[0.72445]	[-0.80468]	[0.18675]
PS(-3)	0.009284	0.142672	0.010257
	(0.18867)	(0.05804)	(0.06836)
	[0.04921]	[2.45830]	[0.15004]
PS(-4)	0.009061	0.062552	-0.087504
	(0.18823)	(0.05790)	(0.06821)
	[0.04814]	[1.08031]	[-1.28294]
PS(-5)	0.102170	-0.041897	-0.169400
	(0.18615)	(0.05726)	(0.06745)
	[0.54886]	[-0.73166]	[-2.51138]
PS(-6)	0.512402	0.077549	-0.036866
	(0.18340)	(0.05642)	(0.06646)
	[2.79390]	[1.37455]	[-0.55473]
PS(-7)	0.001853	0.132547	-0.118844
	(0.18432)	(0.05670)	(0.06679)
	[0.01005]	[2.33762]	[-1.77932]
PS(-8)	0.071953	0.083100	-0.087340
	(0.18719)	(0.05758)	(0.06783)
	[0.38438]	[1.44309]	[-1.28760]
NS(-1)	0.181214	0.018101	0.180532
	(0.16695)	(0.05136)	(0.06050)
	[1.08545]	[0.35246]	[2.98425]
NS(-2)	0.360115	-0.050048	0.058449
	(0.16539)	(0.05088)	(0.05993)
	[2.17736]	[-0.98370]	[0.97528]
NS(-3)	0.328087	-0.004142	0.019833
	(0.16732)	(0.05147)	(0.06063)
	[1.96080]	[-0.08048]	[0.32710]
NS(-4)	0.528139	-0.070159	0.050322

	(0.16655)	(0.05124)	(0.06035)
	[3.17097]	[-1.36935]	[0.83380]
NS(-5)	-0.331223	-0.042068	0.022777
	(0.16978)	(0.05223)	(0.06152)
	[-1.95090]	[-0.80547]	[0.37023]
NS(-6)	-0.301156	-0.155860	0.114960
	(0.16937)	(0.05210)	(0.06137)
	[-1.77811]	[-2.99151]	[1.87316]
NS(-7)	0.366866	-0.107772	0.119522
	(0.17459)	(0.05371)	(0.06326)
	[2.10131]	[-2.00668]	[1.88926]
NS(-8)	0.055786	0.049965	0.000325
	(0.17851)	(0.05491)	(0.06469)
	[0.31251]	[0.90988]	[0.00502]
R-squared	0.385658	0.100002	0.158281
Adj. R-squared	0.337922	0.030070	0.092877
Sum sq. resids	3772.407	356.9773	495.3330
S.E. equation	3.569961	1.098182	1.293608
F-statistic	8.078965	1.429983	2.420051
Log likelihood	-848.8040	-471.5565	-523.9658
Akaike AIC	5.455025	3.097228	3.424786
Schwarz SC	5.737649	3.379852	3.707410
Mean dependent	-0.254790	0.515520	-0.733955
S.D. dependent	4.387416	1.115075	1.358219

Determinant resid covariance (dof adj.)	23.07273
Determinant resid covariance	18.26098
Log likelihood	-1826.944
Akaike information criterion	11.86840
Schwarz criterion	12.71627

C7 – SUPERMARKETS DIESEL

UNIT ROOT TEST ON P

Null Hypothesis: P has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.571540	0.9995
Test critical values:	1% level	-3.448998	
	5% level	-2.869653	
	10% level	-2.571161	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(P)

Method: Least Squares

Sample (adjusted): 2/01/2008 30/12/2008
Included observations: 347 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
P(-1)	0.005372	0.003419	1.571540	0.1170
C	-0.976628	0.499893	-1.953673	0.0515

R-squared	0.007108	Mean dependent var	-0.210263
Adjusted R-squared	0.004230	S.D. dependent var	2.052430
S.E. of regression	2.048084	Akaike info criterion	4.277434
Sum squared resid	1447.154	Schwarz criterion	4.299620
Log likelihood	-740.1348	Hannan-Quinn criter.	4.286268
F-statistic	2.469738	Durbin-Watson stat	2.295855
Prob(F-statistic)	0.116974		

COINTEGRATION TEST

Sample (adjusted): 10/01/2008 24/12/2008
Included observations: 295 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: P W
Lags interval (in first differences): 1 to 8

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.100759	32.81794	20.26184	0.0006
At most 1	0.005030	1.487553	9.164546	0.8756

