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12th Conference on Energy Economics and Technology (ENERDAY 2018) – Market and Sector Integration – National and European Perspectives

Analyzing the Relationship of German Retail Fuel Prices and Oil Prices

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27th April 2018

Agenda

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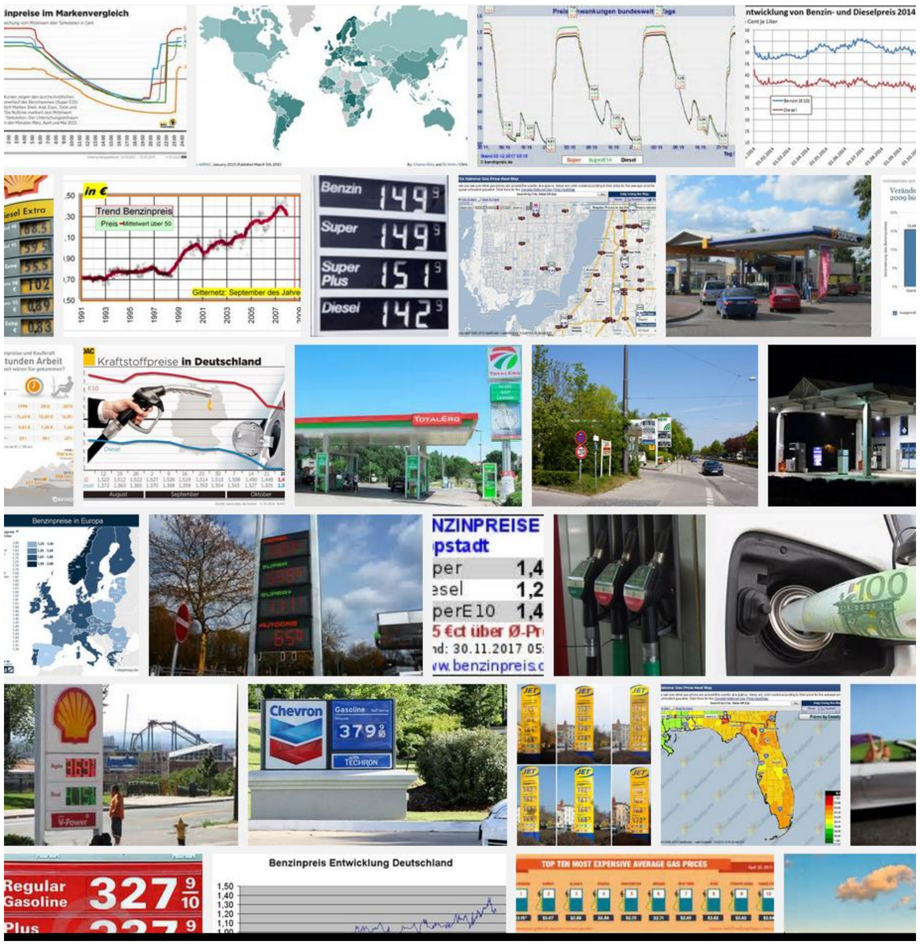
- Introduction
- Data
- Research Questions
- Methods
  - Asymmetric Error Correction Model
- Current Results

Introduction



Rising **fuel costs** erode benefits of Trump tax cut
Financial Times - 16 Apr 2018
Tim Rogus, a retired publisher in suburban Chicago, has noticed **fuel prices** at the petrol station creeping up towards $3 a gallon, as oil has rebounded to four-year highs this month, but he is philosophical about it. "Our prices were nearly $4 at one point," he says. "Life has to go on somehow." His attitude ...

Yahoo7 News

No Qld **fuel price** monitoring despite hikes
Daily Mail - 1 hour ago
The Queensland government isn't moving any closer to introducing real-time **fuel price** monitoring despite prices in the southeast set to hit a three-year high. Prices as high as 156.6 cents per litre were recorded at some southeast Queensland service stations on Thursday. If the average price goes above ...

