



Current and Future Challenges to Energy Security
2nd AIEE Energy Symposium, Rome, Italy

Pricing Characteristics in the German Diesel Retail Market after the Introduction of the Market Transparency Unit

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Rome, 3rd November 2017

Agenda

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- ◆ Introduction
 - ◆ Data
 - ◆ Research Questions
 - ◆ Methods:
 - Asymmetric Error Correction Model
 - Semi-Asymmetric Error Correction Model
 - ◆ Results
 - ◆ Further Research
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Introduction

- ◆ High public relevance of gasoline price development
- ◆ Long tradition of research concerning relationship of gasoline and oil prices, e. g.

Rockets and Feathers (Asymmetric Price Transmission) → “Rockets and Feathers are given when fuel prices increase faster than they decrease after oil price changes.”

- ◆ Widely discussed questions:
 - Do retailers increase prices faster with increasing oil prices?
 - Is market power given?

Rockets and feathers: the asymmetric speed of adjustment of UK retail gasoline prices to cost changes

Robert W. Bacon

The paper develops a quadratic quantity adjustment model to test the hypothesis put forward in the recent Monopolies and Mergers Commission Report, that the speed of adjustment of UK retail gasoline prices to cost changes is more rapid when costs rise than when they fall, and that the adjustment path is more concentrated around the mean value on the upswing. Using data from 1982 to 1989 evidence of faster and more concentrated responses to cost increases were found.

Keywords: Gasoline prices, Speed of adjustment, Asymmetric adjustment

The determination of retail gasoline prices in the UK has long been the subject of debate. There have been three inquiries by the Monopolies and Mergers Commission (MMC), leading to the publication of the reports MMC [5, 6, 7], in which the industry was examined for evidence of non-competitive pricing and collusive behaviour. In the most recent inquiry a major

there was an initial delay followed by a rapid adjustment, while in the cost decrease case downward price adjustment started sooner but in a series of smaller steps. This asymmetrical pattern of adjustment, termed 'rockets and feathers', was not established through econometric work but with the help of descriptive and graphical analysis of weekly company data for the



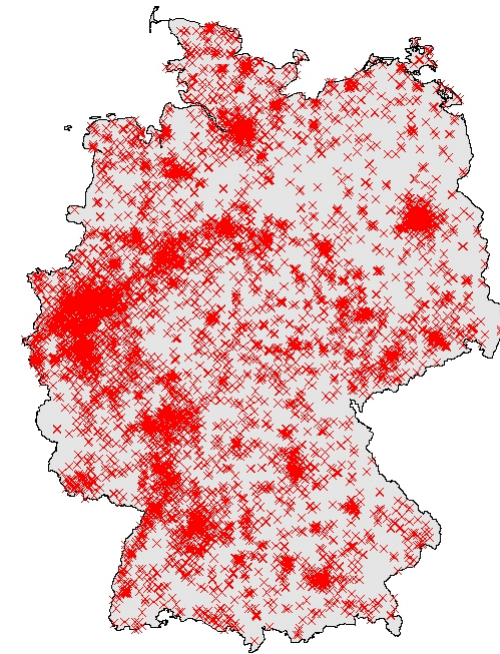
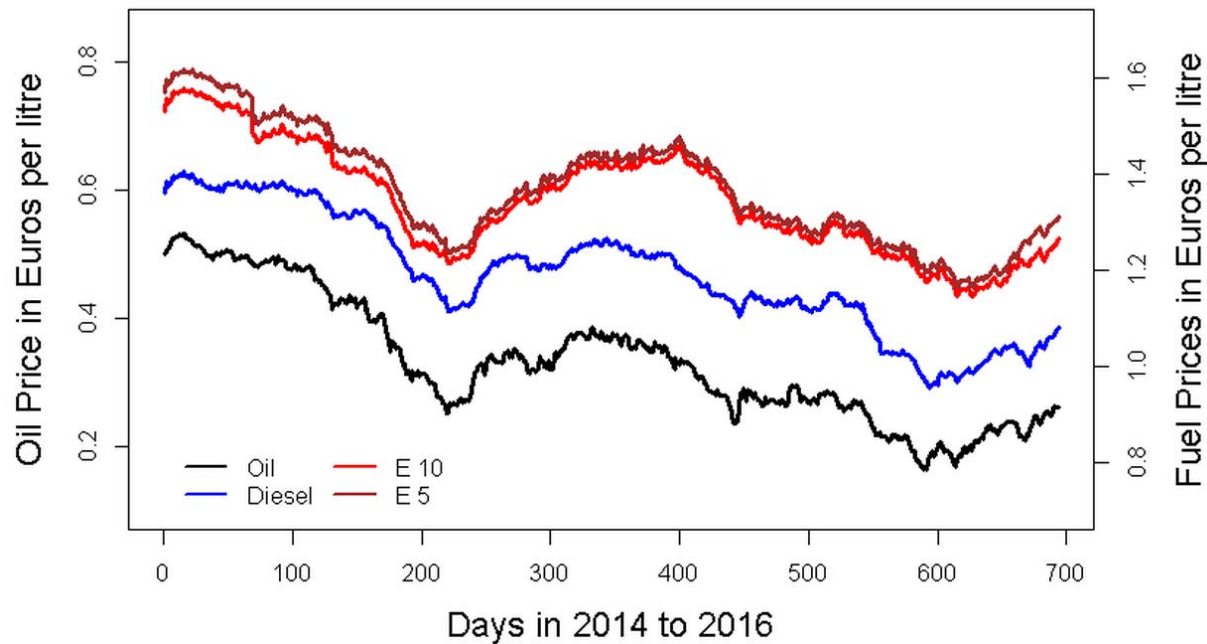
Data (1): Market Transparency Unit in Germany

