Can survey questions on expected price developments improve inflation forecasting?

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Raïsa Basselier (raisa.basselier@nbb.be)
David de Antonio Liedo
Jana Jonckheere
Geert Langenus

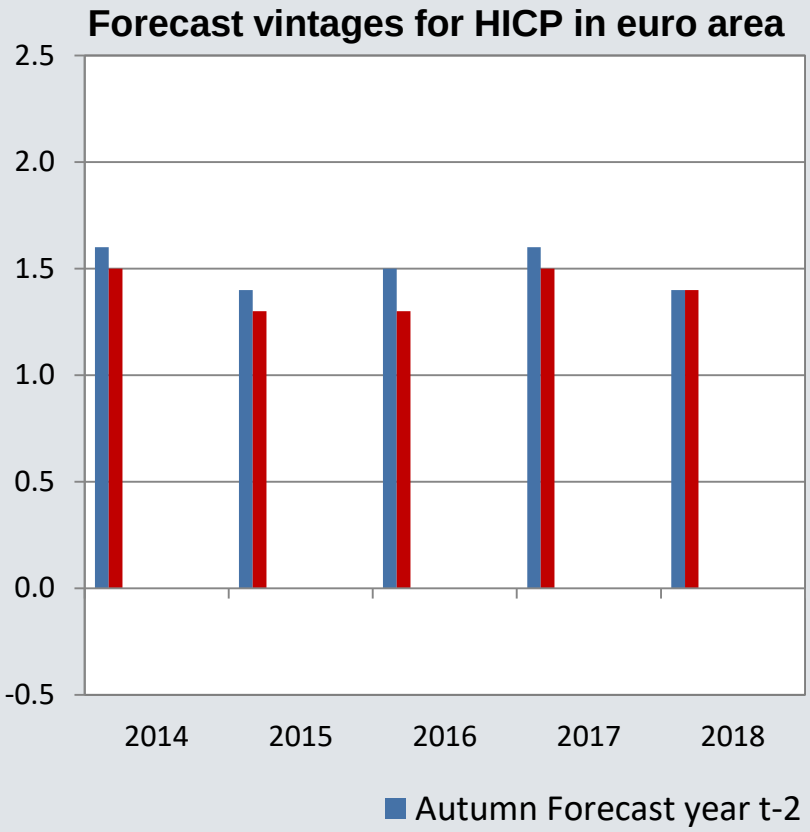
BanqueNationaleBank
DE BELGIQUE
VAN BELGIË
Eurosystem

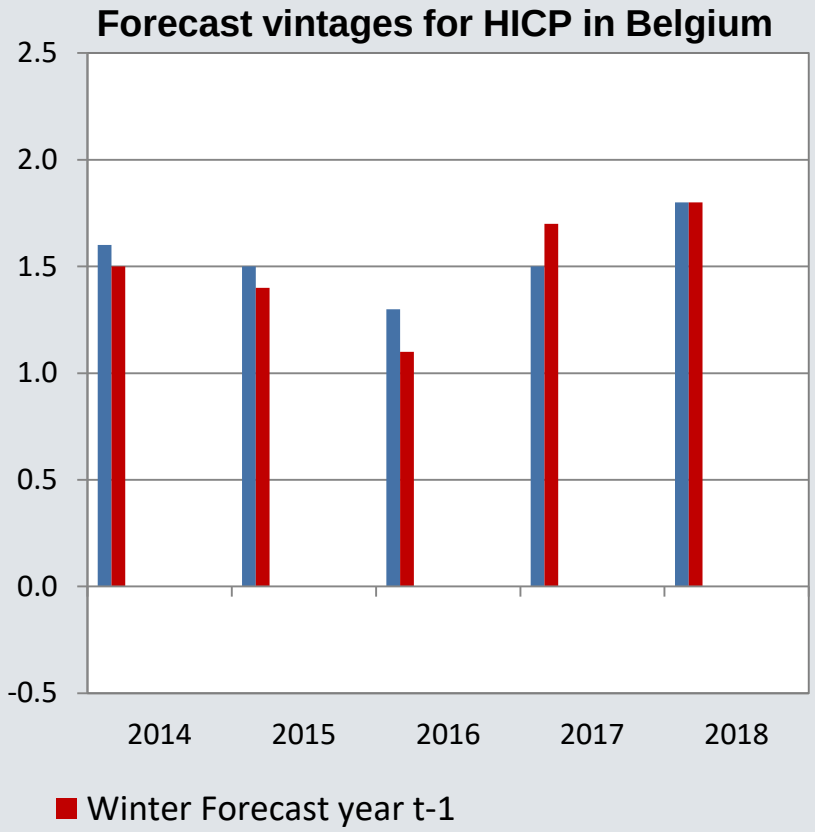
Outline of the presentation

1. **Introduction and motivation**
2. Linking Belgian inflation and survey data
3. Model selection and results for Belgium
   - basic model and expansion
   - forecasting accuracy
4. A look at the euro area case
5. Concluding remarks

Goal of the paper: improving forecasting accuracy

- HICP inflation has been difficult to forecast lately





Source: EC.

