Using survey data for predicting Belgian GDP

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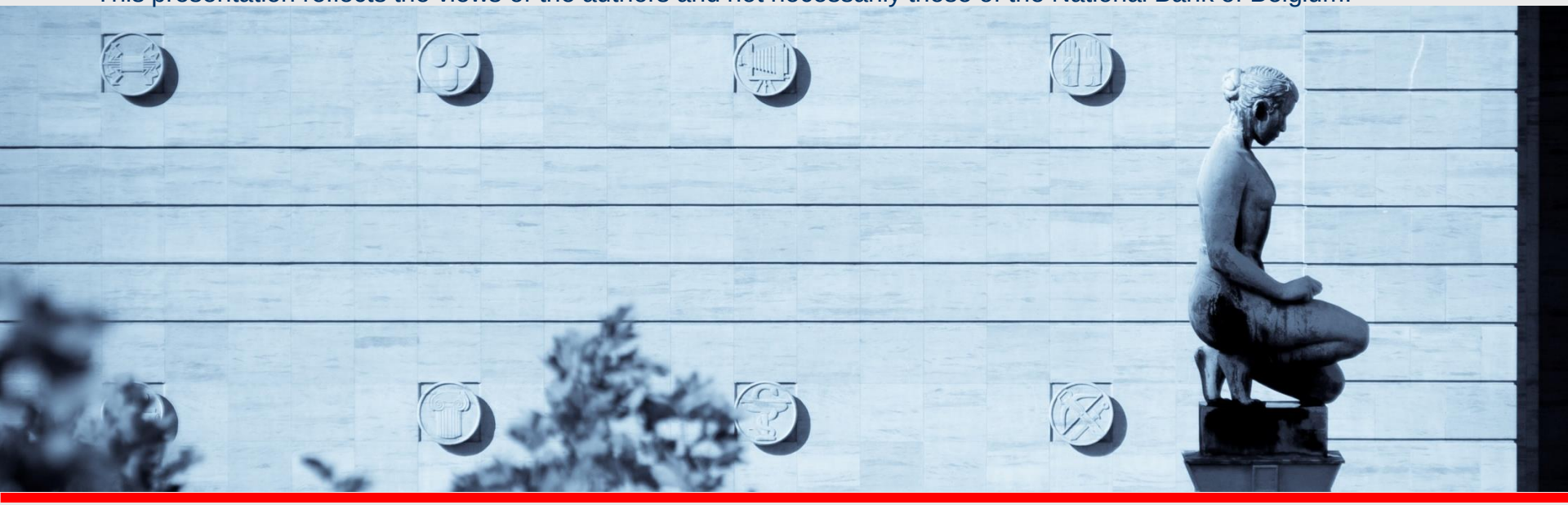
[1] This presentation reflects the views of the authors and not necessarily those of the National Bank of Belgium.



Workshop on central bank surveys

Federal Reserve Bank of Atlanta
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Banque Nationale Bank
DE BELGIQUE VAN BELGIË
Eurosystem

Outline of the presentation

1. **Survey data and short term-forecasting**
2. Introducing BREL
3. Predictors for GDP
4. Predictors for other macro aggregates
5. Extensions
6. Conclusions & further work

The art of short-term forecasting

- Quarterly national accounts not available in in real time (and, even then, are prone to revisions)

- Business cycle analysis needs to rely to a large extent on monthly indicators, including:
  - **Hard data** (e.g. industrial production, turnover based on the VAT declarations, car registrations, labour market data,...)
  - **Soft/survey data** (e.g. indicators related to business and consumer surveys)

- Survey data compared to hard data:
  - become available earlier (month t vs month t+1 or t+2 for hard data)
  - are typically not revised
  - but ... may be correlated less strongly with GDP and other macroeconomic aggregates

- **Short-term forecasting/nowcasting models** extract relevant information from these high-frequency data

Different technical approaches

- **Joint** models
  - multivariate models that can be written in state-space form
  - exploiting joint dynamics of GDP and the other varaibles considered
  - mostly Dynamic Factor Models (but also VARs)
  - better suited to interpret the 'data flow'
  - ... and quantify of impact of each new data release

- **Partial** models
  - single-equation approaches or '**bridge**' models
  - long tradition in central banks and other policy instiutions
  - flexibility: easier to take into account different data availability scenarios

- **Hybrid** models
  - bridging with factors (Giannone et al., 2008)
  - MIDAS applications for daily financial data

- Workhorse of our paper: **BREL** - the NBB's new bridge model infrastructure
  - technical details: Piette (forthcoming)
  - note: the NBB's DFM for Belgium/euro area, see de António (forthcoming)

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What is BREL?