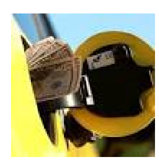
Battle intensifies with controversy over lack of real-time **fuel price** ...
The Cairns Post - 17 Apr 2018
The state government said it was "working on possible solutions" to tackle the pressure on Queensland drivers, but rebuffed demands for laws forcing retailers to reveal prices. Energy Minister Anthony Lynham blamed price hikes on a lack of competition. "We know that **fuel price** gouging by retailers ...

Another hefty **fuel price** increase expected – AA
Citizen - 16 Apr 2018
The Rand also weakened slightly against the US dollar in the first half of April, but the AA points out that the spike in international petroleum prices accounts for nearly the entire rise in **fuel prices** predicted by the mid-month data. ALSO READ: **Petrol prices** skyrocket today. "On the current data, petrol is set ...

Fuel price expected to rise in May - AA
Eyewitness News - 17 Apr 2018

View all

European fuel oil, bunker **fuel prices** hit multi-year highs on firming ...
Platts - 7 hours ago
In the bunker market, it's not just the blend of **fuel** that has to be right. Whatever your position in the supply chain, the combination of business intelligence you use is also crucial. From breaking news to detailed market analysis, **price** assessments to in-depth credit reports, Platts Bunker Portfolio offers a ...



Petrol price: This is where your money actually goes
BizNews - 12 Apr 2018
The Basic **Fuel Price** (BFP) is calculated based on costs associated with shipping petroleum products to South Africa from the Mediterrean area, Arab Gulf, and Singapore. These costs include insurance, storage, and wharfage (the cost to harbour facilities when off-loading petroleum products into storage).

Why you should fill your car up with petrol TODAY - **Fuel prices** set to ...
Express.co.uk - 13 Apr 2018

Introduction

- High public relevance of gasoline price development
- Long tradition of research concerning relationship of gasoline and oil prices, e. g. **<u>Rockets and Feathers (Asymmetric Price Transmission)</u>** → "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)?

Data: Diesel Data of the German Market Transparency Unit

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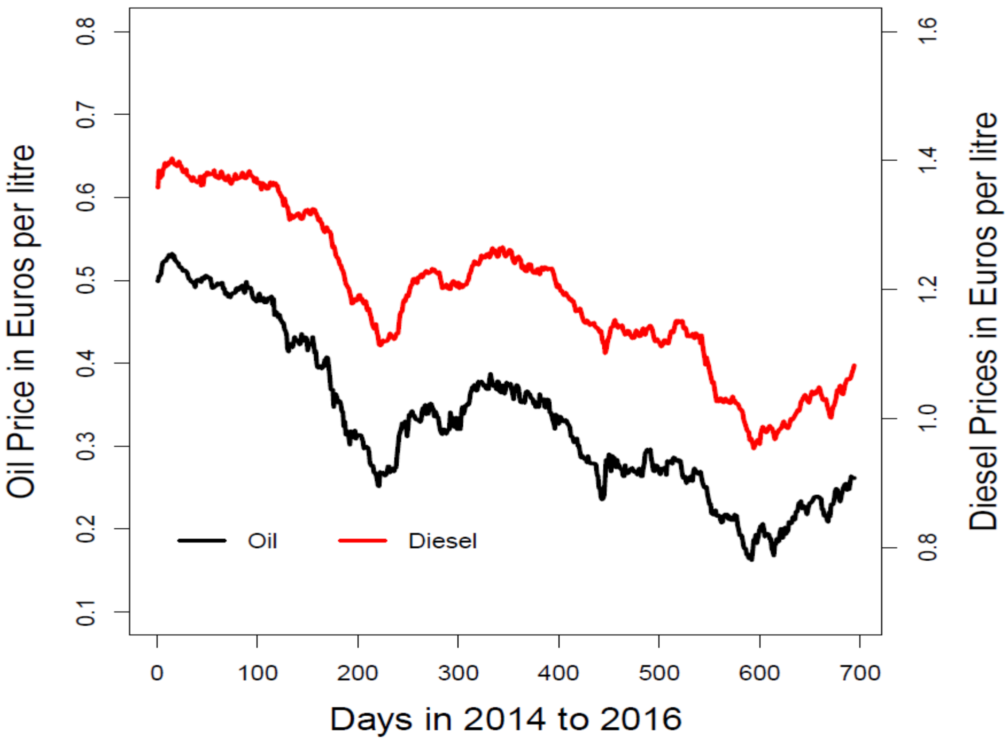
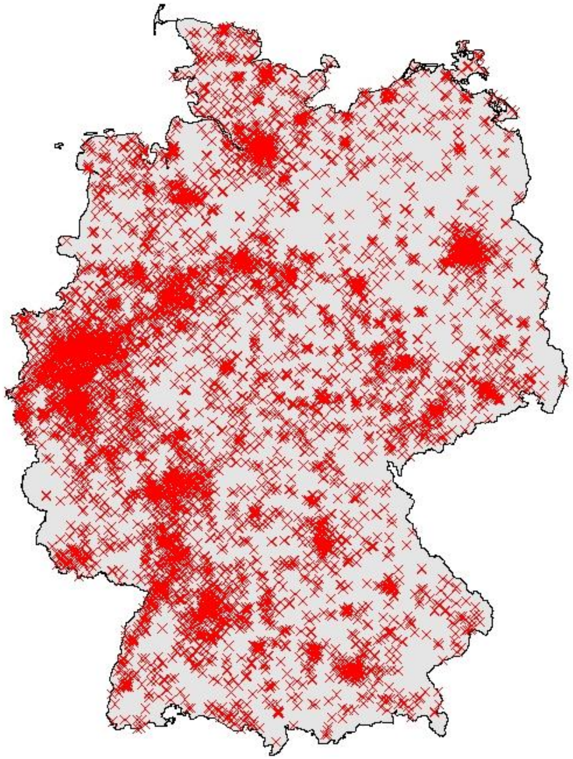
- In total: More than 66 million prices for “all” German fuel stations
- Daily prices for the period from June 2014 to May 2016 of about 8600 retail stations
- Each retail station can be identified by an ID