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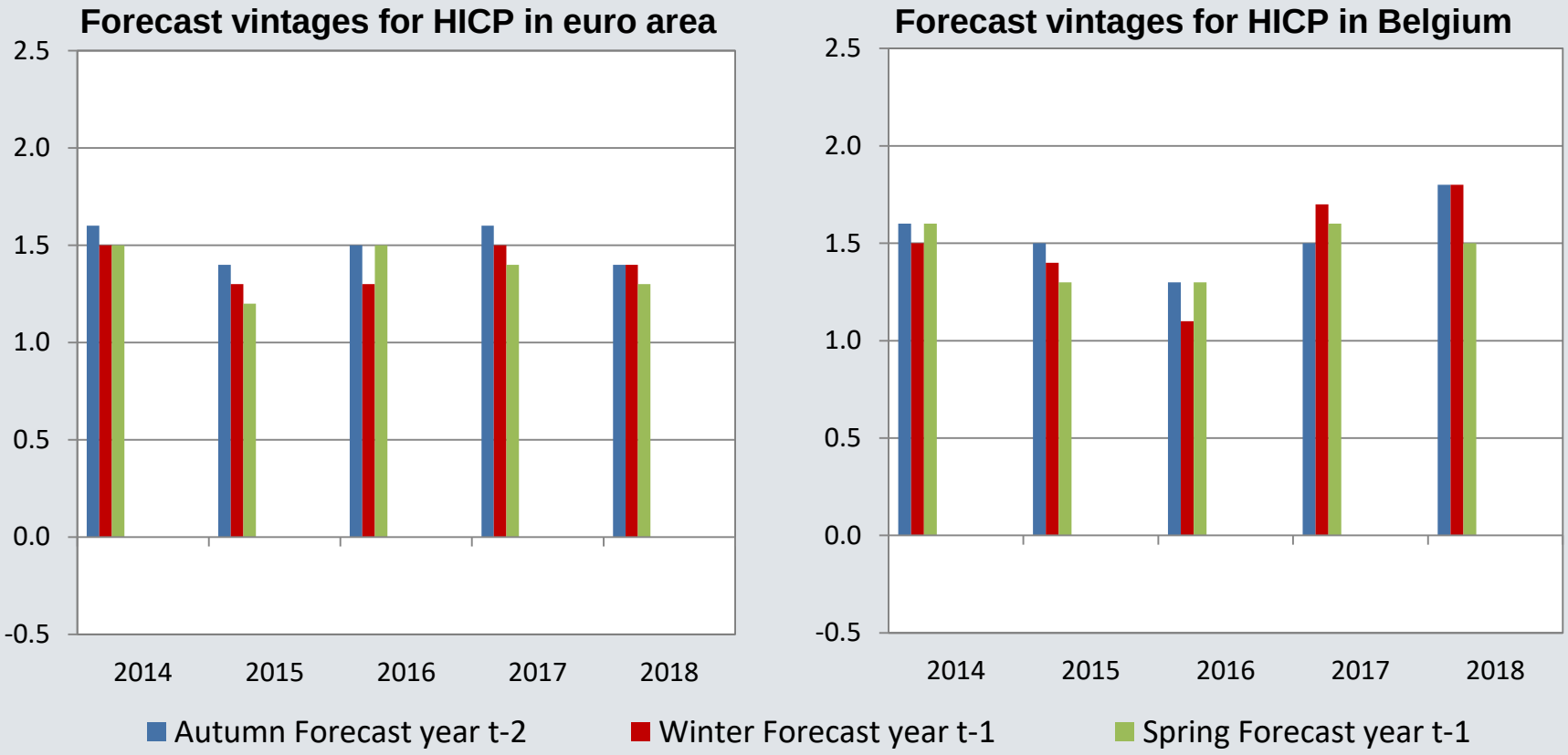

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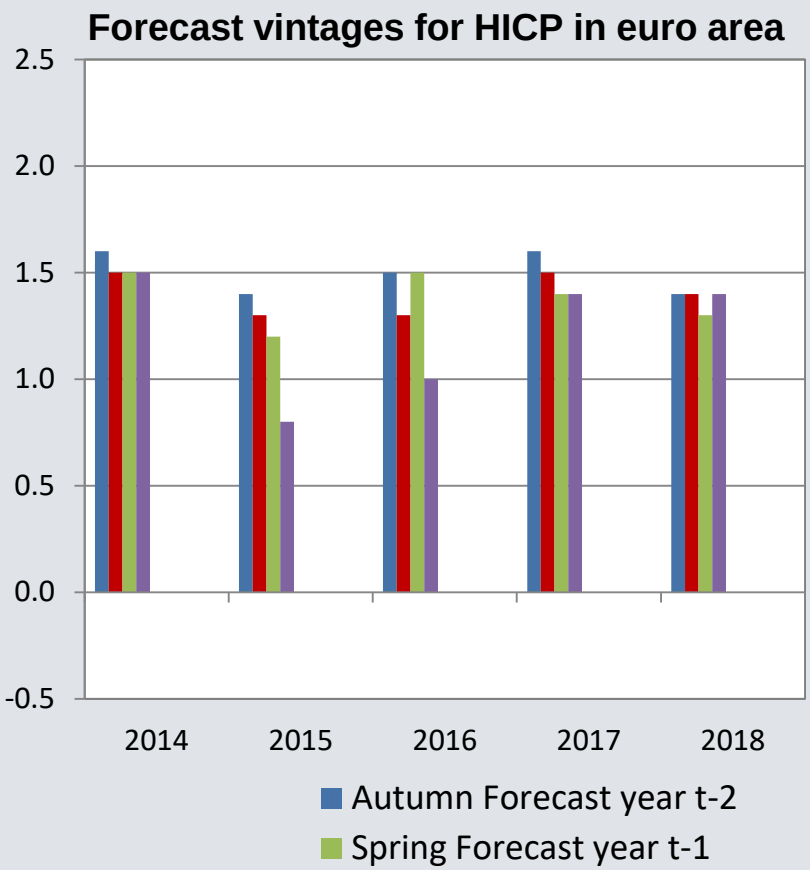