- Standard **BR**idge model (using the **EL**astic-net regression to select predictors, cf. Zou and Hastie, 2005)

- Bridge equation:

$$Y_{t+h} = \mu + \sum_{j=1}^{p} \rho_j Y_{t-j} + \sum_{i=1}^{n} \sum_{j=0}^{q} \beta_{i,j} X^{Q}_{i,t-j} + \varepsilon_t$$

Quarterly aggregate

Lagged dependent

Monthly predictors converted to the quarterly frequency

- Satellite AR model to prolong the monthly series if necessary:

$$X_{i,m} = \phi_0 + \sum_{j=1}^{l} \phi_j X_{i,m-j} + \eta_m$$

Some (important) technicalities

- Two key advantages of the elastic net in this context:
  - the elastic-net regression can handle large data sets of potential predictors
  - that may be strongly correlated (which is usually the case with macroeconomic data)

- Technical approach attuned to different data availability scenarios
  - selection procedures takes due account of **ragged-edge** nature of data set (cf. Bessec, 2013)
  - exact **econometric specifications vary** according to data availability (and, obviously, the forecast horizon)

- Our data set;
  - **SURVEY**: net balances of individual questions (business sentiment: 5 industries, all questions; consumer sentiment: only four questions)
  - **HARD**: industrial production, turnover, labour market, etc.
  - **FINANCIAL**: stock market indices, commodity prices, interest rates, etc.
  - **INTERNATIONAL**: survey and hard data related to external environment (trade, industrial production, EC confidence indicators)

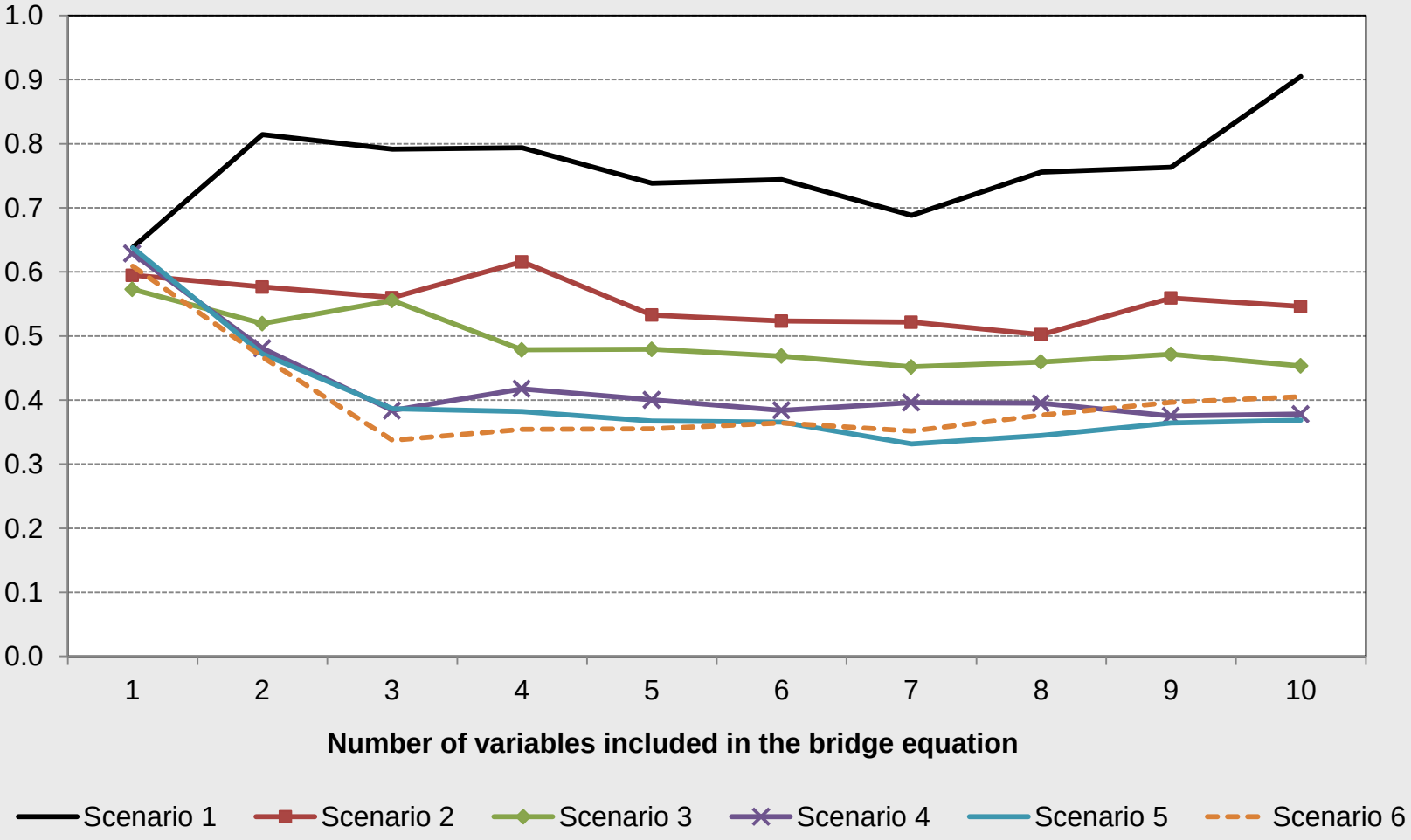
Data availability scenarios (quarter Q)

