ECO00033M: Project

Exam No: Y3913493

Asymmetric Pass-through of the Gasoline Prices: 'Rockets and Feathers'

Have you ever noticed that when the price of crude oil increases, the cost of Gasoline at the pump appears to increase very instantly, but when the price of crude oil decreases, the cost of gasoline frequently decreases considerably more slowly or not at all? It has been widely discussed by economists, decision-makers, and consumers. This observation has been named the "rockets and feathers" phenomenon in the gasoline industry. The rockets and feathers phenomenon in the gasoline market is the theory that when the price of crude oil increases, gasoline prices tend to climb swiftly in response, but when the price of crude oil decreases, they tend to decline more slowly or not at all. This might make consumers more sensitive to the negative consequences of rising Gasoline prices than to the beneficial implications of falling prices. This phenomenon has come to be referred to as the "rockets and feathers" hypothesis, following the early contribution of Bacon (1991).

In this study, the author examines the empirical evidence for the unequal pass-through of Gasoline prices as well as its implications for consumers and decision-makers. The first section of the article summarises the main findings from a few well-known studies on the topic, including both theoretical and empirical research. The asymmetric pass-through of fuel pricing,

which influences Gasoline prices at the pump in many countries throughout the world, is a real and ubiquitous phenomenon, according to various research. They argue that market strength, poor competition, and other market factors allow for high Gasoline prices to persist even when the price of crude oil drops.

The data from 2009 to 2019 quarterly are the data used for this investigation. It is primarily a result of neglecting the time periods during the financial crisis and the covid pandemic. Five nations are represented in the data: Denmark, France, Switzerland, the Netherlands, and the United Kingdom. The NARDL model was the analysis strategy used to identify the significant model for this investigation. That provided more flexible modelling of non-linear relationships by allowing for the estimation of the asymmetric short- and long-run impacts of an independent variable on a dependent variable. Also, it was useful for examining the intricate connections between economic variables, particularly where non-linearities and asymmetries were present.

The findings demonstrated that when crude oil prices rise, gasoline prices react more swiftly than when they fall. The research also discovered evidence of long-run equilibrium linkages between crude oil and gasoline prices, with the short-run adjustment process being quicker than the long-run adjustment process. The study also revealed the existence of threshold effects, in which the magnitude and direction of the impacts of changes in crude oil prices on Gasoline prices vary with oil price levels. The results show that while formulating policies to lessen the effects of oil price volatility on the economy, policymakers should take into account the non-linear and asymmetric nature of the relationship between crude oil and Gasoline prices.

2. LITERATURE REVIEW

Study	Method	Findings
Rockets and feathers: the asymmetric speed of adjustment of UK retail gasoline prices to cost changes. (Bacon, 1991)	An error correction model was used to analyse retail Gasoline prices and expenses in the United Kingdom from 1979 to 1989.	Evidence of asymmetric adjustment is discovered, with retail Gasoline prices rising faster than falling in response to cost changes.
Taxation and the asymmetric adjustment of selected retail energy prices in the UK (Greenwood-Nimmo and Shin, 2013)	The method used for this study is a nonlinear autoregressive distributed lag (NARDL) approach	There is evidence of significant asymmetric adjustment in the UK Gasoline retail market, with prices rising faster in response to increases in crude oil prices than falling in response to decreases.
The Asymmetric Effects of Crude Oil Prices and Exchange Rates on Diesel Prices for 27 European Countries (Haliloglu and Berument, 2021)	The method used for this study was Panel cointegration analysis with the Pooled Mean Group (PMG) estimator and Panel Dynamic Ordinary Least Squares (PDOLS)	The findings revealed that both crude oil prices and exchange rates have asymmetric effects on diesel prices, with the effects varying by country. The asymmetric effect is stronger when oil prices are rising and the currency is depreciating.
Retail Fuel Price Response to Oil Price Shocks in EU Countries (Clerides and Others, 2010)	The methods used are Panel VAR models and impulse response analysis to test the response of retail gasoline and diesel prices to oil price shocks in 14 EU countries from 1996 to 2008.	Retail fuel prices respond asymmetrically to oil price shocks, with an increase in response to an increase in oil prices being faster and larger than a decrease in oil prices. The degree of asymmetry is greater for diesel than for Gasoline, and it is greater for countries that are net oil importers. The short-run pass-through of oil price shocks to retail fuel prices is greater than the long-run pass-through.
Inflation targets and (a)symmetries in the oil price pass-through to inflation. Antonia	The method used for this paper is an ARDL model to analyse the asymmetry in the oil price pass-through	The findings indicate that the pass-through is asymmetric in all four countries, with a greater pass-through during increases in oil prices than during