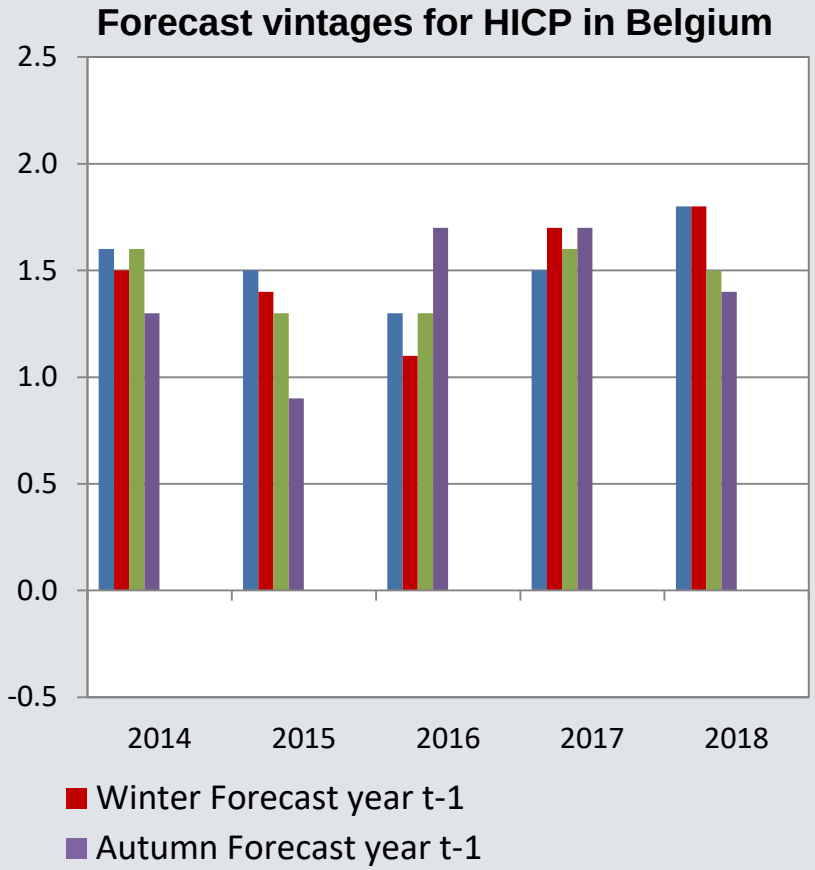

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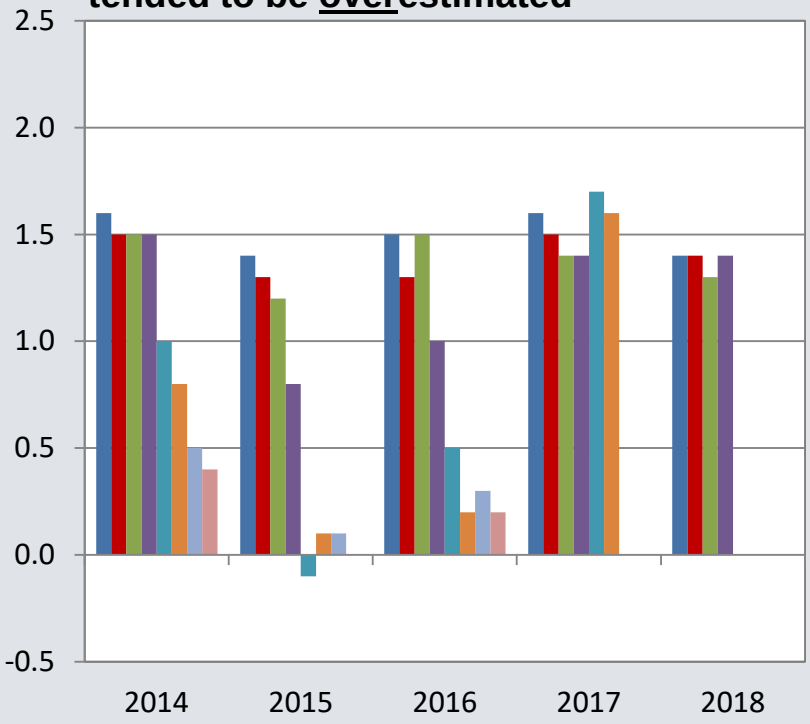
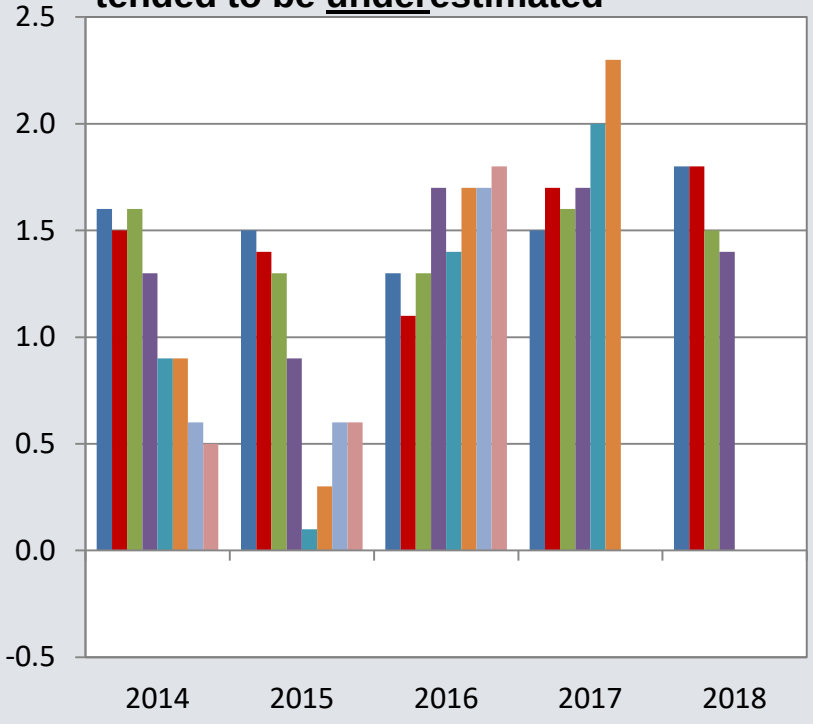
- HICP inflation has been difficult to forecast lately … but Belgium is different from the euro area!

