# How far we are from a price convergence in the EU energy markets?

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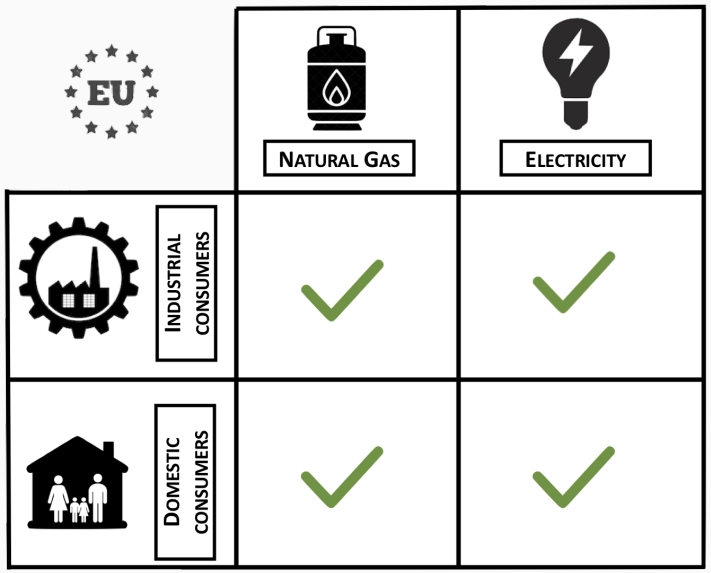
# The state of art

- Energy Union Strategy $\rightarrow$ construction of a fully-integrated internal energy market enabling the free flow of energy across the EU countries.
- Competition between energy suppliers should thus force down prices and foster their convergence (Ciferri et al., 2020).
- Improvement of the design of energy markets and cross-border exchanges (Fifth report on the State of the Energy Union).
- Retail price convergence is more pronounced for industrial consumers than for households.

# The state of art

- As other tradable goods, electricity and natural gas prices are expected to have the same price in unified energy markets (Bastianin et al., 2019; Dreger et al., 2007).
- Estimates of the reduction of average prices and price dispersion in single EU markets show mixed results (see e.g. Batalla et al., 2019; Saez et al., 2019; Telatar and Yasar, 2020,...).
- Less attention has been paid to price convergence in European gas markets (Bastianin et al., 2019; Robinson, 2007)