	Survey and financial data until	'Early' hard data[1] until	Hard data until
scenario 1 (3 months before the end of Q)	3rd month of Q-1	2nd month of Q-1	1st month of Q-1
scenario 2 (2 months before the end of Q)	1st month of Q	3rd month of Q-1	2nd month of Q-1
scenario 3 (1 month before the end of Q)	2nd month of Q	1st month of Q	3rd month of Q-1
scenario 4 (end of Q)	3rd month of Q	2nd month of Q	1st month of Q
scenario 5 (1 month after the end of Q)	1st month of Q+1	3rd month of Q	2nd month of Q
scenario 6 (2 months after the end of Q)	2nd month of Q+1	1st month of Q+1	3rd month of Q

[1] Including, in particular, data related to the labour market and car registration.

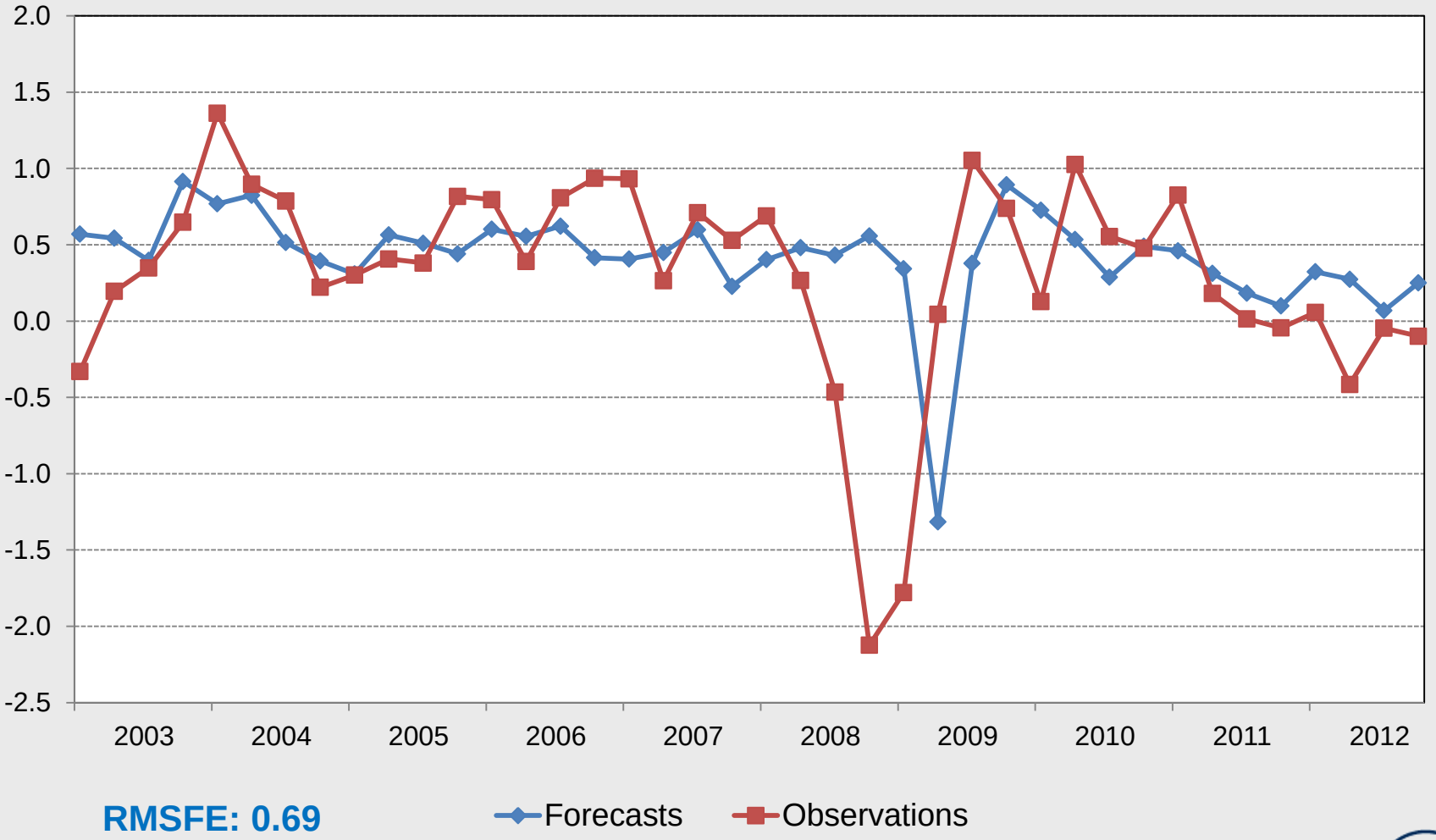
Forecast errors as a function of the data scenario and the number of variables included in the bridge model