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.100759	31.33039	15.89210	0.0001
At most 1	0.005030	1.487553	9.164546	0.8756

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

P	W	C
-0.183379	0.197247	1.023278
-0.003017	0.010463	0.096995

Unrestricted Adjustment Coefficients (alpha):

D(P)	0.600225	-0.031453
D(W)	0.007509	-0.175377

1 Cointegrating Equation(s): Log likelihood -1275.861

Normalized cointegrating coefficients (standard error in parentheses)

P	W	C
1.000000	-1.075626	-5.580135
	(0.03244)	(4.35503)

Adjustment coefficients (standard error in parentheses)

D(P)	-0.110068
	(0.02032)
D(W)	-0.001377
	(0.02720)

THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 24/12/2008
Included observations: 295 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DP	PW	NW
DP(-1)	-0.178227	0.115052	-0.031390
	(0.06216)	(0.05085)	(0.04708)
	[-2.86702]	[2.26268]	[-0.66680]
DP(-2)	0.015845	-0.004915	0.004102
	(0.06184)	(0.05058)	(0.04683)
	[0.25621]	[-0.09715]	[0.08759]
DP(-3)	0.016003	0.066205	-0.065513
	(0.06018)	(0.04923)	(0.04558)
	[0.26590]	[1.34488]	[-1.43745]
DP(-4)	0.106682	-0.015680	0.057837
	(0.05966)	(0.04880)	(0.04518)
	[1.78827]	[-0.32134]	[1.28023]
DP(-5)	0.009768	0.108044	0.164464
	(0.05977)	(0.04889)	(0.04526)
	[0.16344]	[2.21015]	[3.63382]
DP(-6)	0.053451	-0.008602	0.011115
	(0.06164)	(0.05042)	(0.04668)
	[0.86721]	[-0.17062]	[0.23814]
DP(-7)	0.272345	2.35E-05	-0.041670
	(0.06182)	(0.05057)	(0.04682)
	[4.40541]	[0.00046]	[-0.89010]
DP(-8)	-0.025722	0.009429	0.004274
	(0.06442)	(0.05269)	(0.04878)
	[-0.39930]	[0.17896]	[0.08761]

PW(-1)	0.124778	0.077834	-0.034351
	(0.07845)	(0.06417)	(0.05941)
	[1.59051]	[1.21294]	[-0.57820]
PW(-2)	0.045530	0.042133	-0.000665
	(0.07801)	(0.06381)	(0.05908)
	[0.58363]	[0.66029]	[-0.01125]
PW(-3)	0.064865	0.035459	0.024044
	(0.07964)	(0.06514)	(0.06031)
	[0.81450]	[0.54435]	[0.39869]
PW(-4)	0.018936	0.032005	-0.073769
	(0.07832)	(0.06406)	(0.05931)
	[0.24178]	[0.49960]	[-1.24382]
PW(-5)	0.067424	-0.104512	-0.027471
	(0.07702)	(0.06300)	(0.05833)
	[0.87539]	[-1.65892]	[-0.47098]
PW(-6)	0.063670	0.088418	0.006679
	(0.07662)	(0.06267)	(0.05802)
	[0.83099]	[1.41083]	[0.11511]
PW(-7)	-0.144247	0.068942	-0.224263
	(0.07386)	(0.06041)	(0.05593)
	[-1.95298]	[1.14115]	[-4.00950]
PW(-8)	-0.063532	0.011549	-0.070342
	(0.07592)	(0.06210)	(0.05749)
	[-0.83685]	[0.18598]	[-1.22352]
NW(-1)	0.013460	-0.051153	0.104355
	(0.08240)	(0.06740)	(0.06240)
	[0.16335]	[-0.75898]	[1.67242]
NW(-2)	-0.054538	-0.075850	-0.033793
	(0.07764)	(0.06350)	(0.05879)
	[-0.70248]	[-1.19444]	[-0.57479]
NW(-3)	0.015410	-0.173817	-0.007072
	(0.07683)	(0.06284)	(0.05818)
	[0.20058]	[-2.76603]	[-0.12155]
NW(-4)	0.023792	0.044466	0.067862
	(0.07680)	(0.06282)	(0.05816)
	[0.30980]	[0.70788]	[1.16688]
NW(-5)	-0.025912	0.007672	-0.037959
	(0.07674)	(0.06277)	(0.05812)
	[-0.33764]	[0.12222]	[-0.65316]
NW(-6)	0.185136	-0.054994	0.100991
	(0.07595)	(0.06212)	(0.05752)
	[2.43761]	[-0.88524]	[1.75589]
NW(-7)	-0.017544	-0.189861	0.329649
	(0.07715)	(0.06311)	(0.05843)
	[-0.22739]	[-3.00850]	[5.64205]
NW(-8)	0.198601	-0.016676	0.106842