Forecasts for HICP in euro area: tended to be overestimated



Forecasts for HICP in Belgium: tended to be underestimated



Autumn Forecast year t-2
Winter Forecast year t-1
Spring Forecast year t-1
Autumn Forecast year t-1
Winter Forecast year t
Spring Forecast year t
Autumn Forecast year t
Winter Forecast year t+1

Source: EC.

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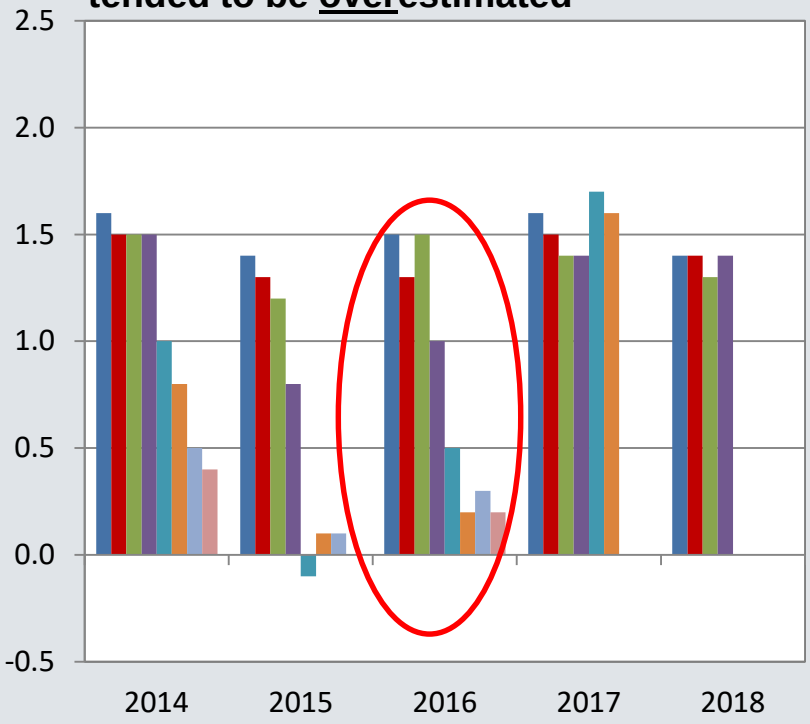
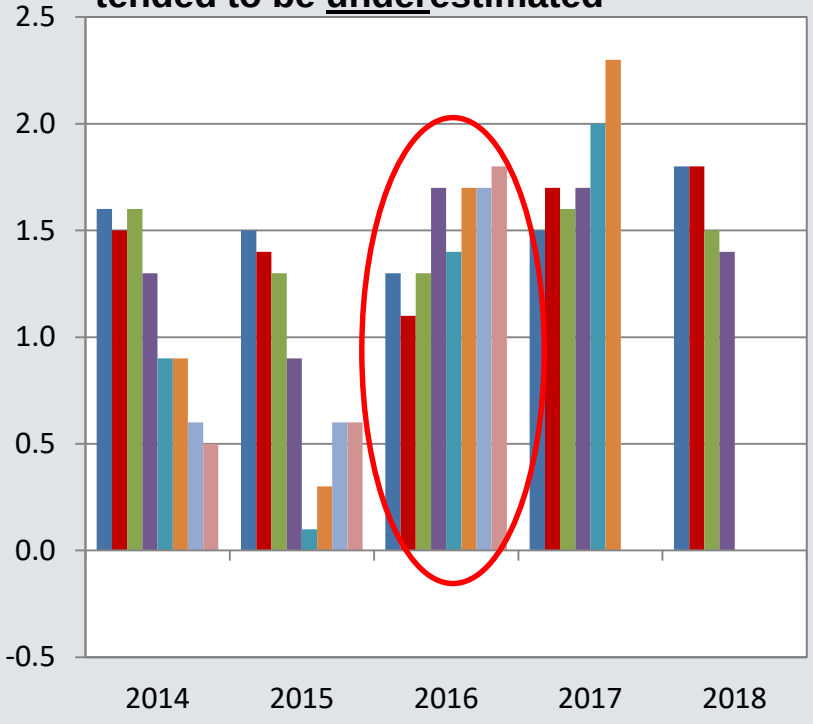


Forecasts for HICP in Belgium: tended to be underestimated



Autumn Forecast year t-2
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Winter Forecast year t
Winter Forecast year t+1
Spring Forecast year t-1
Spring Forecast year t

Source: EC.

Belgium has rigid prices (cf. recent issue of incomplete pass-through from (very low) costs to prices)

Share of employees' wages in the production cost[1]

(in %)

Total economy	28,0
Industry	12,7
Services	33,8
→ Market services	28,3
→ Non-market services	55,0