(López-Villavicencio and Pourroy, 2019)	inflation for four countries: the US, the UK, France, and Japan.	decreases. The authors also discover that countries with inflation-targeting regimes exhibit more pronounced asymmetry, implying that monetary policy can influence pass-through.
Modelling Asymmetric Cointegration and Dynamic Multipliers in an ARDL Framework. (Shin, Yu and Greenwood-Nimmo, 2014)	The method used for this paper is the ARDL (autoregressive distributed lag) framework.	The paper presents a nonlinear ARDL model which is used in the study to examine the asymmetric adjustments of selected retail energy prices in the UK. The paper also results in asymmetric error correction terms that play an important role in explaining the transition process and the adaption speed.

According to the literature review, "Rocket and Feather" refers to the asymmetric speed of adjustment of retail gasoline prices to changes in the cost of crude oil, with a significant and rapid response to increases in crude oil prices, but a slower and less significant response to decreases in crude oil prices. This suggests that retailers may have a degree of market power or collusion, allowing them to keep retail Gasoline prices higher for longer periods of time even when crude oil prices have fallen. The literature also emphasises the importance of taxes, government policies, and other factors in determining retail Gasoline prices, particularly in countries such as the United Kingdom, Denmark, Switzerland, and others countries. The literature review consists mainly of recent data. Due to a lack of data, it was hard to find literature reviews on specific countries that are chosen for this paper.

3. DATA

The data covered in this report are from five countries in Europe, i.e. Denmark, France, Netherlands, Switzerland, United Kingdom. That includes the time after the financial crisis and before COVID-19 Pandemic, i.e. from Quarter 3 of 2009 to Quarter 2 of 2019. They have been measured as price indices of wholesale and retail prices of oil products which are considered from that data sourced from UK Data Services, which has been provided by the International Energy Agency. Variables are in the form of logged values of price indices having a base of 100.

Country (W- Wholesale) (R- Retail)	Mean	Std. dev.	Skewness	Kurtosis
DenmarkR	110.368	17.515	-0.456	-0.880
DenmarkW	105.115	9.478	-0.118	-1.074
FranceR	121.239	25.466	-0.089	-1.125
FranceW	107.850	11.109	-0.411	-1.031
NetherlandR	196.905	39.305	0.047	-1.229
NetherlandW	139.380	15.441	0.006	-1.345
SwitzerlandR	241.659	52.161	-0.239	-1.102
SwitzerlandW	187.861	19.049	-0.226	-1.209
United KingdomR	104.808	9.544	-0.307	-1.023
United KingdomW	103.939	13.603	-0.165	-1.187

Table 1

According to Table 1, it can be seen that the mean retail prices exceed the mean wholesale prices in all five countries. However, the United Kingdom is an exception where the standard deviation of wholesale prices surpasses that of retail prices. This suggests that retail prices in Finland, France, Norway, and Switzerland have greater variability compared to wholesale prices, potentially due to the influence of other factors such as taxes. Additionally, all considered variables exhibit negative kurtosis, implying that the tails of their distributions are

thin. Furthermore, negative skewness is present, indicating a slight leftward skew in the distributions.

4. METHODOLOGY

- Nonlinear Autoregressive Distributed Lag (NARDL)

The NARDL model can be used to investigate the relationship between two or more variables over time. It allows for the examination of long-run equilibrium relationships between variables while also taking short-run dynamics and potential asymmetries into account during the adjustment process. The NARDL model contributes to the understanding of this phenomenon by capturing the nonlinearity and asymmetry in the adjustment of Gasoline prices to changes in crude oil prices. The NARDL model can be used to estimate the speed and magnitude of adjustment of Gasoline prices to changes in crude oil prices in the context of studying the asymmetric pass-through of Gasoline prices, while also accounting for other factors that may affect the relationship between the two variables. The model can also be used to determine the direction and degree of asymmetry in crude oil price changes passing through to Gasoline prices. This model helps us build an asymmetric long-run relationship in a form of

$$r_t + \alpha + \beta h_t + \mu_t$$

This helps us consider the following relation between retail and wholesale gasoline prices with time trends.