- ◆ Data set was gathered from an online platform via the market transparency unit
- ◆ Part of the German Federal Cartel Office; established to increase market transparency in the retail market
- ◆ “Since [...] 2013 companies which operate public petrol stations [...] are obliged to report price changes [...] of fuel [...] in real time“



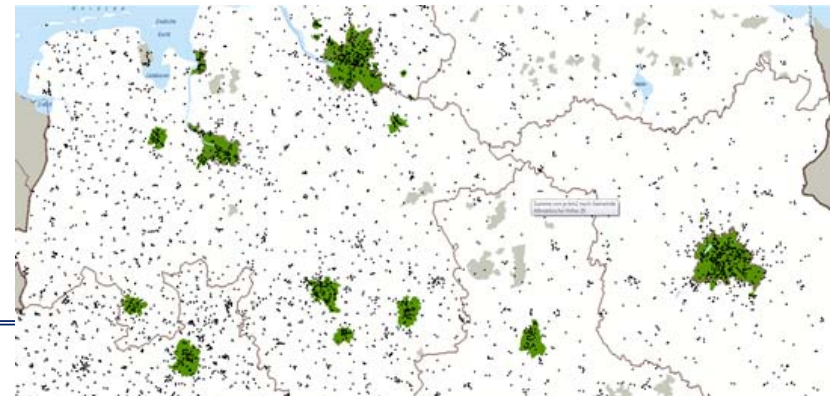
Data (2): Diesel Data

- ◆ In total: More than 20 million prices for all german fuel stations
- ◆ Daily prices for the period from June 2014 to May 2016 of about 6800 retail fuel stations → highly disaggregated data
- ◆ The database enables to differentiate between brands and regions



Research Questions

1. Do diesel prices follow oil prices in the long-run (**cointegration**)?
2. Do **major brands (Shell, Total, Jet, Esso, Aral)** show different pricing characteristics concerning asymmetry than all other stations?
3. Do **independent petrol stations** show different pricing characteristics concerning asymmetry than all other stations?
4. Do petrol stations in **lower populated regions (PopDens low)** behave differently concerning asymmetry from stations in more **urban areas (PopDens high)**?
 - Threshold: 1000 inhabitants/km²