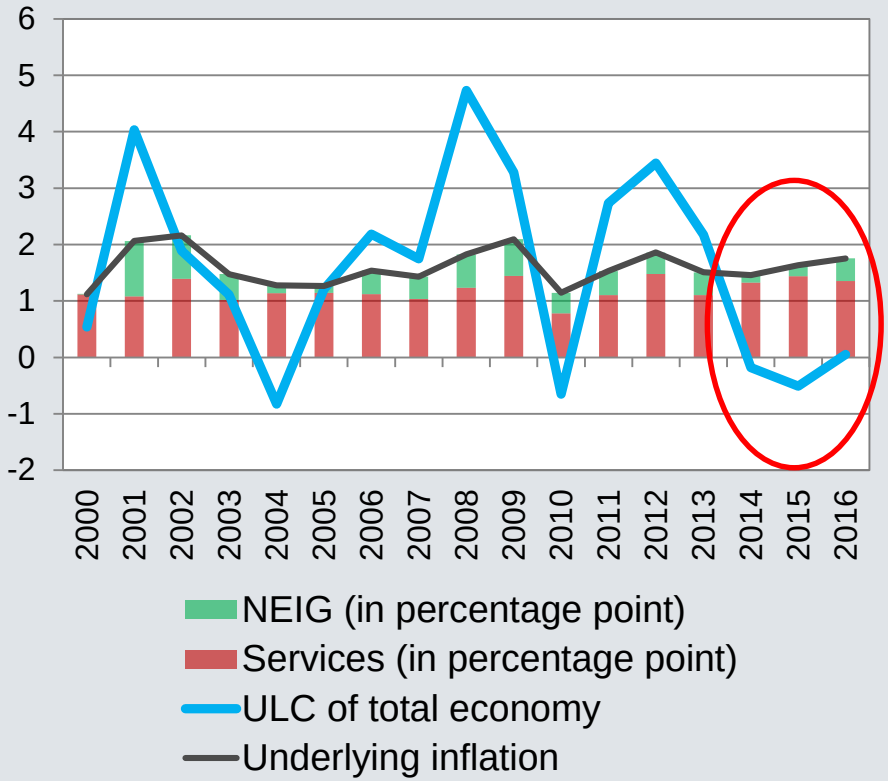
ULC in Belgium

(in %)

	Average annual growth rate 1997-2008	Average annual growth rate 2009-2016
Enterprises[2]	1,3	0,4
Market services	2,3	1,1

Yet, mostly services prices remain sticky

(year-on-year price change in %, unless otherwise stated)



Hence: interesting to know what business owners say about expected price developments → surveys!

Sources: EC, FPB, NAI, NBB.

[1] The distribution of the total production cost has been calculated on the basis of Input-Output tables of 2010, without net taxes on the final demand.

[2] Nace B-N.

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Introducing the survey dataset …

- Regular **producer survey** used for business sentiment indicators

WHO ARE THE RESPONDENTS?

- Business leaders from 4 different industries: manufacturing, services, trade, (construction) – fixed panel
- Survey is carried out on a national basis, but questions are harmonised in the EU

WHAT DOES IT CAPTURE?

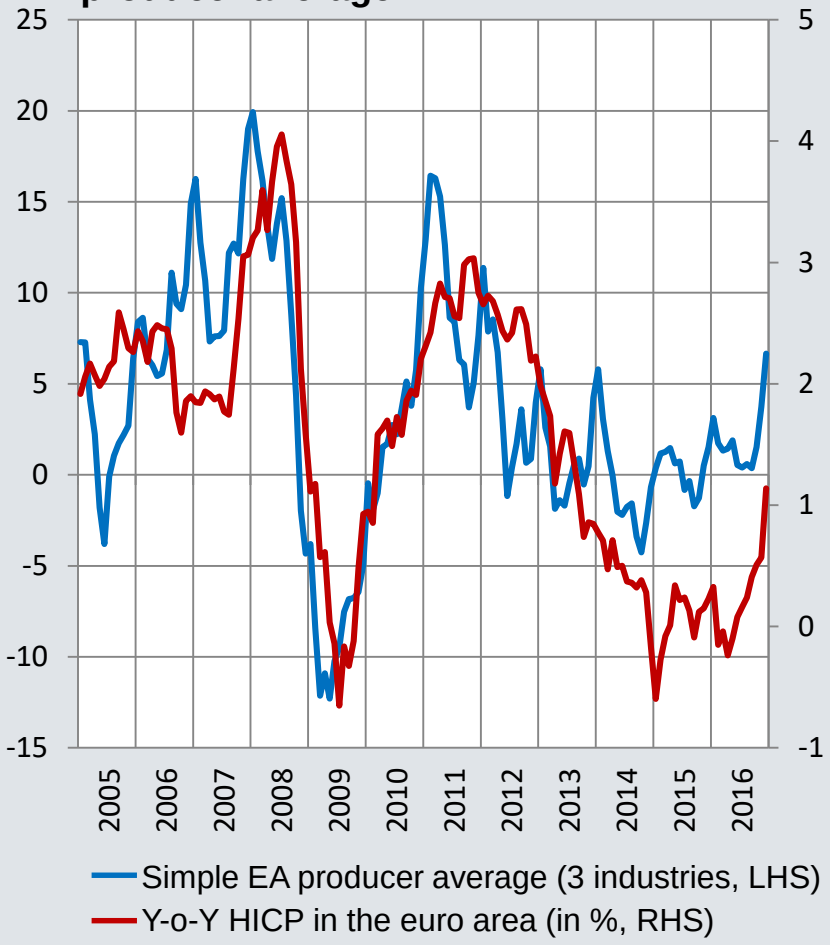
- Expected evolution of producers' selling prices **over the next 3 months**
  - replies pertain to a precise forecasting interval (↔ certain other surveys of forecasters)
  - incorporating information directly from price-setters
- Qualitative responses
  - less prone to sampling and measurement errors, compared to direct measures
- Monthly data, starting in 1996 for Belgium and 2005 for the euro area