(RMSFEs in percentage points; simulations performed over the period 2003Q1-2012Q4)



GDP forecast accuracy in scenario 1: 3 months before the end of the target quarter

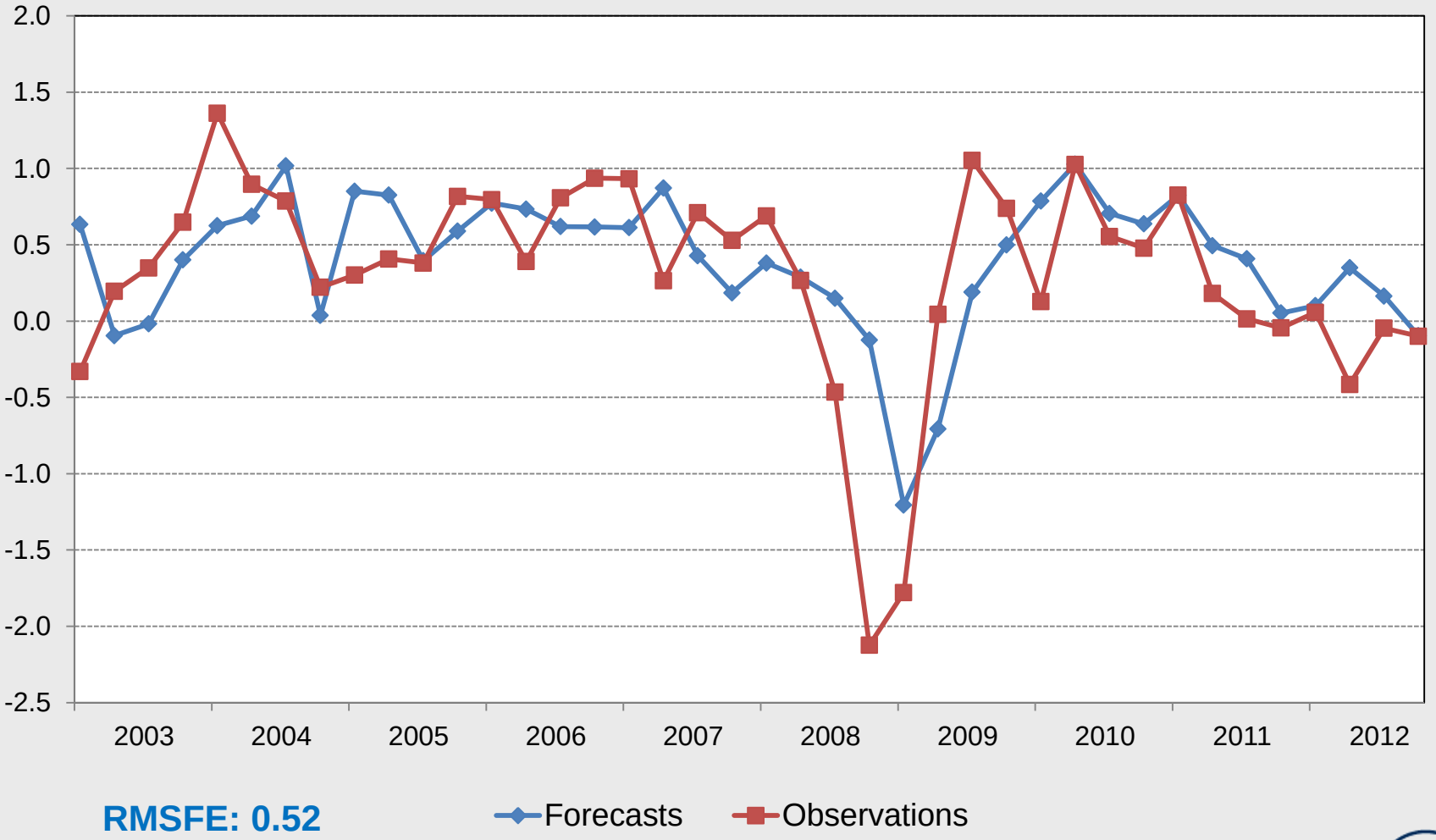
(based on a bridge model with 7 predictors, percentage changes compared to the previous quarter)