	(0.08431)	(0.06896)	(0.06384)
	[2.35566]	[-0.24182]	[1.67347]
R-squared	0.180543	0.086109	0.198761
Adj. R-squared	0.110995	0.008546	0.130759
Sum sq. resids	1076.188	720.0186	617.1667
S.E. equation	1.992780	1.629999	1.509095
F-statistic	2.595952	1.110183	2.922877
Log likelihood	-609.4821	-550.2014	-527.4660
Akaike AIC	4.294794	3.892891	3.738753
Schwarz SC	4.594751	4.192848	4.038710
Mean dependent	-0.222029	0.696379	-0.952904
S.D. dependent	2.113525	1.637009	1.618626

Determinant resid covariance (dof adj.)	20.94151
Determinant resid covariance	16.23491
Log likelihood	-1666.867
Akaike information criterion	11.78893
Schwarz criterion	12.68880

C8 – SUPERMARKETS GASOLINE

UNIT ROOT TEST ON G

Null Hypothesis: G has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.683661	0.9917
Test critical values:	1% level	-3.452911	
	5% level	-2.871367	
	10% level	-2.572078	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(G)
Method: Least Squares

Sample (adjusted): 9/01/2008 24/12/2008
Included observations: 288 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G(-1)	0.003055	0.004468	0.683661	0.4948
D(G(-1))	-0.214619	0.056304	-3.811800	0.0002
D(G(-2))	0.002216	0.057674	0.038430	0.9694
D(G(-3))	0.055183	0.057231	0.964215	0.3358
D(G(-4))	0.125454	0.056879	2.205632	0.0282
D(G(-5))	0.018173	0.057077	0.318395	0.7504
D(G(-6))	0.032531	0.057494	0.565813	0.5720
D(G(-7))	0.344669	0.056446	6.106121	0.0000
C	-0.552101	0.562582	-0.981369	0.3273

R-squared	0.196735	Mean dependent var	-0.255236
Adjusted R-squared	0.173703	S.D. dependent var	2.002407
S.E. of regression	1.820206	Akaike info criterion	4.066528
Sum squared resid	924.3688	Schwarz criterion	4.180995
Log likelihood	-576.5800	Hannan-Quinn criter.	4.112399
F-statistic	8.541581	Durbin-Watson stat	1.974343
Prob(F-statistic)	0.000000		

COINTEGRATION TEST

Sample (adjusted): 6/01/2008 24/12/2008
Included observations: 312 after adjustments
Trend assumption: No deterministic trend (restricted constant)
Series: G S
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.095392	35.58544	20.26184	0.0002
At most 1	0.013707	4.306210	9.164546	0.3684

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.095392	31.27923	15.89210	0.0001
At most 1	0.013707	4.306210	9.164546	0.3684

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

G	S	C
-0.171536	0.200678	0.710689
0.113572	-0.100888	-4.570367

Unrestricted Adjustment Coefficients (alpha):

D(G)	0.586151	0.021635
D(S)	0.067727	0.222595

1 Cointegrating Equation(s): Log likelihood -1266.619

Normalized cointegrating coefficients (standard error in parentheses)

G	S	C
1.000000	-1.169888	-4.143090
	(0.04299)	(4.36406)

Adjustment coefficients (standard error in parentheses)

D(G)	-0.100546
	(0.01788)
D(S)	-0.011618
	(0.01885)

THE VAR

Vector Autoregression Estimates

Sample (adjusted): 10/01/2008 24/12/2008
Included observations: 280 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DG	PS	NS