Research Questions

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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

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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.

$$\Delta fuel_{i,t} = \beta_{0,i} + \beta_{1,i} fuel_{t-1} + \sum_{j=1}^{p} \beta_{2,i,j} \Delta fuel_{t-j} + \varepsilon_t$$

$$\Delta oil_t = \beta_0 + \beta_1 oil_{t-1} + \sum_{j=1}^{p} \beta_{2,j} \Delta oil_{t-j} + \varepsilon_t$$

a) OLS: Estimating the **cointegration relationship** and testing residuals for stationarity

b) DOLS: If residuals are stationary in OLS, estimating an improved model and using the residuals within the Error Correction Model (Contín-Pilart et al. 2009, Stock & Watson 1993)

$$OLS\colon\ fuel_{i,t} = \theta_i + \mu_i oil_t + \tau_t$$

$$DOLS\colon\ fuel_{i,t} = \theta_i + \mu_{1,i} oil_t + \sum_{k=0}^{n} \mu_{2,i,k}\, \Delta oil_{t-k} + \sum_{l=1}^{6} \sigma_{i,l} weekday_l + \boldsymbol{\tau_t}$$

Estimate asymmetric error correction model: threshold variable for decomposing $\boldsymbol{\tau_t}$, $\boldsymbol{\Delta oil_t}$ and $\boldsymbol{\Delta fuel_t}$ is zero;

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

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

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

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

Methods (2): Interpretation of model results

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

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

→ 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 $\boldsymbol{\gamma_i^+}$ and $\boldsymbol{\gamma_i^-}$ (Wald-test) → $\mathrm{H}(0){:}\ \boldsymbol{\gamma_i^+} = \boldsymbol{\gamma_i^-}$ and $\mathrm{H}(1){:}\ \boldsymbol{\gamma_i^+} \neq \boldsymbol{\gamma_i^-}$

Current Results

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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?
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Current Results (research questions 1, 2 and 3) for all cointegrated retail stations