$$\Delta r_t = \rho r_{t-1} + \theta h_{t-1} + \sum_{j=1}^{p-1} \varphi_j \Delta r_{t-j} + \sum_{j=0}^{q} \pi_j \Delta h_{t-j} + \varepsilon_t$$

where Δr is a change in the retail price which depends on ρr_{t-1} the retail price in the previous period which represents the persistence of the variable being analysed where ρ is the coefficient measuring the strength and persistence and the rest is the value of the variable at the previous time period plus the positive change in the wholesale price from the previous period and the negative change in wholesale price from the previous period $\theta + h^{+}_{t-1} + \theta - h^{-}_{t-1}$

which may impact the variable being analysed θ is the coefficient measuring the strength of the effect, h is the size of the impact, and t-1 represents the time period of the impact. Including the retail price in the past over (p-1) period, which represents the lag effects of the variable p-1j=1 jr_{t-j} and j is the coefficient measuring the strength of the lag effect. With respect to the positive and negative changes in the past over the wholesale (q) period, $\sum_{j=0}^{q} \pi_j \Delta h_{t-j}$. This represents the conditional heteroskedasticity in the variable being analysed, where q is the number of lags considered, +j and -j are the coefficients measuring the strength of the positive and negative shock impacts, and h^{+}_{t-j} and h^{-}_{t-j} are the lagged shock impacts.

5. EMPIRICAL RESULTS

NARDL Estimation Result

	Denmark	France	Netherland	Switzerland	UK
Estimated Coefficients					
ρ	-1.1149***	-3.1844***	-1.0393	-2.0545***	-1.0912***
θ^+	0.6240***	1.9647***	0.5156	0.9565***	0.78929***
θ^-	0.7150***	1.5758***	0.5890	0.8731***	0.7487***
φ_1	0.1650***	1.9903***	0.7490	0.9617	0.1583
φ_2	0.2335	1.4720***	0.4179	0.7038	-0.2134
π_0^+	0.5631***	0.5454***	0.6017***	0.4142***	0.5260***
π_1^+	-1.697**	-1.0384***	-0.2151	-0.6526	-0.0497
π_2^+	-1.1838**	0.8875***	-0.4343	-0.5151	0.0404
π_3^+	-0.0764***	-0.6625***	-0.0750	-0.3700	0.1094
π_0^-	0.5507***	0.3735***	0.2780***	0.4811***	0.7250***
π_1^-	-0.1707***	-1.2216***	-0.6136	0.4810***	-0.1983
π_2^-	-0.2530**	-0.8431***	-0.2532	-0.2961	0.0343
π_3^-	-0.1230**	-0.8571***	-0.3191	-0.2286	-0.0680
Symmetry tests					
Long-run effect (+)	0.560***	0.617***	0.496***	0.466***	0.717***
Long-run effect (-)	-0.641***	-0.495***	-0.567***	-0.425***	-0.686***
Long-run asymmetry (F-stat)	60.31***	1291***	12.15***	31.89***	1.993
Short-run asymmetry (F-stat)	2.841***	6.122***	0.1765	0.8761	0.4558
Diagnostic Tests					
Autocorrelation	13.22	11.56	26.26	16.63	17.69
Heteroskedasticity	2.208*	0.1727	0.863	0.0031	1.198
Omitted Variables	0.829	4.486	1.937	2.15	2.262
Cointegration (F_PSS)	2.284	1.713	1.156	1.268	5.757

Table 2

*** Significance level of 1%, ** Significance level of 5%, * Significance level of 10%

In the five countries, the NARDL model shows evidence of asymmetric pass-through of Gasoline prices, with retail Gasoline prices reacting more strongly to increases in wholesale

prices than decreases. The negative values of ρ show that the link between wholesale and retail gas prices is asymmetric over the long term. France has the greatest absolute value of ρ, suggesting that France has a stronger response in terms of retail Gasoline prices to changes in wholesale prices.

The positive values of θ+ and θ- indicate that there is an asymmetric short-run link between wholesale and retail gasoline prices, with the latter rising more in response to positive changes in wholesale prices than falling in response to negative changes. France has the highest value of θ+, suggesting that the country has the biggest positive response of retail prices to an increase in wholesale prices. The speed at which retail prices respond to changes in wholesale prices is shown by the predicted coefficients for adjustment parameters φ1 and φ2. While a negative value of φ2 means that retail prices adapt more slowly when they are above their long-run equilibrium, a positive value of φ1 implies that retail prices adjust more swiftly towards long-run equilibrium after a shock. Lastly, the speed of adjustment of retail Gasoline prices to departures from long-run equilibrium is represented by the calculated coefficients for the error correction factors, π0+, π1+, π2+,π 3+, π0-, π1-, π2-, and π3-. Retail Gasoline prices are thought to adjust more quickly in reaction to positive departures from long-run equilibrium, according to the positive values of 0+ and 1+, and more slowly in response to negative departures from long-run equilibrium, according to the negative values of π1- and π2-.