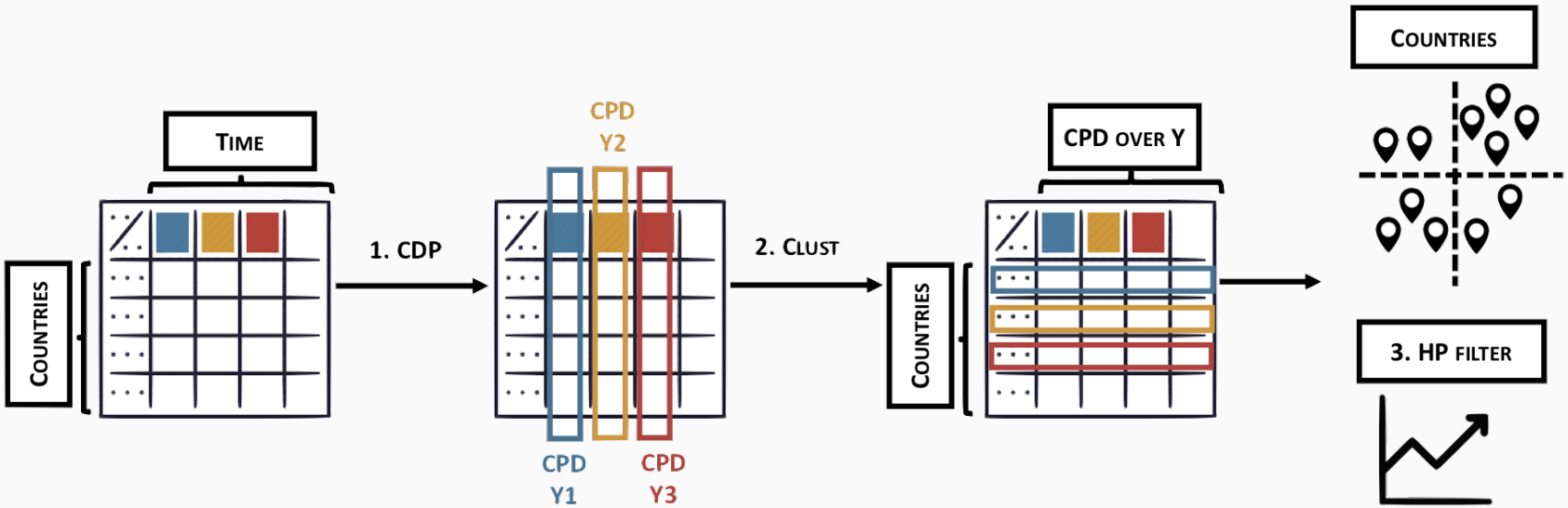


# The methodological proposal

A three-step procedure to define a composite index of electricity and natural gas prices

1. CPD (Diewert, 2005; Rao and Hajargasht, 2016) index, used by the International Comparison Program at the World Bank;
2. cluster analysis of EU countries;
3. HP filter.

$\rightarrow$ Evaluate price convergence.



# The basic idea of the CPD index

Within the stochastic approach, let:

- $p_{ij}$ be the real price of the $i^{th}$ commodity ($i = 1, \ldots, N$) in the $j^{th}$ country ($j = 1, \ldots, M$)
- $PPP_j$ be the purchasing power parity (PPP) of the currency of country $j$ with respect to a reference country currency, $M$.

The CPD model, in its additive form, is

$$\begin{aligned} \ln p_{ij} &= \ln p_i + \ln PPP_j + \ln u_{ij}^* = \eta_i + \pi_j + \varepsilon_{ij} \\ &= \sum_{i=1}^{N} \eta_i D_i^P + \sum_{j=1}^{M-1} \pi_j D_j^C + \varepsilon_{ij} \end{aligned} \tag{1}$$

where $\varepsilon_{ij}$ is a random error term and $D_i^P$, $D_j^C$ are binary variables. The former takes values 1 for commodity $i$ and 0 otherwise, while the latter is equal to 1 for country $j$ and 0 otherwise.

# The basic idea of the CPD index

The model in Eq. 1 has been estimated with the ordinary least squares (OLS). The OLS estimator of $\pi_j$ is

$$\hat{\pi}_j = \frac{1}{N} \sum_{i=1}^{N} \ln p_{ij} - \ln p_{iM}$$

and, accordingly $P\hat{P}P_j = e^{\hat{\pi}_j}$.

# The dataset

- *Source*: the official Eurostat statistics.
- *Prices*: Average national prices without taxes paid for **electricity** and **natural gas** by:
  - medium size **industrial** consumers (respectively with annual consumption between 500 - 2000 MWh and 10000 - 100000 GJ)
  - **domestic** consumers (respectively with annual consumption between 2500 - 5000 kWh and 20 - 200 GJ).
- *Period*: 2008–2018 for a total of 44 observations per country.
- *Commodities*: electricity and gas for household and non-household consumers.
- *Base country*: EU28.
- *Sample*: 25 EU countries are considered (Greece, Malta and Republic of Cyprus are excluded and the UK is still included).