Source: ICN, NBB.

GDP forecast accuracy in scenario 2: 2 months before the end of the target quarter

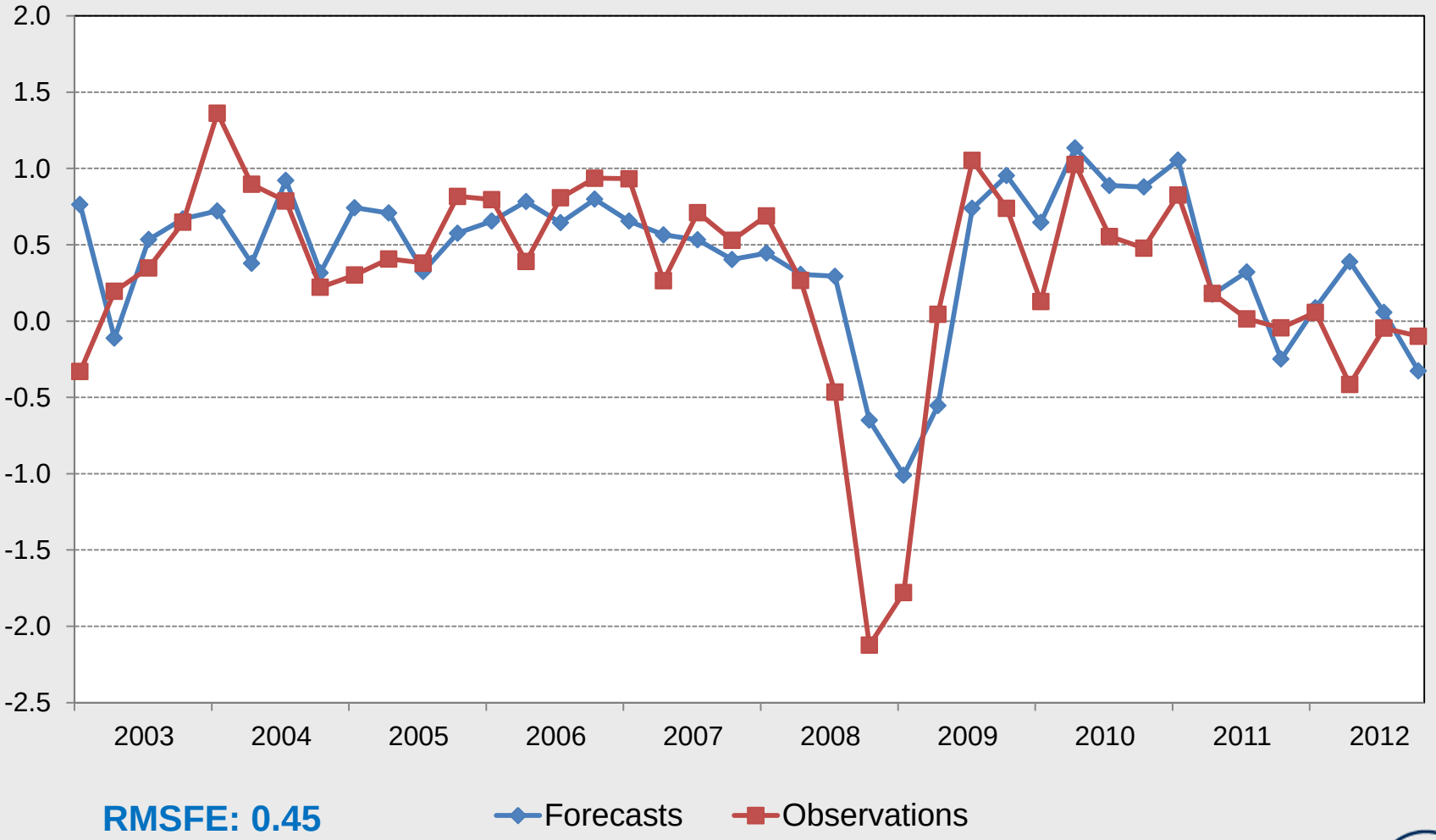
(based on a bridge model with 7 predictors, percentage changes compared to the previous quarter)