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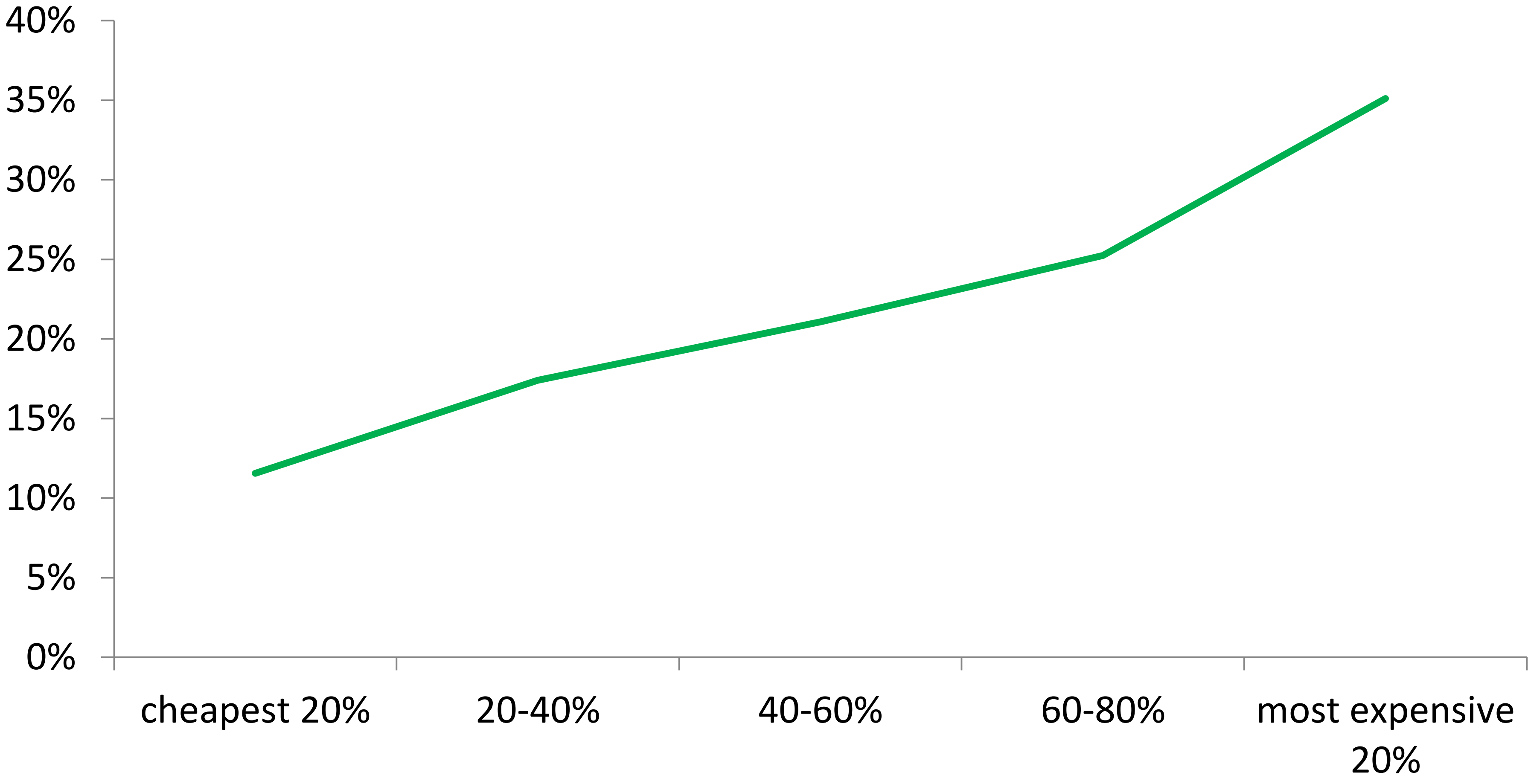
- Wald-Test: 10 % Significance level