# Results: two-step procedure

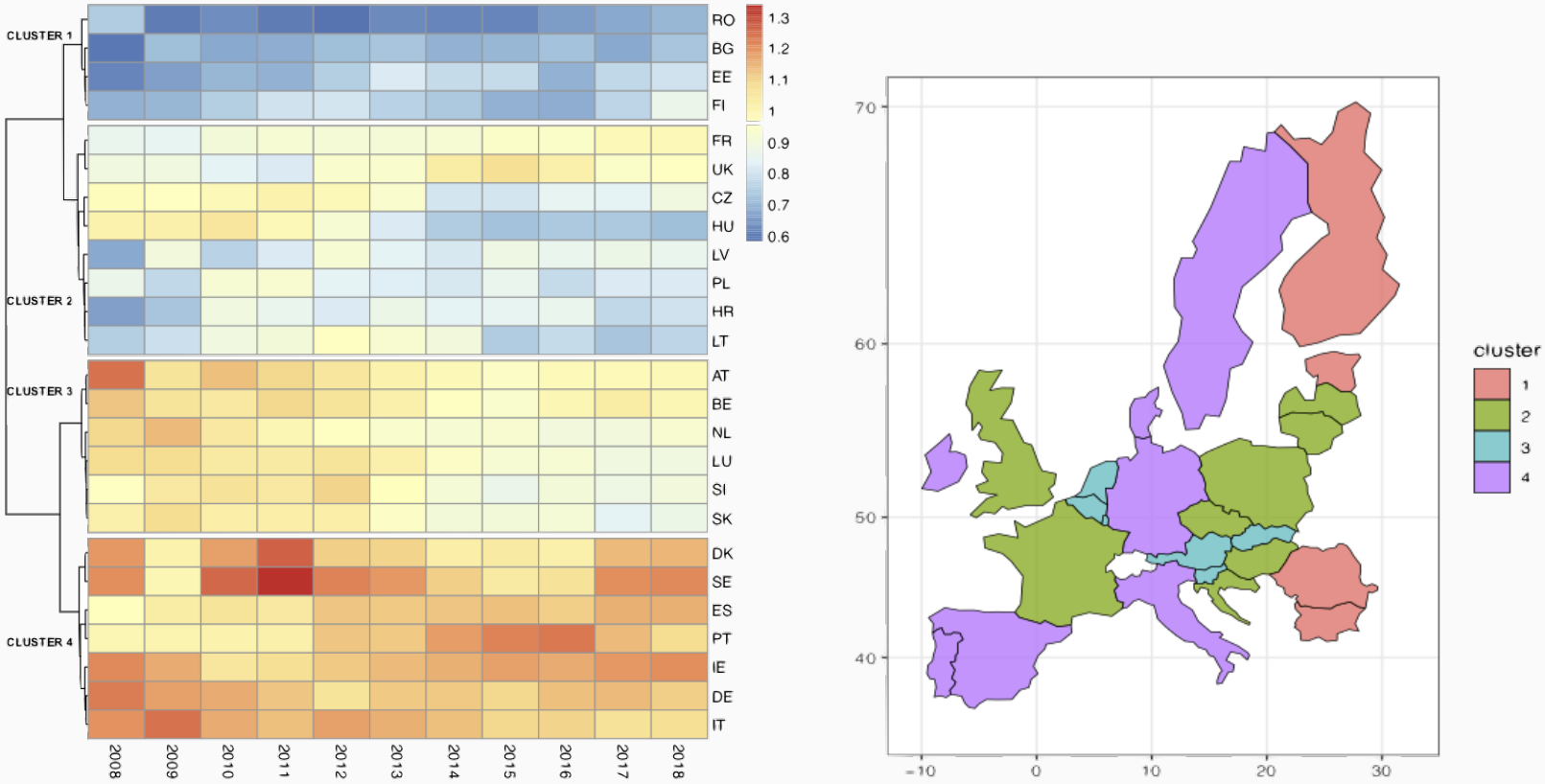



**Figure 1:** a) Heatmap - hierarchical clustering (Ward's method) of the PPPs; b) Cluster map

- Cluster 1 - Low-priced; Cluster 2 - Low average-priced;
- Cluster 3 - High average-priced; Cluster 4 - High-priced.