… and processing the data

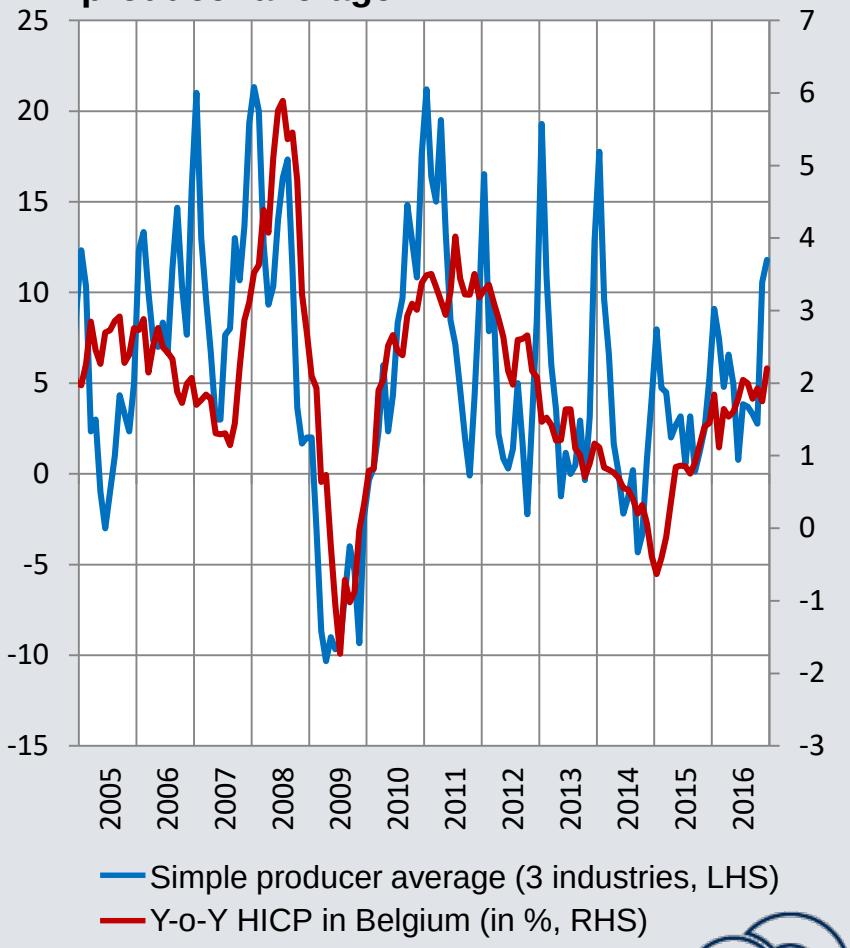
- Survey asks about “expectations of the prices over the next 3 months”
  - more specifically, selling prices in the industry concerned
  - three possible answers: rise, drop, remain unchanged
- We ditch construction as price developments there do not seem to be directly linked to consumer inflation (but rather to the investment deflators)
- An industry **balance** is constructed as the difference between the percentages of respondents giving positive and negative replies (weighted by value added)
- Industry results are then aggregated into one **composite indicator**.
- We could rely on a **simple or a weighted average**, either according to importance of three industries in value added or according to their weights in the HICP consumer inflation basket
  - start with simple average for now (seems valid as weights do not deviate too strongly from 0.33 for each industry), to be expanded in robustness exercise later