Source: ICN, NBB.

GDP forecast accuracy in scenario 3: 1 month before the end of the target quarter

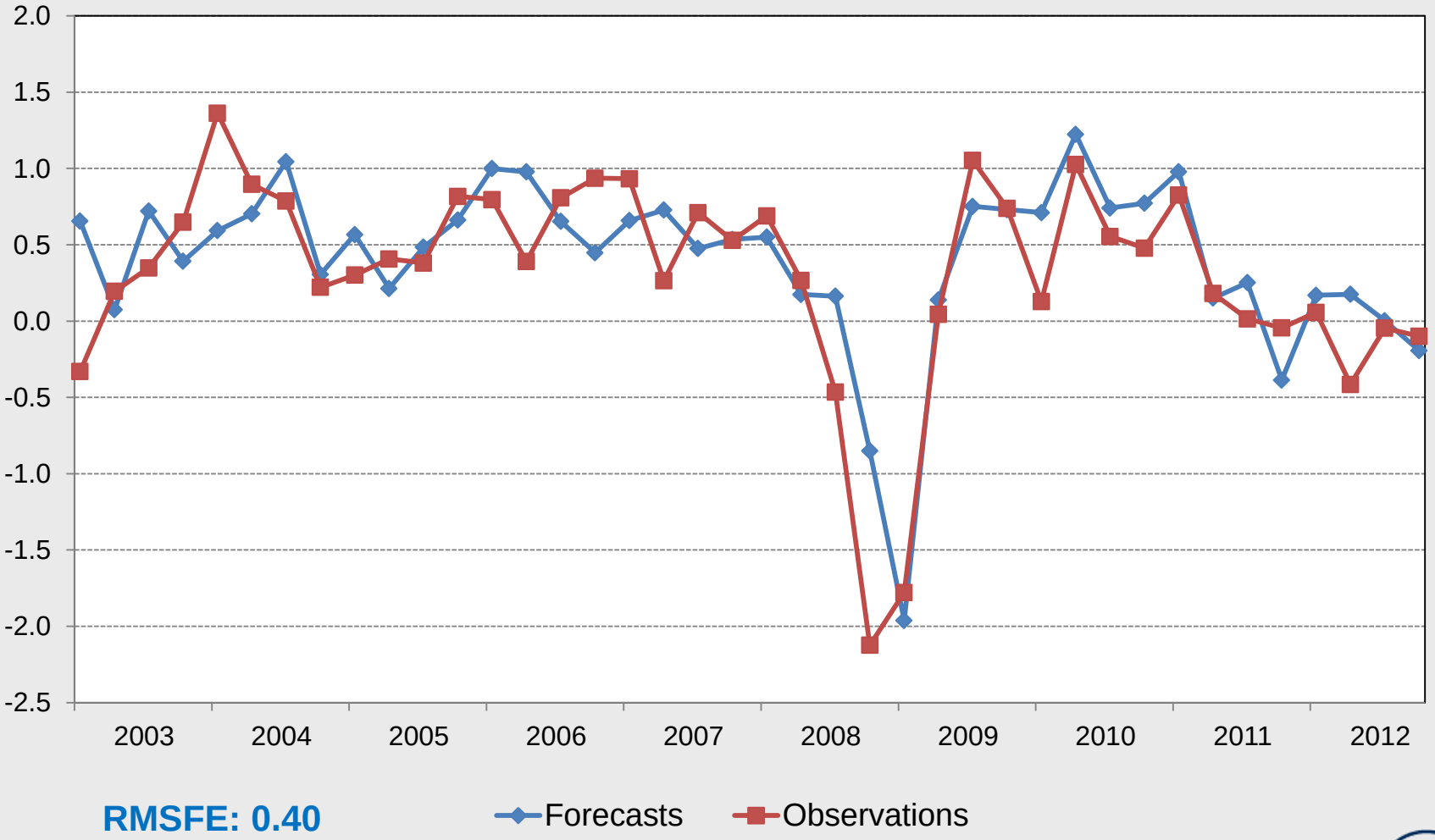
(based on a bridge model with 7 predictors, percentage changes compared to the previous quarter)



Source: ICN, NBB.