# Results: PPP trend via HP filter

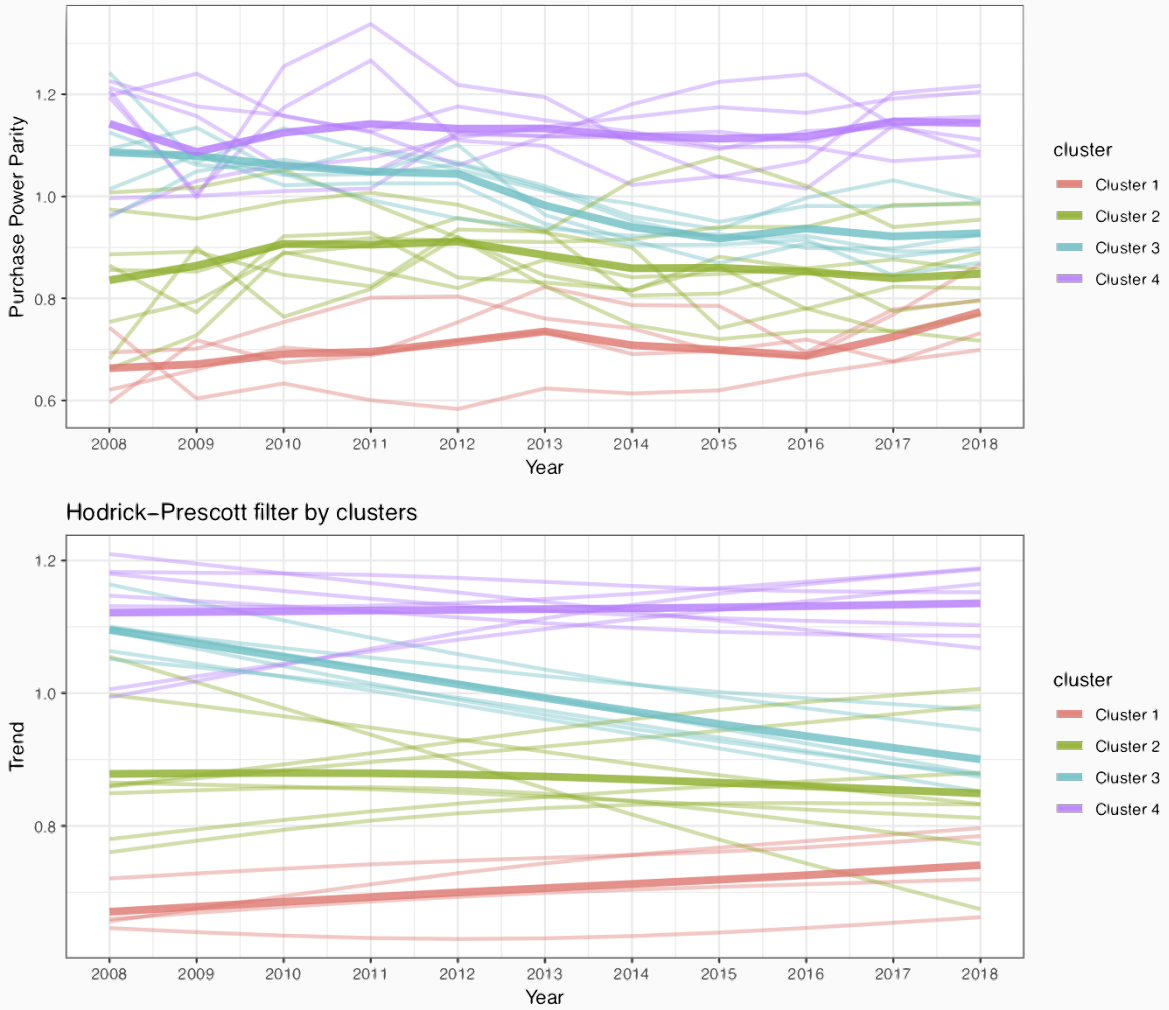



**Figure 2:** a) PPP over time given clusters; b)Trend component of the PPP estimated via the HP filter with smoothing parameter equal to 100 (Ravn and Uhlig, 2002)