Methods (1a): Creating the Asymmetric Error Correction Model following Engle/Granger

Test for stationarity (ADF-Test) of fuel and oil in levels and in first differences
→ Results need to show that the data is integrated on the same scale of integration.

$$\Delta fuel_{i,t} = \alpha_{0,i} + \beta_i fuel_{t-1} + \sum_{m=1}^p \delta_{i,m} \Delta fuel_{t-m} + \varepsilon_t$$

$$\Delta oil_{i,t} = \alpha_i + \beta_i oil_{t-1} + \sum_{m=1}^p \delta_{i,m} \Delta oil_{t-m} + \varepsilon_t$$

OLS: $fuel_{i,t} = \theta_i + \sum_{l=1}^6 \sigma_{i,l} weekday_t +$

$$\sum_{k=0}^n \mu_{i,k} oil_{t-k} + \tau_t$$

- a) OLS: Estimate the **cointegration relationship** and testing residuals for stationarity
b) Using the residuals within the Error Correction Model

Estimate asymmetric error correction model: threshold

variable for decomposing τ_t , Δoil_t and $\Delta fuel_t$ is zero;

$$\Delta fuel_{i,t} = \gamma_i^+ \tau_{t-1}^+ + \gamma_i^- \tau_{t-1}^- + \sum_{j=0}^K \vartheta_{1,i,j}^+ \Delta oil_{t-j}^+ + \sum_{j=0}^K \vartheta_{1,i,j}^- \Delta oil_{t-j}^- + \sum_{n=1}^L \vartheta_{2,i,n}^+ \Delta fuel_{t-n}^+ + \sum_{n=1}^L \vartheta_{2,i,n}^- \Delta fuel_{t-n}^- + \varepsilon_t$$

$$\tau_t^+ = \tau_t \wedge \tau_t^- = 0 \text{ if } \tau_t > 0, \tau_t^- = \tau_t \wedge \tau_t^+ = 0 \text{ if } \tau_t < 0;$$

$$\Delta oil_t^+ = \Delta oil_t \wedge \Delta oil_t^- = 0 \text{ if } \Delta oil_t > 0, \Delta oil_t^- = \Delta oil_t \wedge \Delta oil_t^+ = 0 \text{ if } \Delta oil_t < 0; \Delta fuel_t^+ = \Delta fuel_t \wedge \Delta fuel_t^- = 0 \text{ if } \Delta fuel_t > 0, \Delta fuel_t^- = \Delta fuel_t \wedge \Delta fuel_t^+ = 0 \text{ if } \Delta fuel_t < 0$$

Methods (1b): Interpretation of model results

$$\Delta fuel_{i,t} = \underbrace{\gamma_i^+ \tau_{t-1}^+ + \gamma_i^- \tau_{t-1}^-}_{\text{Testing for speed back into the long-term equilibrium}} + \sum_{j=0}^K \vartheta_{1,t,j}^+ \Delta oil_{t-j}^+ + \sum_{j=0}^K \vartheta_{1,t,j}^- \Delta oil_{t-j}^- + \sum_{i=1}^L \vartheta_{2,t,i}^+ \Delta fuel_{t-i}^+ + \sum_{i=1}^L \vartheta_{2,t,i}^- \Delta fuel_{t-i}^- + \varepsilon_t$$

Testing for speed back into
the long-term equilibrium

- Positive error term: real diesel price is higher than equilibrium price → Rockets and feathers: this reversion should be slower.
- Negative error term: real diesel price is lower than equilibrium price → Rockets and feathers: this reversion should be faster.
- ◆ Testing for difference between γ_i^+ and γ_i^- (Wald-test) → $H(0): \gamma_i^+ = \gamma_i^-$ and $H1: \gamma_i^+ \neq \gamma_i^-$

Methods (2a): Creating the Semi-Asymmetric Error Correction Model following Engle/Granger

Test for stationarity (ADF-Test) of fuel and oil in levels and in first differences
 → Results need to show that the data is integrated on the same scale of integration.