GDP forecast accuracy in scenario 4: end of the target quarter

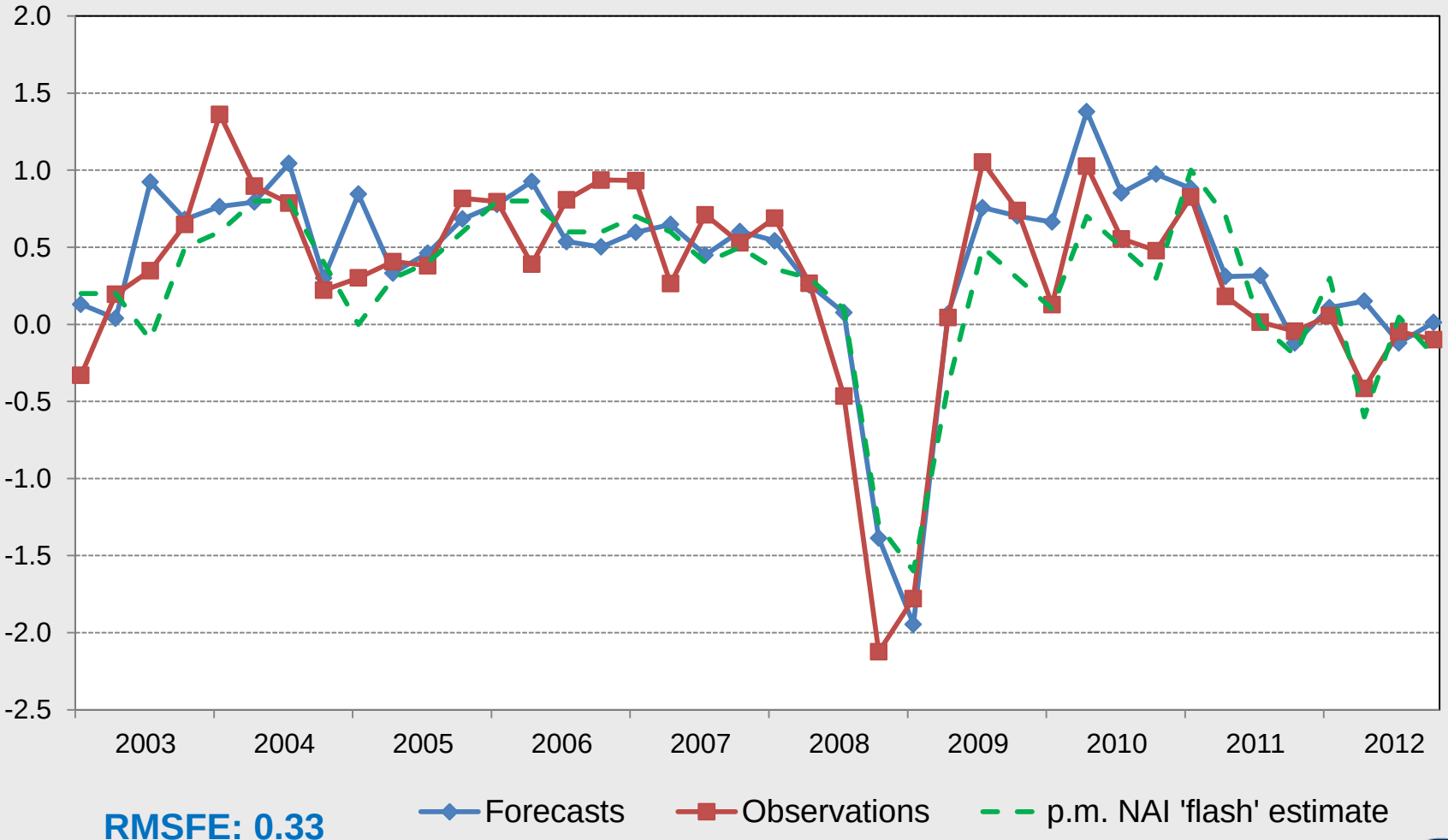
(based on a bridge model with 7 predictors, percentage changes compared to the previous quarter)



Source: ICN, NBB.

