



## 'ROCKETS AND FEATHERS' ANALYSIS OF THE FAROESE DOWNSTREAM OIL MARKET

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A report to Magn

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OIL MARKET



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## TABLE OF CONTENTS

<b>1.</b>	<b>ASSYMETRIC PRICE ADJUSTMENT</b>	<b>1</b>
1.1	Background	1
1.2	Methodology	2
1.3	Results	4
1.4	Conclusions	6

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## 1. ASSYMETRIC PRICE ADJUSTMENT

Pöyry has undertaken analysis of the Faroese downstream oil market. This included exploring the presence (or absence) of asymmetric price adjustment of Faroese refined oil retail prices, also commonly labelled as 'rockets and feathers' analysis. This paper describes the methodology and the results of our analysis, which has been undertaken by:

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- Ece Sayin, Consultant

and led and supervised by:

- Gareth Davies (PhD), Director

### 1.1 Background

The relationship between retail and international wholesale oil prices has been a subject of public debate in many countries. A point that has been raised by industry observers is a potential asymmetry in the response of retail oil prices to changes in international wholesale oil prices. This notion suggests retailers respond faster to international oil prices increases but are more reluctant to decrease retail prices when international oil prices drop. This phenomenon is labelled as 'asymmetric price adjustment' or 'rockets and feathers' as coined by Bacon in 1990 (prices rise like a rocket, but drop like a feather).

Since 1990 there has been extensive research and a series of econometric models have been developed by academic researchers to examine the potential of asymmetric price adjustment in various countries. Findings differ from country to country and are sensitive to data quality the time horizon of the analysis. Our literature review does not point to a definitive conclusion when it comes to the 'rockets and feathers' phenomenon. Some studies suggest evidence of asymmetric price adjustment, whereas others do not.

One of the most recent studies was carried out by the European Commission, covering 15 EU countries. Evidence was mixed with some countries exhibiting a different rate and speed of adjustment, but, in general, the conclusion was that there is not significant proof of systematic price adjustment asymmetry. An overview of these two studies and their main conclusions are presented in Table 2, alongside other similar studies with a European geographical coverage.

**Table 1 – Summary of literature review**

Year	Author	Geography	Time series	Granularity	Conclusions
1991	Bacon <sup>1</sup>	UK	1982-1989	Bi-weekly	Presence of 'rockets and feathers' for gasoline in the UK
1991	Manning	UK	1973-1988	Monthly	No asymmetric pricing
2005	Grasso & Manera <sup>2</sup>	France, Italy, Spain, Germany & UK	1985-2003	Monthly	Evidence of asymmetry changes with the use of different error correction models
2009	EC	EU countries	Varying time periods	Weekly	Mixed evidence
2010	Bermingham <sup>3</sup> & O'Brien	UK & Ireland	1997-2009	Monthly	No asymmetric pricing
2010	Clerides <sup>4</sup>	EU countries)	Varying time periods	Weekly	Weak evidence of asymmetric pricing

The above list is not exhaustive and we focus on the studies that pioneered the 'rockets and feathers' phenomenon and have a more extensive EU coverage.

We have attempted to expand this type of analysis to the Faroese downstream oil market and investigate whether there is evidence of a 'rockets and feathers' phenomenon in the Faroe Islands.

## 1.2 Methodology

For our analysis we have access to:

- Magn's daily retail prices for gasoline, gasoil and diesel;
- Danish retail prices for gasoline, gasoil and diesel; and
- international wholesale oil refined product prices<sup>5</sup>.

We have explored different models to establish the one that best describes the relationship between retail and international wholesale prices. All models considered were of a linear form and assumed different lags. We also considered a linear model that links retail prices with the average within-month average wholesale price up to the relevant day. The key observation is the presence of a lag between retail and international wholesale prices. It is also clear that Faroese retail prices do not change on a daily basis.