A first look at the statistical correlations

Euro area HICP inflation and simple producer average

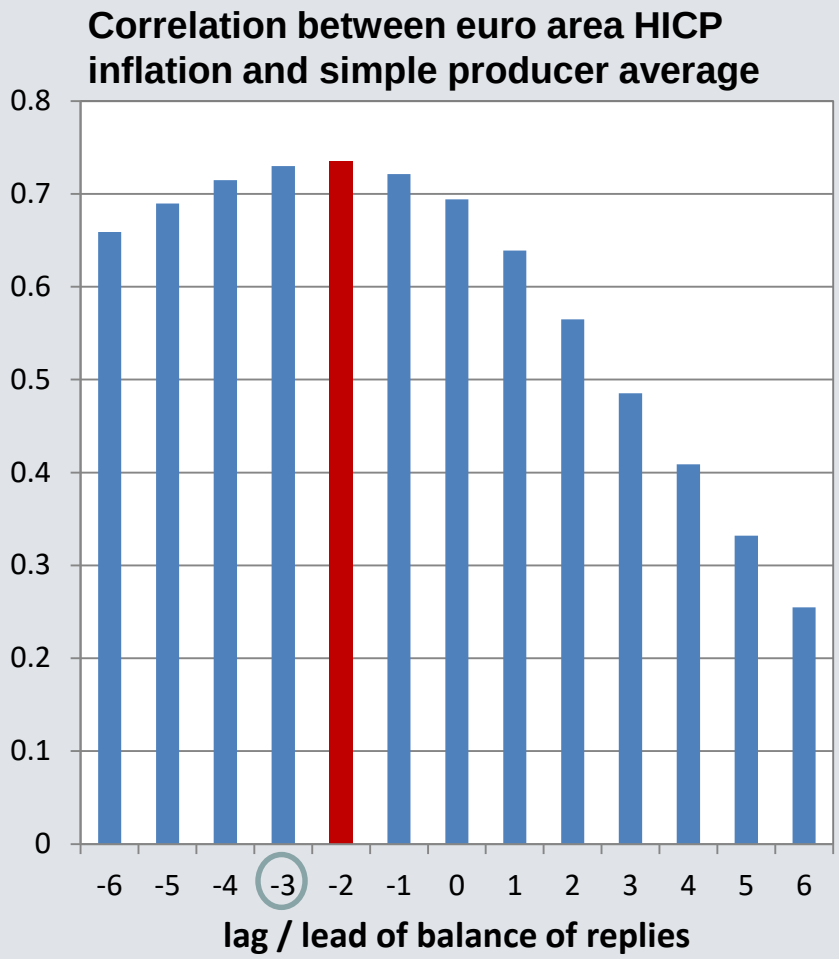


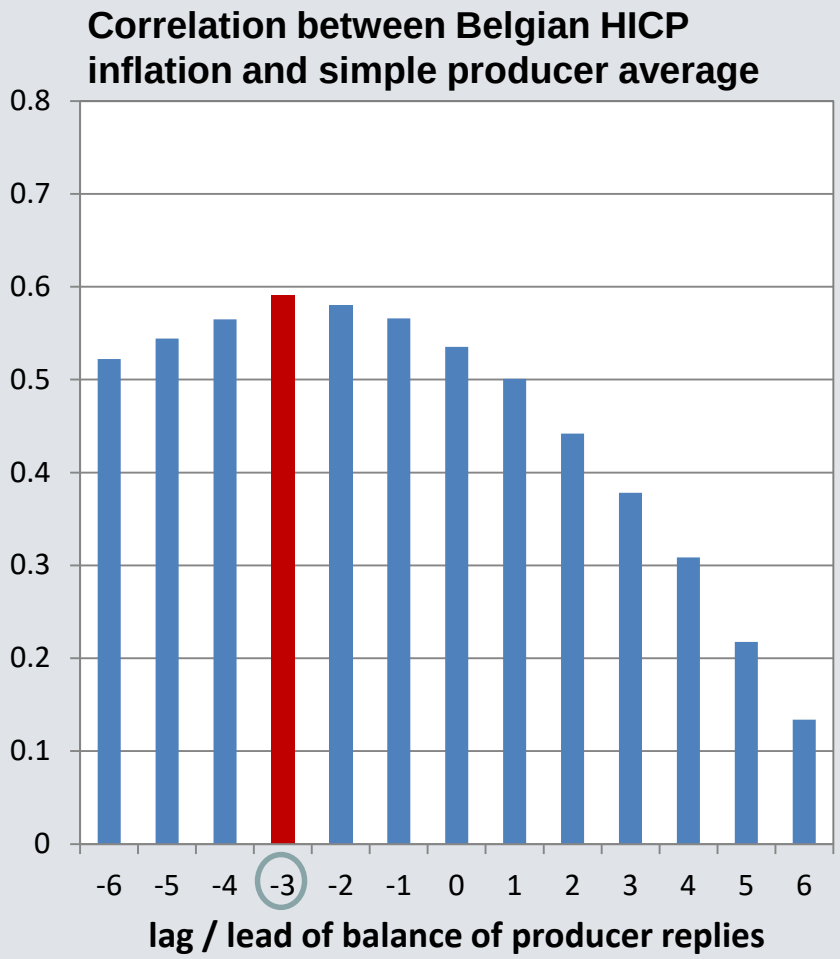
Belgian HICP inflation and simple producer average



Source: EC.

Lags seem to correspond to survey horizon





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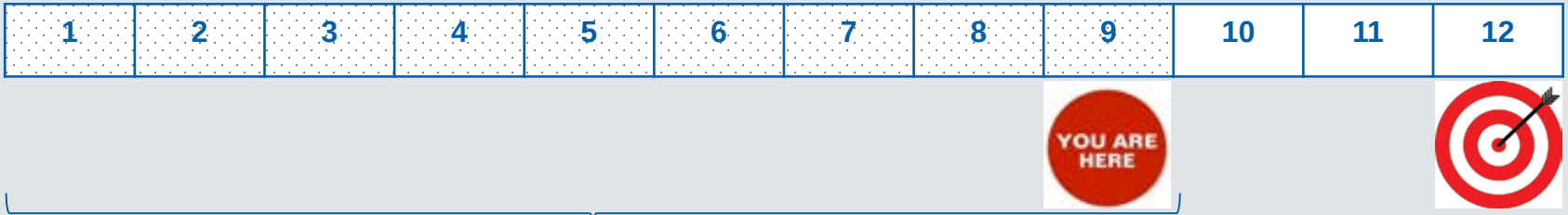
A basic model for Belgian inflation

- Start from an as simple as possible model
  - for example: link inflation to its own past
  - correlogram shows that, additionally, two moving average terms are required
- Dependent variable (inflation) is defined as: $\log(HICP_t) - \log(HICP_{t-12})$

	Coefficient	Probability
c	0.0014	0.0032
Inflation (-1)	0.9276	0.0000
MA(6)	0.3872	0.0000
MA(12)	-0.4946	0.0000
R-squared	0.9079	

Expanding the basic model with survey data

- The goal is to forecast the year-on-year inflation rate three months ahead and incorporate as much information as possible…



We already have information on inflation over the past nine months, i.e. $\log(HICP_t) - \log(HICP_{t-9})$ is given

	Coefficient	Probability
c	0.0086	0.0000
9M Inflation (-3)	0.5188	0.0000
Prod. survey (-3)	0.0005	0.0000
MA(6)	0.5327	0.0000
MA(12)	0.1299	0.0366
R-squared	0.6990	

Inflation over the next three months, i.e. $\log(HICP_{t+3}) - \log(HICP_t)$, is still missing …

… but could be approximated by survey data, as the survey at time t should exactly capture expected price evolutions over the next three months

Expanding the basic model with survey data and oil futures

- What if survey data are but a mere proxy for other volatile variables (like oil prices) that could affect the general price level?
- Incorporate information from the price of **crude oil futures** for delivery in 3 months time

	Coefficient	Probability
c	0.0090	0.0000
9M Inflation (-3)	0.4856	0.0000
Prod. survey (-3)	0.0005	0.0000
Expected oil price evolution (-3)	0.0058	0.0006
MA(6)	0.4454	0.0000
MA(12)	0.1714	0.0084
R-squared	0.7141	

Assessing the out-of-sample forecasting accuracy of these models

- What about the out-of-sample (three months ahead) forecasting performance of the selected models?

