Analyzing the Relationship of German Retail Fuel Prices and Oil Prices

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Agenda

- Introduction
- Data
- Research Questions
- Methods
  - Asymmetric Error Correction Model
- Current Results
Introduction
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.”

Popular research question:
- Do (which?) retailers increase prices faster with increasing oil prices (and vice versa)?
In total: More than 66 million prices for “all” German fuel stations

- Daily prices for the period from June 2014 to May 2016 of about 8600 retail stations
- Each retail station can be identified by an ID
Research Questions

1. Do **major brands (Shell, Total, Jet, Esso, Aral)** show different pricing characteristics concerning asymmetry than all other stations?

2. Do **independent petrol stations** show different pricing characteristics concerning asymmetry than all other stations?

3. 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

4. Does **cheap retail stations** behave differently in their pricing patterns regarding asymmetry **compared to more expensive stations**?

5. Does the **number of competitors in a specific radius of each station** influences the chance of asymmetry of that station?
Methods (1): 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.

**OLS:** \( fuel_{i,t} = \theta_i + \mu_{i,oil_t} + \tau_t \)

**DOLS:** \( fuel_{i,t} = \theta_i + \mu_{1,i,oil_t} + \sum_{k=0}^{n} \mu_{2,i,k} \Delta oil_{t-k} \) + \( \sum_{l=1}^{6} \sigma_{i,l} \text{weekday}_{l} + \tau_t \)

Estimate asymmetric error correction model: threshold variable for decomposing \( \tau_t, \Delta oil_t \) and \( \Delta fuel_t \) is zero;

\[
\begin{align*}
\Delta fuel_{i,t} &= \beta_{0,i} + \beta_{1,i}fuel_{t-1} + \sum_{j=1}^{p} \beta_{2,i,j}\Delta fuel_{t-j} + \epsilon_t \\
\Delta oil_t &= \beta_0 + \beta_{1,oil_{t-1}} + \sum_{j=1}^{p} \beta_{2,j}\Delta oil_{t-j} + \epsilon_t \\
\end{align*}
\]

\[\tau_t^+ = \tau_t \land \tau_t^- = 0 \text{ if } \tau_t > 0, \tau_t^- = \tau_t \land \tau_t^+ = 0 \text{ if } \tau_t < 0;\]
\[\Delta oil_t^+ = \Delta oil_t \land \Delta oil_t^- = 0 \text{ if } \Delta oil_t > 0, \Delta oil_t^- = \Delta oil_t \land \Delta oil_t^+ = 0 \text{ if } \Delta oil_t < 0;\]
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Methods (2): Interpretation of model results

\[
\Delta fuel_{i,t} = \gamma_i^+ \tau_{t-1}^+ + \gamma_i^- \tau_{t-1}^- + \sum_{m=0}^{K} \theta_{1,i,m}^+ \Delta oil_{t-m}^+ + \sum_{m=0}^{K} \theta_{1,i,m}^- \Delta oil_{t-m}^- + \sum_{n=1}^{L} \theta_{2,i,n}^+ \Delta fuel_{t-n}^+ + \sum_{n=1}^{L} \theta_{2,i,n}^- \Delta fuel_{t-n}^- + \epsilon_t
\]

Testing for the difference of the speed back into the long-run equilibrium

→ Positive error term: real fuel price is higher than predicted equilibrium price → Rockets and feathers: this downward price reversion should be slower.

→ Negative error term: real fuel price is lower than predicted equilibrium price → Rockets and feathers: this upward price reversion should be faster.

❖ Testing for difference between \(\gamma_i^+\) and \(\gamma_i^-\) (Wald-test) → \(H(0): \gamma_i^+ = \gamma_i^-\) and \(H(1): \gamma_i^+ \neq \gamma_i^-\)
1. Test for scale of integration
2. Cointegration
3. Asymmetric Error Correction Model
   - Research questions 1 – 5

1. Do major brands (Shell, Total, Jet, Esso, Aral) show different pricing characteristics concerning asymmetry than all other stations?
2. Do independent petrol stations show different pricing characteristics concerning asymmetry than all other stations?
3. 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
4. Does cheap retail stations behave differently in their pricing patterns regarding asymmetry compared to more expensive stations?
5. Does the number of competitors in a specific radius of each station influences the chance of asymmetry of that station?
Current Results (research questions 1, 2 and 3) for all cointegrated retail stations

- Wald-Test: 10 % Significance level

<table>
<thead>
<tr>
<th>Cases/Data</th>
<th>Asymmetric Error Correction Model (BIC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockets and Feathers Asymmetry</td>
<td>22 %</td>
</tr>
<tr>
<td>Brand Asymmetry</td>
<td>25 %</td>
</tr>
<tr>
<td>Non-Brand Asymmetry</td>
<td>18 %</td>
</tr>
<tr>
<td>Independent Asymmetry</td>
<td>18 %</td>
</tr>
<tr>
<td>Non-Independent Asymmetry</td>
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</tr>
<tr>
<td>PopDens high Asymmetry</td>
<td>18 %</td>
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<tr>
<td>PopDens low Asymmetry</td>
<td>23 %</td>
</tr>
</tbody>
</table>
Current Results (question 4): Cheap stations and expensive stations
Current Results (question 5): Relationship between asymmetry and closeness of competitors

- Share of asymmetric station with a specific amount of competitors (x-axis) in a radius of 1 km and 3 km
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Thank you very much for your attention.

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