

# Master thesis presentation 3

Grahl, Lukas

Paris 1: Panthéon Sorbonne

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# Time line and completion overview

To this date I have obtained the following data.

Data	Purpose	Source	Status	Frequency
Inflation $\pi$	realised inflation	Eurostat	obtained	M
Infl. expectation $\pi^e$	consumer inflation expectation	Bundesbank	obtained	M
ECB speeches	Supplement news data	ECB	obtained	6-W
Break-even inflation	market measure of inflation expectation	Reuters	obtained	D
News-paper articles	Analyse inflation reporting	Bundesbank	waiting	D

Presenting today:

- ▶ Preprocessing of each time series (trend, seasonality, etc.)
- ▶ Analysis of individual consumer inflation expectation residuals

Next steps

- ▶ Prepare news-paper data analysis, extracting inflation narrative occurrences
- ▶ Run VAR of different narratives on inflation expectation
- ▶ Derive the probabilistic opinion formation model as presented last time
- ▶ Bayesian estimation of opinion formation model

## Preprocessing: Descriptive Statistics

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	bei	pi_de_Y	pi_de_surprise_Y	pi_e_estimate_mean
count	1366.000000	361.000000	361.000000	79.000000
mean	0.017488	0.040043	0.035870	0.055337
min	0.005740	-0.011454	-0.015568	0.032393
25%	0.012847	0.012940	0.009586	0.035076
50%	0.015956	0.023895	0.020491	0.053724
75%	0.023137	0.064795	0.061264	0.072858
max	0.027776	0.114840	0.111615	0.074694
std	0.005353	0.033591	0.034792	0.017541

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## Preprocessing: Covariance matrix

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	bei	pi_de_Y	pi_de_surprise_Y	pi_e_estimate_mean
bei	0.000029	0.000158	0.000163	0.000080
pi_de_Y	0.000158	0.001128	0.001166	0.000482
pi_de_surprise_Y	0.000163	0.001166	0.001210	0.000479
pi_e_estimate_mean	0.000080	0.000482	0.000479	0.000308

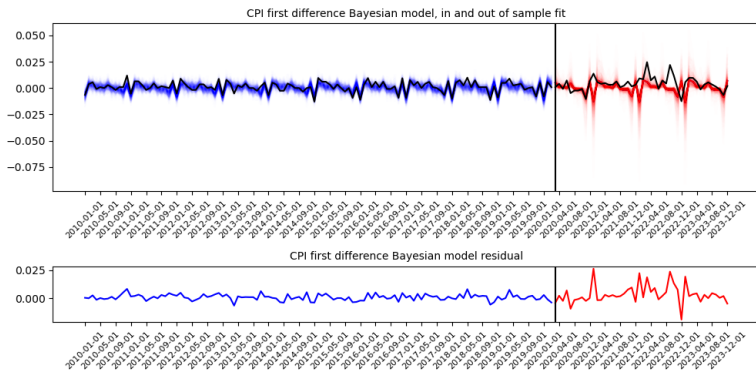
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## Preprocessing: Identifying surprise inflation

Pre-pandemic inflation follows a stable path, which can be described by an intercept  $\alpha$ , deterministic trend  $\beta_1 t$  and seasonality  $s_{t|s}$ .

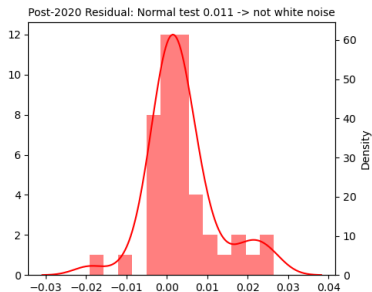
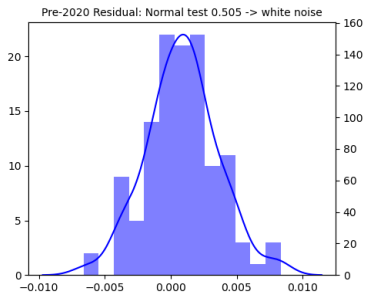
$$CPI_t - CPI_{t-1} = \pi_t = \alpha + \beta_1 t + \beta_2 s_{t|s} + \epsilon_t$$

The post-pandemic up-tick in inflation can be identified as a divergence from this model. Such strategy, evidently, only holds for a limited period.