# Results: trend in electricity prices

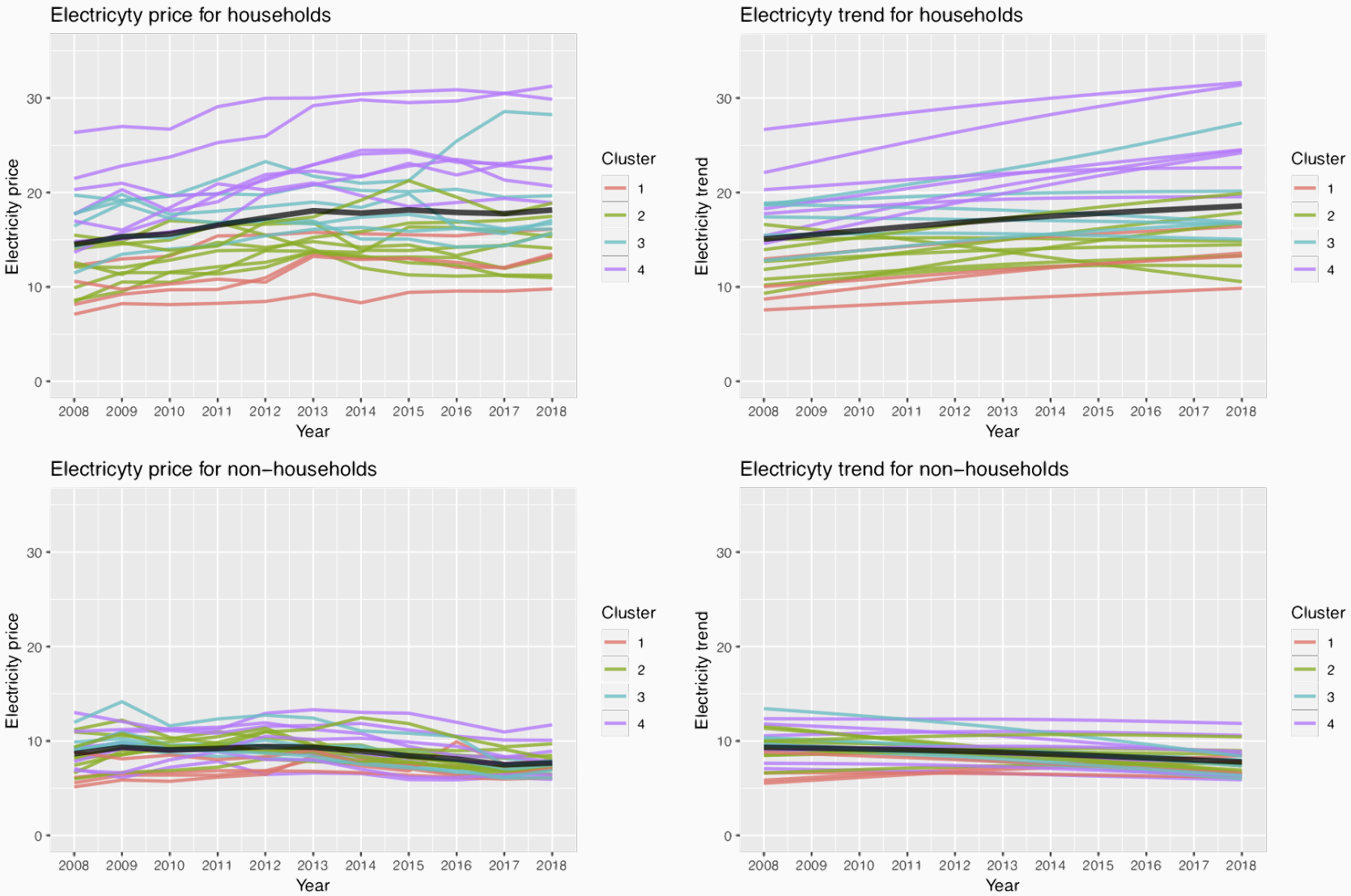



**Figure 3:** Electricity prices and trend (household vs non-household)

# Results: trend in natural gas prices

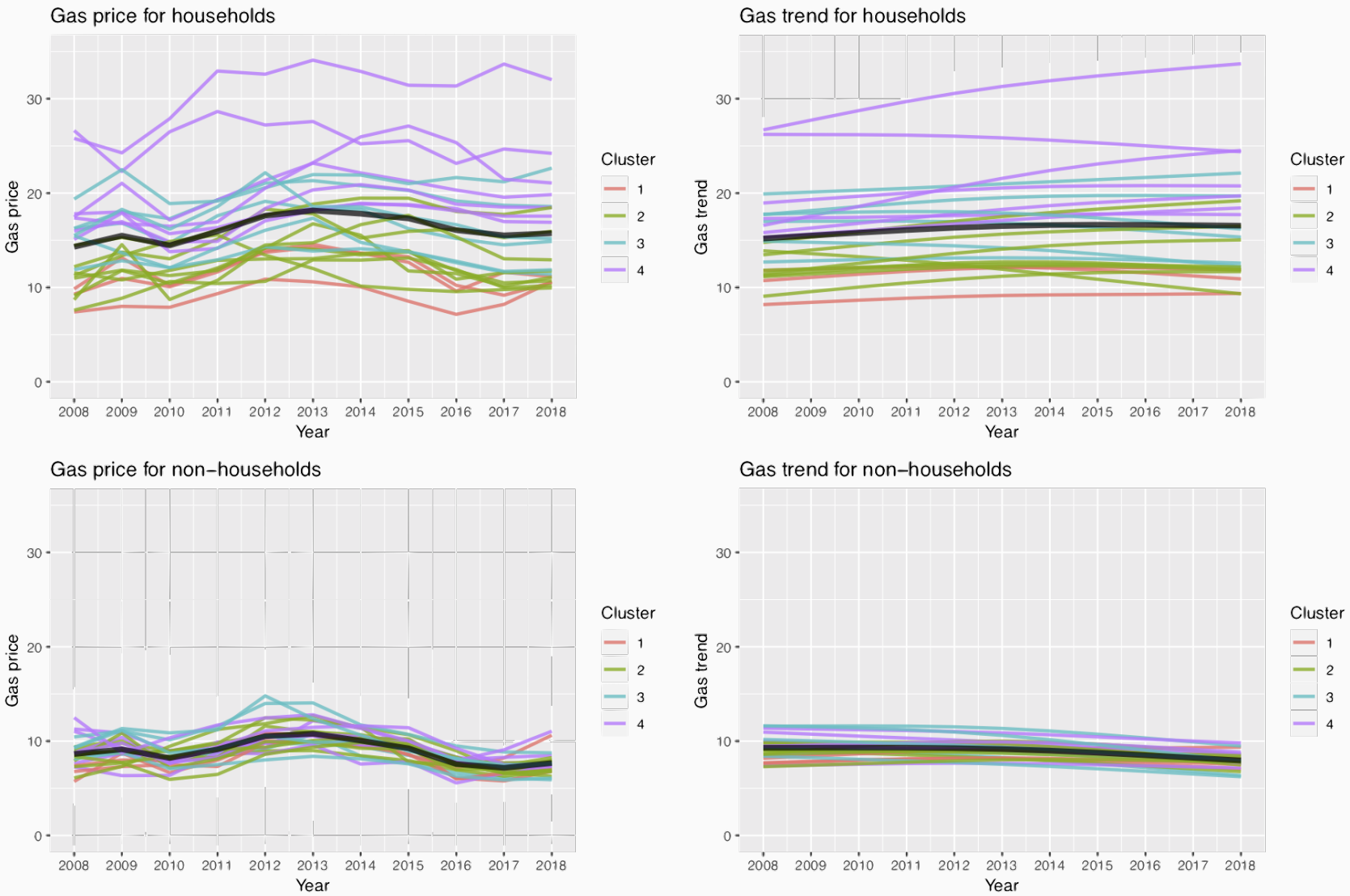



**Figure 4:** Natural gas prices and trend (household vs non-household)

# Further research

- Further convergence studies
- Application of other price indexes such as the MPL
- Stock energy markerts
- ...

**Thank you!**

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