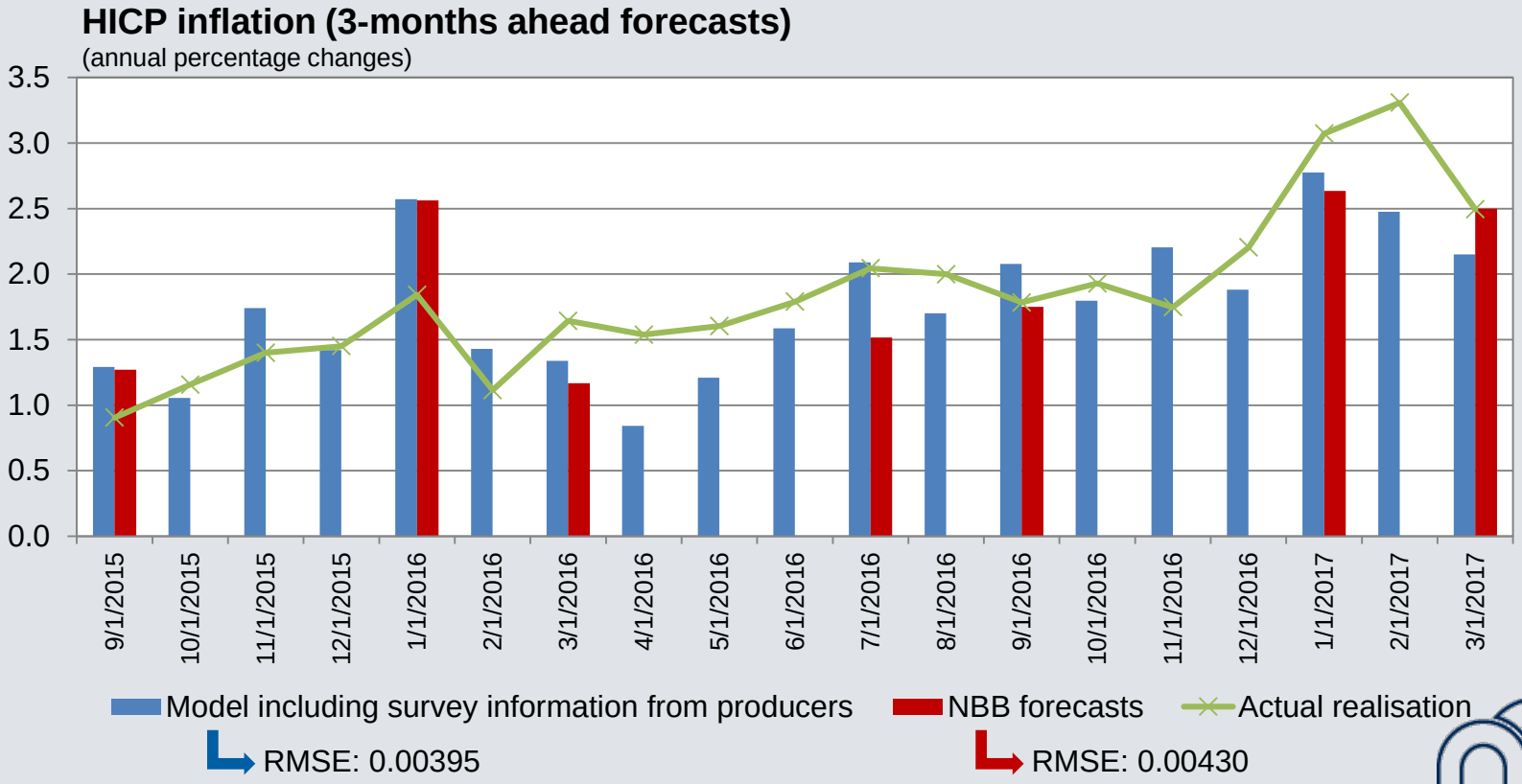
RMSE for Belgian inflation

	2010M03 – 2017M03	2013M03 – 2017M03	2015M09 – 2017M03
Basic equation with constant	0.00521	0.00517	0.00463
Equation with producers' expectations on price evolution	0.00654	0.00611	0.00395
Equation with producers' expectations on price evolution and expected oil price growth	0.00632	0.00588	0.00395

- Larger (>)-or smaller (<)-than signs indicate when the difference between models is statistically significant according to the Diebold-Mariano test, at a 95 % confidence level.

Comparing the model results to NBB forecasts

- NBB produces inflation forecasts four times per year, during its forecasting exercise → does the model including survey data hold up?
  - p.m. NBB inflation experts currently use integrated/bottom-up models, as well as expert judgment



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A quick look at the results for the euro area …

- Using similar models as for Belgian inflation, but with some “peculiarities”:
  - constant was excluded, as this yielded somewhat better results in terms of RMSE
  - the basic model required an extra lag of inflation

RMSE for euro area inflation

	2010M03 – 2017M03	2013M03 – 2017M03	2015M09 – 2017M03
Basic equation (no constant, 2nd lag of dependent variable)	0.004223	0.004149	0.004655
	^		
Equation with producers’ expectations on price evolution	0.005416	0.004518	0.004595
	^		
Equation with producers’ expectations on price evolution and expected oil price growth	0.005624	0.004557	0.004618

Larger (>)-or smaller (<)-than signs indicate when the difference between models is statistically significant according to the Diebold-Mariano test, at a 90% confidence level.

… where the naive forecast is hard to beat

- A naive forecast, made at time t, assumes that the annual inflation rate at time t+3 will be exactly equal to that observed at time t

RMSE for euro area inflation

	2010M03 – 2017M03	2013M03 – 2017M03	2015M09 – 2017M03
Equation with producers' expectations on price evolution	0.005416	0.004518	0.004595
Naive forecast	0.004286	0.004704	0.005393

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Conclusions

- Inflation developments have been diverging strongly between Belgium and the euro area
- Can we improve forecasting accuracy by exploiting information on expected price developments from the producer survey?
- No surprise: inflation is highly persistent and a basic ARMA model already gives nice forecasting results for the short run
- Current results seem to suggest that, for the most recent period and for Belgium, survey data matter:
  - a simple model including survey data outperforms both the ARMA benchmark
  - … and our own NBB forecasts
- This could indeed point to the importance of company decisions on the pass-through of lower costs (that seems to be more partial in Belgium?)
- Current evidence on relevance of survey data is much less convincing for the euro area

Ongoing/future work

- Analyse alternative inflation concepts, e.g. core inflation or inflation including indirect taxes and government measures
- Assess the importance of consumer survey responses
- Use news analysis to determine which indicators matter most for short-term inflation forecasting (along the lines of Basselier, de Antonio, Langenus, presented @CIRET2016)
  - currently setting up a database with possible relevant variables (past prices, unit labour costs, oil prices, competitor's prices, unemployment rate, output gap,…) → next step: constructing a DFM

Thanks for your attention!

PS) See you in Brussels for CBBS-2019 ?