The long-term results of the symmetry tests for the NARDL model of Gasoline prices in five different countries(Denmark, France, Netherlands, Switzerland, and the United Kingdom) indicate that price transmission is asymmetric, with higher effects when prices rise than when they fall. There isn't much proof of short-run asymmetry, though. Strong evidence of asymmetry

is found in Denmark, France, the Netherlands, and Switzerland according to the long-run asymmetry tests' F-statistics, but not in the United Kingdom. Serial correlation is not present in all countries, according to autocorrelation testing. Tests for heteroskedasticity indicate that no countries have heteroskedasticity. Omitted variable tests indicate that, in the case of France, there might be more variables that could enhance the model. The cointegration experiments also show that, with the exception of the Netherlands, there is a long-term link between Gasoline retail and wholesale prices, indicating that these prices eventually adjust to each other in the long run.

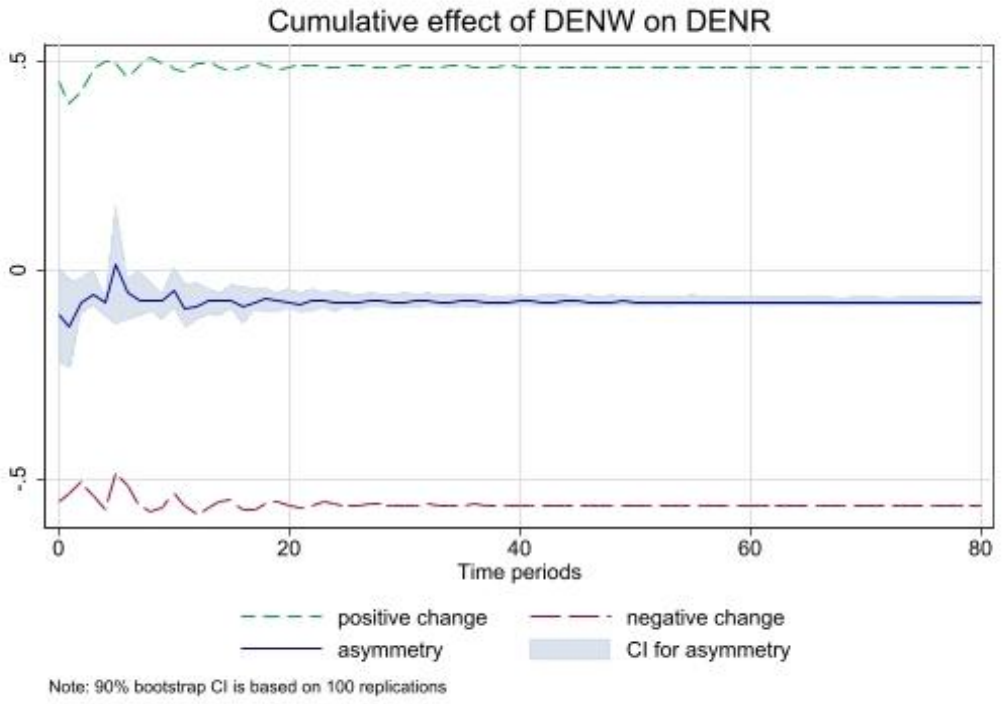

Figure 5.1 Asymmetric pass-through of oil prices in Denmark

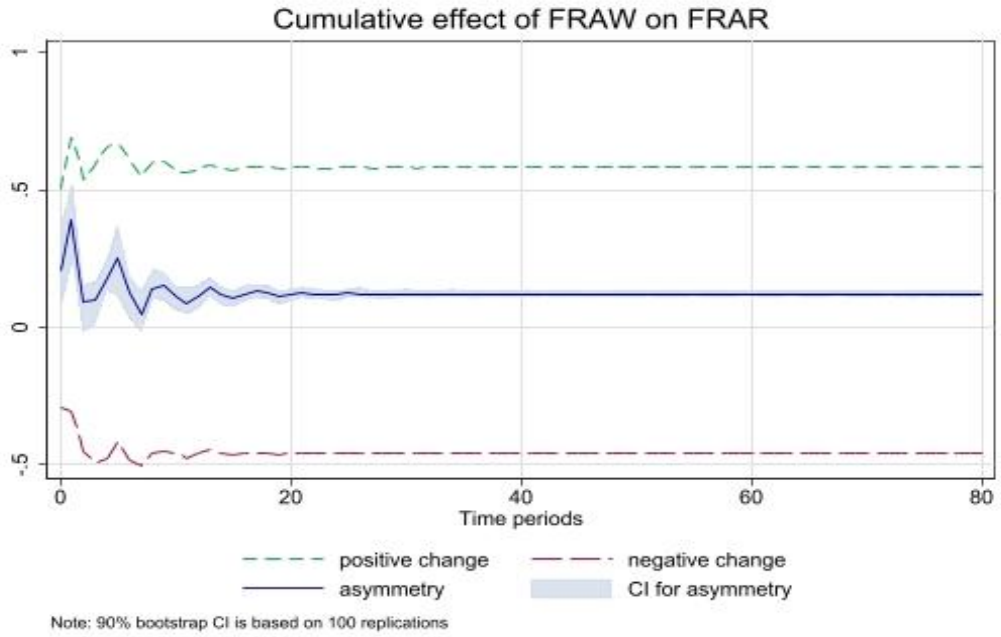

Figure 5.2 Asymmetric pass-through of oil prices in France

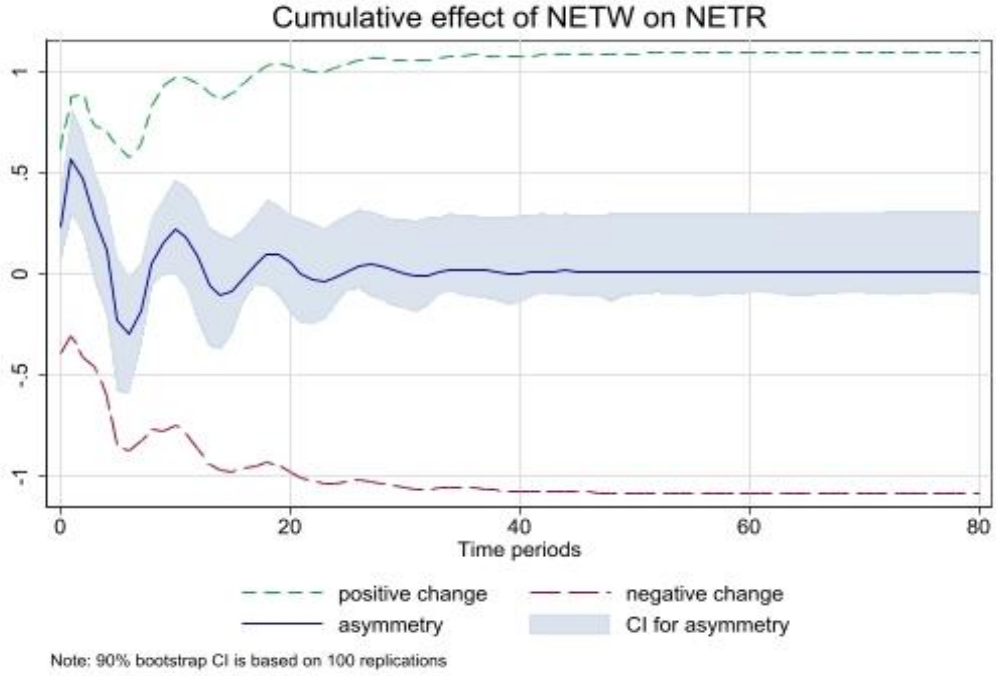

Figure 5.3 Asymmetric pass-through of oil prices in Netherlands

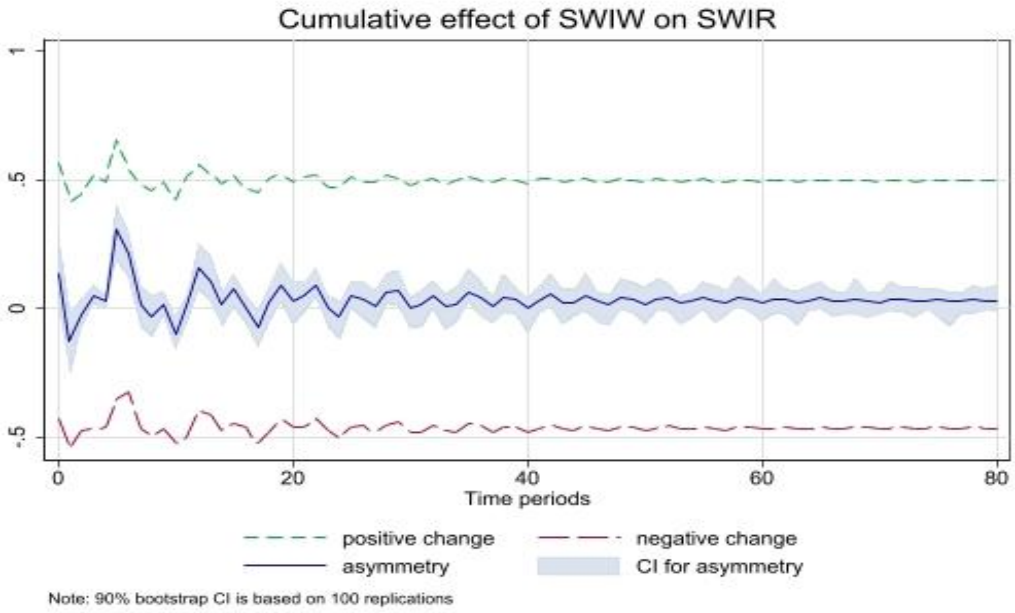

Figure 5.4 Asymmetric pass-through of oil prices in Switzerland

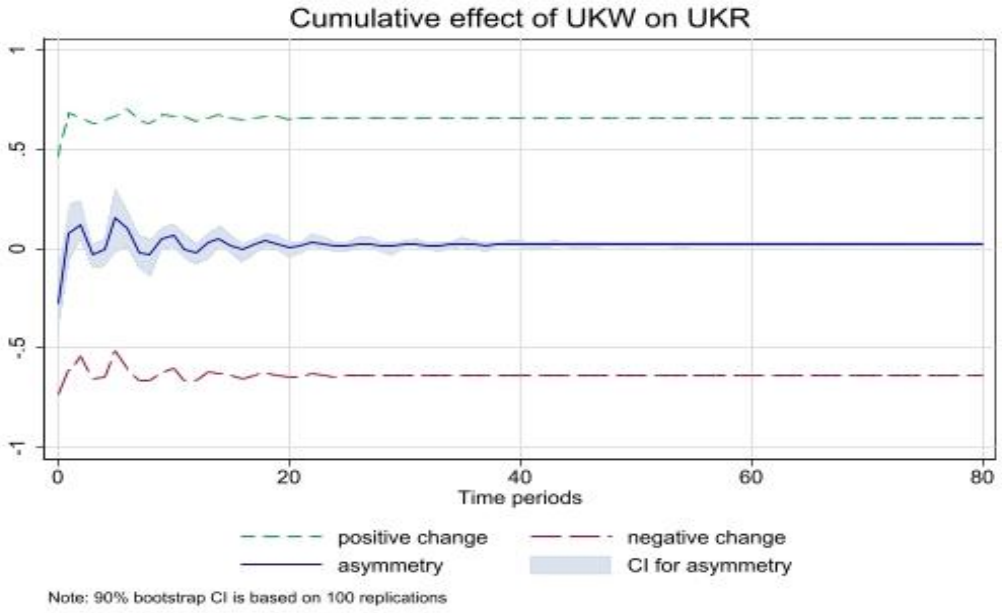

Figure 5.5 Asymmetric pass-through of oil prices in UK

The graphs above represent the five countries' retail and wholesale prices of gasoline. The outcomes imply that asymmetric pass-through effects exist. The significant coefficients for both the long-term positive and negative effects on prices reflect this, showing that prices respond more significantly when oil prices rise than when they fall.

6. CONCLUSION

The study suggests that there is evidence of asymmetric pass-through in the oil market, where the oil price will respond more quickly than the wholesale price, which further responds to increase in crude oil prices than a decrease in crude oil prices. They also exhibit stronger pass-through with retail stations than refineries. The study also proves that retail gasoline prices are also influenced by other factors, such as taxes, transport, and competition among retailers. The limitations faced during the research were limited over a time period as the data above 2009 consists of financial crises which consist of huge volatile prices, and the data after 2019 where the economies took a great turn because of covid pandemic, and secondly, frequencies considered are only quarterly and not monthly. In order to safeguard customers and maintain competition, the retail gasoline market needs to be continuously monitored and analysed, according to the findings.