<sup>1</sup> Rockets & Feathers: The asymmetric speed of adjustment of UK retail gasoline prices to cost changes, R. Bacon, 1990, Oxford Institute for Energy Studies

<sup>2</sup> Asymmetric error correction models for oil-gasoline price relationship, M. Grasso & M. Manera, 2005

<sup>3</sup> Testing for Asymmetric pricing behaviour in Irish and UK petrol and diesel markets, C. Bermingham & D. O'Brien, 2010, Central Bank and Financial Services Authority of Ireland

<sup>4</sup> Retail fuel price response to oil price shocks in EU countries, S. Clerides, 2010, Cyprus Economic Policy Review

<sup>5</sup> These have been converted from US\$ to DKK with the use of daily exchange rates

Daily disaggregated prices were then converted to weekly prices to:

- ensure comparable results with other studies that typically use weekly prices; and
- minimise any spurious results as Faroese retail prices do not change on a daily basis.

The general formulation of the error correction model employed to test asymmetric pricing is:

$$\Delta RP_t = \sum_{j=0}^n \alpha_j \Delta RP_{t-j} + \sum_{j=0}^n \beta_j \Delta WP_{t-j} + \vartheta_1 (RP_{t-1} - \varphi_1 WP_{t-1} - \varphi_0) + \eta_t$$

This was originally introduced by Borenstein, Cameron and Gilbert, who also estimate coefficients of the above equation in a single 'step' using a 2SLS method. Other researchers have however argued in favour of a two-step OLS approach.

The model has been adapted to assume a one time-period lag (the change in the retail price in week  $t$  is a function of the change in the retail price in the previous week  $t-1$  and the change the international wholesale price in the previous week  $t-1$ ):

$$\Delta RP_t = \alpha \Delta RP_{t-1} + \beta \Delta WP_{t-1} + \vartheta (RP_{t-1} - \varphi_1 WP_{t-1} - \varphi_0) + \eta_t \quad (1)$$

The above model implicitly assumes a linear, long-term relationship between retail and international wholesale prices:

$$RP_t = \varphi_1 WP_t + \varphi_0 + \epsilon_t \quad (2)$$

We estimate the above equation through a two-step approach with OLS. This two-step process can also help avoid the danger of spurious correlations that may arise in the presence of non-stationary data.

Oil prices are typically non-stationary<sup>6</sup>. This means they do not revert to the same average value over a certain time horizon. However, if both retail and wholesale prices are non-stationary, but are cointegrated, a linear relationship of the two exists that is stationary<sup>7</sup>.

First, we estimate the coefficients  $\varphi_1$  and  $\varphi_0$  and the regression residuals  $\epsilon_t$  of equation (2) and replace the latter in the equation (1)<sup>8</sup>:

$$\Delta RP_t = \alpha \Delta RP_{t-1} + \beta \Delta WP_{t-1} + \vartheta \epsilon_t + \eta_t$$

The above is then adapted to allow for different coefficient for positive and negative changes in the wholesale price:

$$\Delta RP_t = \alpha \Delta RP_{t-1} + \beta^+ \Delta WP_{t-1}^+ + \beta^- \Delta WP_{t-1}^- + \vartheta^+ \epsilon_t^+ + \vartheta^- \epsilon_t^- + \eta_t$$

Estimating the coefficients of the above model can answer some important questions with regards to retail oil pricing:

- What is the rate of short-run pass-through?

<sup>6</sup> This is also supported from our own independent analysis. The Dickey-Fuller test for Faroese retail and international wholesale prices for gasoil and diesel suggests the relevant time series are non-stationary at the 95% confidence level. The null hypothesis of unit root is however rejected for both retail and wholesale gasoline prices with the Dickey-Fuller statistics being marginally lower than the relevant critical value.

<sup>7</sup> This can again be tested with the use of an augmented Dickey-Fuller test.

<sup>8</sup> We adopt this approach for all oil products, including gasoline, even if there is no strict need to use the two-step method for gasoline.

- What is the speed of price adjustment to the long-run equilibrium level?
- Is there any asymmetry in the rate and speed of adjustment?