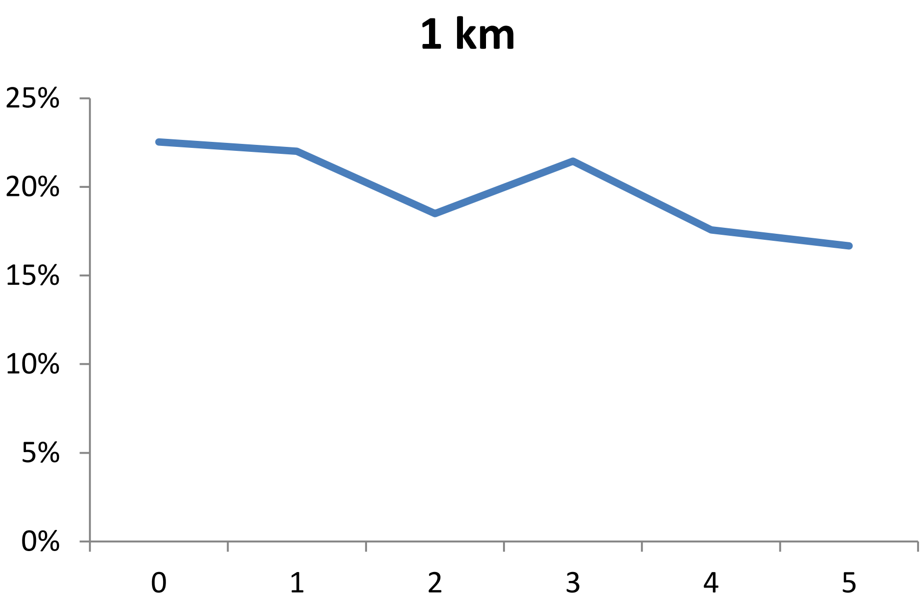
Cases/Data	Asymmetric Error Correction Model (BIC)
Rockets and Feathers Asymmetry	**22 %**
Brand Asymmetry	25 %
Non-Brand Asymmetry	18 %
Independent Asymmetry	18 %
Non-Independent Asymmetry	22 %
PopDens high Asymmetry	18 %
PopDens low Asymmetry	23 %

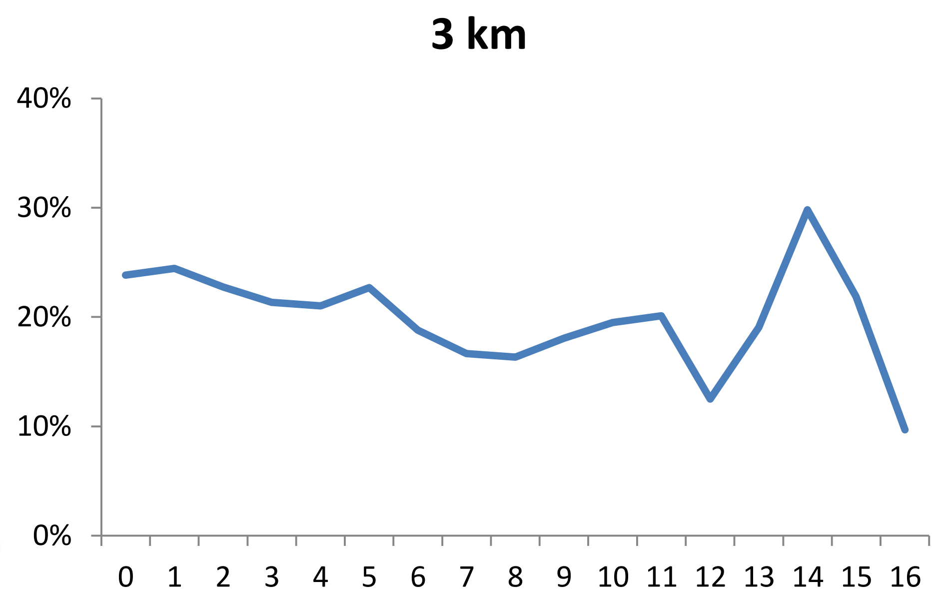
Current Results (question 4): Cheap stations and expensive stations



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





Thank you very much for your attention.

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