7. APPENDIX: STATA OUTPUT

- **Dickey Fuller Test of wholesale and retail.**

Country	**Result**
Denmark (w,r)	Not Stationary.
France (w.r)	Not Stationary
Netherland (w,r)	Not Stationary
Switzerland (w,r)	Not Stationary
United Kingdom (w,r)	Not Stationary

- **Regression analysis of wholesale price and retail price.**

Country	Tests	Results
Denmark	Heteroskedasticity	Heteroskedasticity exists
Denmark	Serial Correlation	serial correlation exists
Denmark	Omitted Variable	no omitted variable exists
Denmark	ARCH disturbance	ARCH disturbance exists
Denmark	Stationary Residuals	Not Stationary
France	Heteroskedasticity	No heteroskedasticity
France	Serial Correlation	Serial correlation exists
France	Omitted Variable	No omitted variable
France	ARCH disturbance	ARCH disturbance exists
France	Stationary Residuals	Non-stationary
Netherland	Heteroskedasticity	No heteroskedasticity
Netherland	Serial Correlation	Serial correlation exists
Netherland	Omitted Variable	No omitted variable
Netherland	ARCH disturbance	ARCH disturbance exists
Netherland	Stationary Residuals	Non-stationary
Switzerland	Heteroskedasticity	Heteroskedasticity exists
Switzerland	Serial Correlation	Serial correlation exists
Switzerland	Omitted Variable	No omitted variable

Switzerland	ARCH disturbance	No ARCH disturbance exists
Switzerland	Stationary Residuals	Non-stationary
United Kingdom	Heteroskedasticity	No heteroskedasticity
United Kingdom	Serial Correlation	Serial correlation exists
United Kingdom	Omitted Variable	No omitted variable
United Kingdom	ARCH disturbance	No ARCH disturbance exists
United Kingdom	Stationary Residuals	Non-stationary

- **Robust OLS Estimation**

Country	Tests	Results
Denmark	Heteroskedasticity	No Heteroskedasticity exists
Denmark	Serial Correlation	Serial correlation exists
Denmark	Omitted Variable	Omitted variable exists
Denmark	ARCH disturbance	ARCH disturbance exists
Denmark	Robust	Not Significant
France	Heteroskedasticity	No heteroskedasticity
France	Serial Correlation	Serial correlation exists
France	Omitted Variable	Omitted variable
France	ARCH disturbance	ARCH disturbance exists
France	Robust	Non-significant
Netherland	Heteroskedasticity	Heteroskedasticity exists
Netherland	Serial Correlation	Serial correlation exists
Netherland	Omitted Variable	No Omitted variable
Netherland	ARCH disturbance	ARCH disturbance exists
Netherland	Robust	Non-stationary
Switzerland	Heteroskedasticity	Heteroskedasticity exists
Switzerland	Serial Correlation	Serial correlation exists
Switzerland	Omitted Variable	No omitted variable

Switzerland	ARCH disturbance	No ARCH disturbance exists
Switzerland	Robust	Non-stationary
United Kingdom	Heteroskedasticity	Heteroskedasticity
United Kingdom	Serial Correlation	Serial correlation exists
United Kingdom	Omitted Variable	Omitted variable
United Kingdom	ARCH disturbance	No ARCH disturbance exists
United Kingdom	Robust	Non-stationary

- **Dynamic Regression**

Country	Tests	Results
Denmark	Heteroskedasticity	No Heteroskedasticity exists
Denmark	Serial Correlation	No Serial correlation
Denmark	Omitted Variable	Omitted variable exists
Denmark	ARCH disturbance	No ARCH disturbance
Denmark	PSS Ftest	No Cointegration
France	Heteroskedasticity	No heteroskedasticity
France	Serial Correlation	No Serial correlation
France	Omitted Variable	Omitted variable
France	ARCH disturbance	No ARCH disturbance
France	PSS Ftest	No Cointegration
Netherland	Heteroskedasticity	No Heteroskedasticity
Netherland	Serial Correlation	No Serial correlation
Netherland	Omitted Variable	Omitted variable
Netherland	ARCH disturbance	No ARCH disturbance
Netherland	PSS Ftest	No Cointegration
Switzerland	Heteroskedasticity	Heteroskedasticity exists
Switzerland	Serial Correlation	Serial correlation exists
Switzerland	Omitted Variable	No omitted variable

Switzerland	ARCH disturbance	No ARCH disturbance exists
Switzerland	PSS Ftest	Non-stationary
United Kingdom	Heteroskedasticity	No Heteroskedasticity
United Kingdom	Serial Correlation	No Serial correlation
United Kingdom	Omitted Variable	No Omitted variable
United Kingdom	ARCH disturbance	No ARCH disturbance
United Kingdom	Stationary Residuals	Non-stationary