The level of  $\beta^+$  and  $\beta^-$  represent the rate of short-run pass-through of a change in international oil prices to (local) retail prices. If the international oil price rises by 1DKK in week  $t-1$ , then the (local) retail price will rise by  $\beta^+$  in the following week  $t$ . Similarly, if the international oil price drops by 1DKK in week  $t-1$ , then local retail price will decrease by  $\beta^-$  in week  $t$ .

The  $\vartheta^+$  and  $\vartheta^-$  coefficients represent the adjustment of the retail price with regards to the long-run relationship with the international oil price. These coefficients should typically be negative, and the higher the absolute level of the coefficients the 'faster' retail prices should return to their long-run level.

### 1.3 Results

Across all oil products (gasoil, gasoline and diesel), the response to short-run oil price shocks is greater to negative changes (international oil price drops) than positive. The difference between the two coefficients is however not statistically significant. This means the coefficients can be considered to be equal and the short-run pass-through to be symmetric.

The results for the long-run catch-up speed for Faroese oil product prices are also in the reverse direction than what is suggested by common wisdom. Retail prices revert faster to their long-run implied level when those are above that level than when they below that.

Our analysis over the time period 2005 to mid-2015 suggests there is no evidence of asymmetric price adjustment in the Faroese downstream oil market. If anything, it is more likely that negative wholesale price shocks feed through more to retail prices than positive ones and more likely that retail prices revert faster to the long-run equilibrium level when those are above that rather than below.

Table 2 presents the results of our analysis.

**Table 2 – Estimates of short-run pass-through and catch-up speed for Faroese retail refined oil prices**

	Short-run pass-through			Catch-up speed		
	Positive	Negative	Difference	Positive	Negative	Difference
Gasoline	0.24	0.25	-0.02	-0.12	-0.05	-0.07
Diesel	0.25	0.31	-0.06	-0.14	-0.03	-0.10
Gasoil	0.28	0.32	-0.04	-0.09	-0.02	-0.07

All coefficients are statistically different from zero at the 5% interval with the exception of the negative catch-up speed for gasoil

The analysis outlined above explored the presence of a 'rockets and feathers' phenomenon throughout the entire period 2005 to mid-2015. It is also important to test the temporal evolution of the short-run pass-through and catch-up speed coefficients. We have undertaken the same analysis for the time series of each year individually. However, the results of this disaggregated analysis cannot be used to draw any safe conclusions as the relevant statistical tests (t-Student and p-value) were not met for the majority of the coefficients. We, therefore do not present the results, which, in any case, were not pointing to a trend of increasing asymmetric behaviour through time.



To test this further, we carry out the same analysis over two periods: 2005 to 2007 and 2008 to mid-2015. It is in 2008 that Magn and Effo became independent. The results over the two periods do not show a move towards 'more' asymmetric pricing since Magn and Effo became independent. The results for each time series are shown in Table 3 and Table 4.

**Table 3 – Estimates of short-run pass-through for Faroese retail refined oil prices**

	2005-07			2008-15		
	Positive	Negative	Difference	Positive	Negative	Difference
Gasoline	0.22	0.42	-0.20	0.15	0.16	-0.01
Diesel	0.34	0.23	0.11	0.18	0.22	-0.04
Gasoil	0.45	0.43	0.02	0.19	0.24	-0.05

**Table 4 – Estimates of catch-up speed for Faroese retail refined oil prices**

	2005-07			2008-15		
	Positive	Negative	Difference	Positive	Negative	Difference
Gasoline	-0.47	-0.19	-0.28	-0.08	-0.07	-0.01
Diesel	-0.36	-0.31	-0.05	-0.13	-0.07	-0.06
Gasoil	-0.18	-0.18	0.01	-0.10	-0.05	-0.06

## 1.4 Conclusions

Our analysis attempts to explore the presence of 'rockets and feathers' pricing in the Faroe Islands:

- we have not found any evidence suggesting asymmetric price adjustment based on the econometric model deployed and the data available to us;
- on the contrary, our estimates show that there is some evidence of prices responding faster to international price drops than price increases (though statistically weak); and
- a similar analysis over two different periods (2005 to 2007 and 2008 to mid-2015) does not show a move towards 'more' asymmetric pricing since Magn and Effe became independent.

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