## Testing surprise inflation for white noise

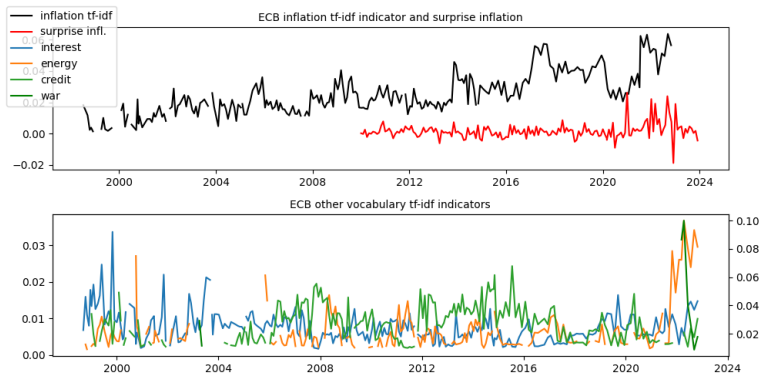
The above model only is a good model if its residual  $\epsilon_t$  is white noise. The test for normality suggests it is. The post-pandemic deviation from the model is not white noise. It may thus be interpreted as surprise inflation from the consumer's point of view.



## Preprocessing: ECB reaction to inflation

Unsurprisingly ECB speeches have been for a long-time concerned with inflation. This is potentially because of previously too low inflation as well as its recent surge.

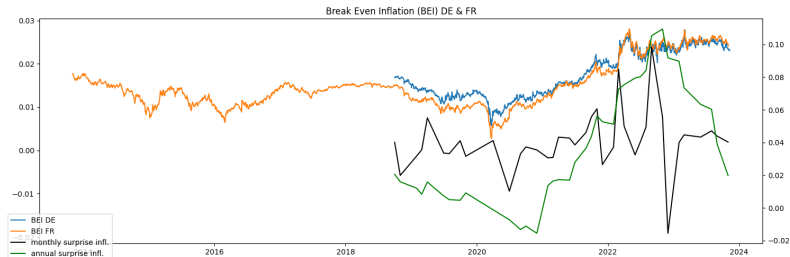
Analysis of news-paper articles will likely present another picture. I suspect inflation mentions to only be recently on the rise.



As validation of the Term-Frequency-Inverse-Document-Frequency (TF-IDF) I have provided other topics, likely related to past and current crisis.

## Preprocessing: Break Even Inflation (BEI)

Break-even inflation for Germany is the difference between the yield to maturity (YTM) of a 10y government bond and its inflation adjusted counterpart. I obtained the YTM through Newton's method solver. The results match up with the BEI for France, obtained from the Banque de France.



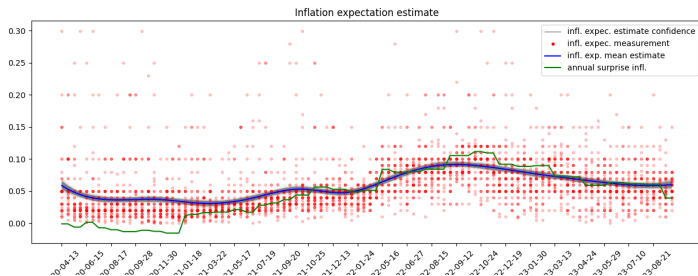
Break-even inflation, though different in levels appear to follow a similar pattern to surprise inflation.



## Preprocessing: Consumer inflation expectation

The household panel inflation expectation survey inquires about inflation expectation of thousands of households every month. Most households are surveyed up to 20 times in two month windows. I am therefore estimating average inflation expectation from the point expectation by household (red dots) using spline Bayesian estimation.

In comparing inflation expectation with surprise and realised inflation a pattern emerges. Inflation expectation underestimates realised inflation.



## Analysis: Consumer inflation expectation

The above provides an estimate for overall inflation expectation. It does not provide an account for the individual errors of agents. An investigation leveraging the panel dimension reveals that less precise agents tend to over rather than underestimate inflation.

$$\pi_t^s = \alpha_i + \beta_i \pi_{i,t}^e + \epsilon_{i,t} \quad \hat{\pi}_{i,t}^e = \alpha_i + \beta_i \pi_{i,t}^e$$

$$mse_i = \sum_{i=0}^I [\pi_t^s - \hat{\pi}_{i,t}^e]^2 \quad me_i = \sum_{i=0}^I [\pi_t^s - \hat{\pi}_{i,t}^e]$$