DG(-1)	-0.206690	0.138664	0.020154
	(0.06291)	(0.03983)	(0.04905)
	[-3.28551]	[3.48140]	[0.41091]
DG(-2)	0.016776	0.027116	-0.029466
	(0.06151)	(0.03895)	(0.04796)
	[0.27271]	[0.69624]	[-0.61440]
DG(-3)	0.024785	0.003911	-0.021164
	(0.06098)	(0.03861)	(0.04754)
	[0.40647]	[0.10131]	[-0.44518]
DG(-4)	0.061496	0.046159	0.037269
	(0.06037)	(0.03822)	(0.04706)
	[1.01870]	[1.20773]	[0.79187]
DG(-5)	-0.004591	0.021160	0.020511
	(0.05960)	(0.03774)	(0.04647)
	[-0.07703]	[0.56074]	[0.44138]
DG(-6)	0.025761	-0.010228	0.061039
	(0.05909)	(0.03741)	(0.04607)
	[0.43599]	[-0.27342]	[1.32501]
DG(-7)	0.318738	0.047739	0.054835
	(0.05982)	(0.03788)	(0.04664)
	[5.32805]	[1.26042]	[1.17571]
DG(-8)	-0.049770	-0.005817	-0.003125
	(0.06165)	(0.03903)	(0.04807)
	[-0.80726]	[-0.14902]	[-0.06501]
PS(-1)	-0.059479	0.029568	-0.023922
	(0.10200)	(0.06458)	(0.07953)
	[-0.58311]	[0.45784]	[-0.30081]
PS(-2)	0.054456	-0.023708	0.059255
	(0.10183)	(0.06447)	(0.07939)
	[0.53480]	[-0.36775]	[0.74640]
PS(-3)	0.169091	0.126015	-0.003076
	(0.10173)	(0.06441)	(0.07931)
	[1.66216]	[1.95651]	[-0.03879]
PS(-4)	0.011443	0.009529	-0.064218
	(0.10254)	(0.06492)	(0.07994)
	[0.11159]	[0.14678]	[-0.80330]
PS(-5)	0.088421	-0.047015	-0.162434
	(0.10074)	(0.06378)	(0.07854)
	[0.87774]	[-0.73715]	[-2.06821]
PS(-6)	0.020249	-0.011919	-0.092186
	(0.09852)	(0.06237)	(0.07681)
	[0.20555]	[-0.19110]	[-1.20024]
PS(-7)	-0.114548	0.118279	-0.171737
	(0.09671)	(0.06123)	(0.07540)
	[-1.18440]	[1.93165]	[-2.27764]
PS(-8)	0.007518	0.169265	-0.092505
	(0.10537)	(0.06671)	(0.08215)

	[0.07135]	[2.53721]	[-1.12604]
NS(-1)	0.045726	-0.068738	0.159409
	(0.08485)	(0.05372)	(0.06615)
	[0.53892]	[-1.27959]	[2.40983]
NS(-2)	-0.059293	-0.068557	0.056827
	(0.08477)	(0.05367)	(0.06609)
	[-0.69943]	[-1.27732]	[0.85981]
NS(-3)	0.060980	0.002230	-0.032443
	(0.08444)	(0.05346)	(0.06583)
	[0.72217]	[0.04170]	[-0.49280]
NS(-4)	0.237417	-0.068853	0.035963
	(0.08399)	(0.05318)	(0.06549)
	[2.82658]	[-1.29473]	[0.54917]
NS(-5)	-0.100538	-0.015155	-0.016262
	(0.08546)	(0.05411)	(0.06663)
	[-1.17639]	[-0.28009]	[-0.24407]
NS(-6)	0.022686	-0.048502	0.160561
	(0.08488)	(0.05374)	(0.06617)
	[0.26729]	[-0.90259]	[2.42641]
NS(-7)	0.030073	-0.140067	0.167456
	(0.08621)	(0.05458)	(0.06721)
	[0.34882]	[-2.56614]	[2.49140]
NS(-8)	0.243422	-0.023631	0.005187
	(0.08885)	(0.05625)	(0.06927)
	[2.73968]	[-0.42008]	[0.07487]
R-squared	0.265660	0.100498	0.098473
Adj. R-squared	0.199685	0.019684	0.017476
Sum sq. resids	825.2836	330.8166	501.6372
S.E. equation	1.795484	1.136773	1.399829
F-statistic	4.026632	1.243568	1.215766
Log likelihood	-548.6340	-420.6512	-478.9351
Akaike AIC	4.090243	3.176080	3.592393
Schwarz SC	4.401797	3.487633	3.903947
Mean dependent	-0.268686	0.519098	-0.787756
S.D. dependent	2.007017	1.148129	1.412223

Determinant resid covariance (dof adj.)	7.233614
Determinant resid covariance	5.528421
Log likelihood	-1431.295
Akaike information criterion	10.73782
Schwarz criterion	11.67248