- **Dynamic regression with dummy and interaction variable**

Country	Tests	Results
Denmark	Heteroskedasticity	No Heteroskedasticity exists
Denmark	Serial Correlation	No Serial correlation
Denmark	Omitted Variable	No Omitted variable
Denmark	ARCH disturbance	No ARCH disturbance
Denmark	Robust	Stationary
France	Heteroskedasticity	No heteroskedasticity
France	Serial Correlation	Serial correlation
France	Omitted Variable	No Omitted variable
France	ARCH disturbance	No ARCH disturbance
France	Robust	Non-stationary
Netherland	Heteroskedasticity	No Heteroskedasticity
Netherland	Serial Correlation	No Serial correlation
Netherland	Omitted Variable	No Omitted variable
Netherland	ARCH disturbance	No ARCH disturbance
Netherland	Robust	Stationary
Switzerland	Heteroskedasticity	No Heteroskedasticity exists
Switzerland	Serial Correlation	No Serial correlation
Switzerland	Omitted Variable	Omitted variable

Switzerland	ARCH disturbance	ARCH disturbance exists
Switzerland	Robust	Non-stationary
United Kingdom	Heteroskedasticity	Heteroskedasticity
United Kingdom	Serial Correlation	Serial correlation
United Kingdom	Omitted Variable	No Omitted variable
United Kingdom	ARCH disturbance	No ARCH disturbance
United Kingdom	Robust	Non-stationary

- **Asymmetric Static Regression (Wholesale - spot price plus euro_to_usd rate, then change in that. (we add because both are log values))**

Country	Tests	Results
Denmark	Heteroskedasticity	Heteroskedasticity exists
Denmark	Serial Correlation	Serial correlation
Denmark	Omitted Variable	Omitted variable
Denmark	ARCH disturbance	No ARCH disturbance
France	Heteroskedasticity	No heteroskedasticity
France	Serial Correlation	No Serial correlation
France	Omitted Variable	No Omitted variable
France	ARCH disturbance	No ARCH disturbance
Netherland	Heteroskedasticity	No Heteroskedasticity
Netherland	Serial Correlation	Serial correlation
Netherland	Omitted Variable	No Omitted variable
Netherland	ARCH disturbance	No ARCH disturbance
Switzerland	Heteroskedasticity	Heteroskedasticity exists
Switzerland	Serial Correlation	No Serial correlation
Switzerland	Omitted Variable	Omitted variable
Switzerland	ARCH disturbance	ARCH disturbance exists
United Kingdom	Heteroskedasticity	Heteroskedasticity
United Kingdom	Serial Correlation	Serial correlation

United Kingdom	Omitted Variable	No Omitted variable
United Kingdom	ARCH disturbance	No ARCH disturbance

- **Asymmetric dynamic regression: you may add more lags if necessary**

Country	Tests	Results
Denmark	Heteroskedasticity	No Heteroskedasticity exists
Denmark	Serial Correlation	No Serial correlation
Denmark	Omitted Variable	Omitted variable exists
Denmark	ARCH disturbance	No ARCH disturbance
Denmark	PSS Ftest	Significant
Denmark	Long Run Symmetry	Asymmetric
Denmark	Short Run Symmetry	Asymmetric
France	Heteroskedasticity	No heteroskedasticity
France	Serial Correlation	No Serial correlation
France	Omitted Variable	Omitted variable
France	ARCH disturbance	No ARCH disturbance
France	PSS Ftest	Significance
France	Long Run Symmetry	Asymmetric
France	Short Run Symmetry	Asymmetric
Netherland	Heteroskedasticity	Heteroskedasticity exists
Netherland	Serial Correlation	Serial correlation
Netherland	Omitted Variable	Omitted variable
Netherland	ARCH disturbance	No ARCH disturbance
Netherland	PSS Ftest	At Least 1 lag is significant
Netherland	Long Run Symmetry	Asymmetric
Netherland	Short Run Symmetry	Asymmetric
Switzerland	Heteroskedasticity	No Heteroskedasticity exists
Switzerland	Serial Correlation	No Serial correlation exists

Switzerland	Omitted Variable	Omitted variable
Switzerland	ARCH disturbance	No ARCH disturbance exists
Switzerland	PSS Ftest	At Least 1 lag is significant
Switzerland	Long Run Symmetry	Asymmetric
Switzerland	Short Run Symmetry	Asymmetric
United Kingdom	Heteroskedasticity	Heteroskedasticity
United Kingdom	Serial Correlation	No Serial correlation
United Kingdom	Omitted Variable	Omitted variable
United Kingdom	ARCH disturbance	No ARCH disturbance
United Kingdom	Stationary Residuals	At Least 1 lag is significant
United Kingdom	Long Run Symmetry	Asymmetric
United Kingdom	Short Run Symmetry	Asymmetric

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