$$\Delta fuel_{i,t} = \alpha_{0,i} + \beta_i fuel_{t-1} + \sum_{m=1}^p \delta_{i,m} \Delta fuel_{t-m} + \varepsilon_t$$

$$\Delta oil_{i,t} = \alpha_i + \beta_i oil_{t-1} + \sum_{m=1}^p \delta_{i,m} \Delta oil_{t-m} + \varepsilon_t$$

$$OLS: fuel_{i,t} = \theta_i + \sum_{l=1}^6 \sigma_{i,l} weekday_t +$$

$$\sum_{k=0}^n \mu_{i,k} oil_{t-k} + \tau_t$$

- a) OLS: Estimate the **cointegration relationship** and testing residuals for stationarity
 b) Using the residuals within the Error Correction Model

Estimate semi-asymmetric error correction model: Threshold variable for decomposing τ_t is sign of the mean of wholesale oil price changes (Δoil_t) over n lags (number of lags from optimal OLS)

$$\Delta fuel_{i,t} = \gamma_i^+ \tau_{t-1}^+ + \gamma_i^- \tau_{t-1}^- + \sum_{j=0}^K \vartheta_{1,i,j} \Delta oil_{t-j} + \sum_{n=1}^L \vartheta_{2,i,n} \Delta fuel_{t-n} + \varepsilon_t$$

where

$$\tau_t^+ = \tau_t \wedge \tau_t^- = 0, \text{ if } \frac{1}{n} \sum_{j=0}^n \Delta oil_{t-j} > 0, \tau_t^- = \tau_t \wedge \tau_t^+ = 0, \text{ if } \frac{1}{n} \sum_{j=0}^n \Delta oil_{t-j} \leq 0,$$

$$\Delta oil_t = oil_t - oil_{t-1}$$

$$\Delta fuel_{i,t} = \underbrace{\gamma_i^+ \tau_{t-1}^+ + \gamma_i^- \tau_{t-1}^-}_{\text{Testing for speed back into the long-term equilibrium}} + \sum_{j=0}^K \vartheta_{1,i,j} \Delta oil_{t-j} + \sum_{n=1}^L \vartheta_{2,i,n} \Delta diesel_{t-n} + \varepsilon_t$$

Testing for speed back into
the long-term equilibrium

- ◆ **But with different interpretation:** Are coefficients $\gamma_i^+ > \gamma_i^-$? \rightarrow faster adjustment for increasing oil prices
- ◆ Testing for difference between γ_i^+ and γ_i^- (Wald-test) $\rightarrow H(0): \gamma_i^+ = \gamma_i^-$ and $H1: \gamma_i^+ \neq \gamma_i^-$

Current Results

1. Test for order of cointegration
- 2. Cointegration**
- 3. ECM**
 - a. **Asymmetric ECM (A-ECM)**
 - b. **Semi-Asymmetric ECM (SA-ECM)**

Current Results (1): Cointegration

Cointegration-Model – lag selection by BIC	Share [%]; significance level 1 %	Share [%]; significance level 5 %
OLS max. 7 lags	85 %	96 %
OLS max. 10 lags	79 %	94 %
OLS max. 14 lags	79 %	94%

Current Results (2): **Asymmetric and Semi-Asymmetric** ECM for all cointegrated retail stations

◆ Wald-Test: 10 % Significance level

Cases/Scenarios/Data	A-ECM (BIC)	SA-ECM (BIC)
Rockets and Feathers Asymmetry	17%	11%
Brand Asymmetry	20%	14%
Non-Brand Asymmetry	13%	5%
Independent Asymmetry	12%	4%
Non-Independent Asymmetry	17%	11%
PopDens high Asymmetry	13%	10%
PopDens low Asymmetry	18%	11%

◆ Comparable results for

- different significance levels of the Wald-Test (5 % significance level),
- DOLS cointegration relationship instead of OLS and
- AIC as lag selection indicator instead of the BIC

“Pricing Characteristics in the German Diesel Retail Market after the Introduction of the Market Transparency Unit”

Thank you very much for your attention.

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