GDP forecast accuracy in scenario 5: 1 month after the end of the target quarter

(based on a bridge model with 7 predictors, percentage changes compared to the previous quarter)



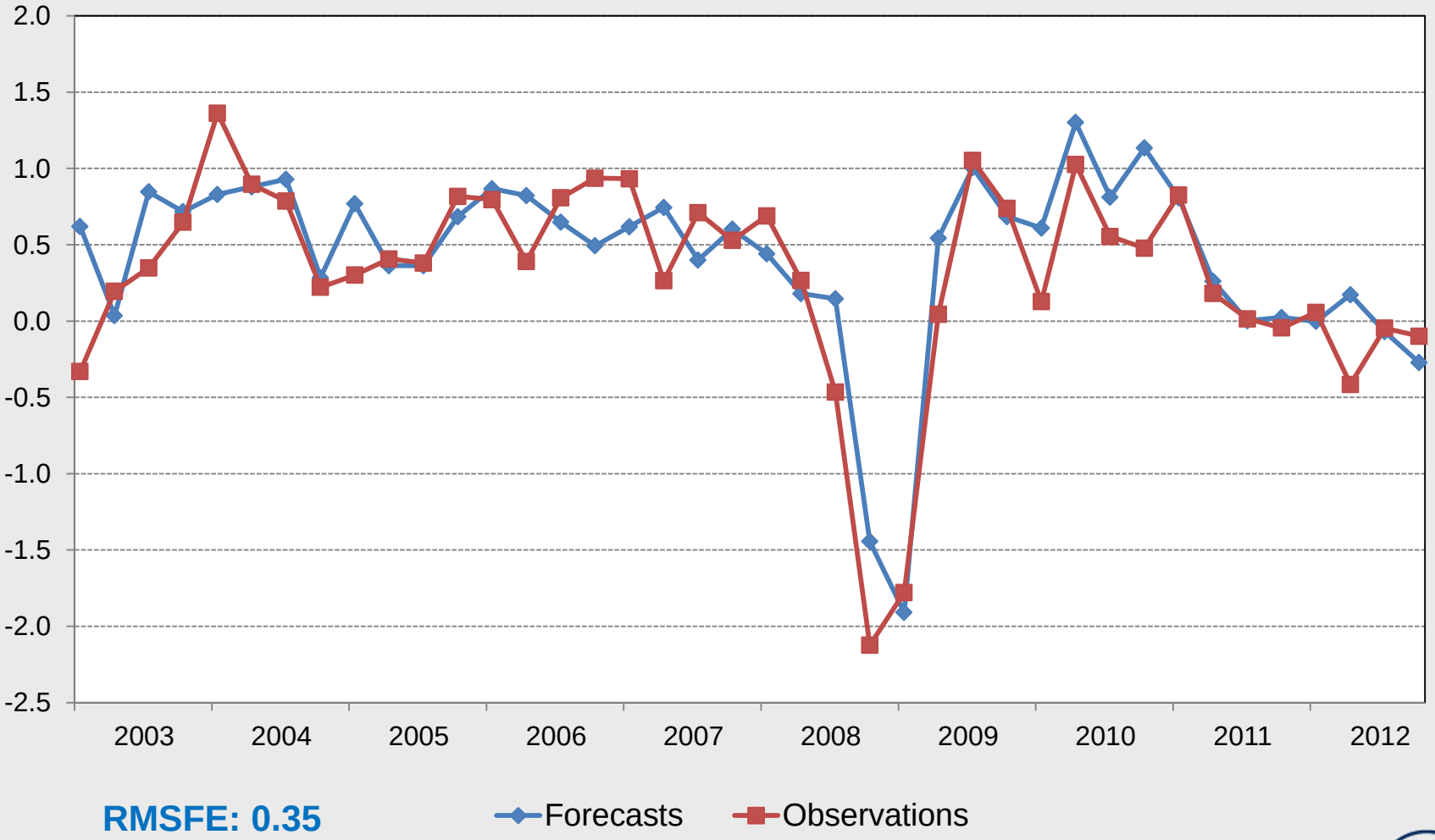
RMSFE: 0.33

RMSFE of the 'flash' estimate (National Accounts Institute): 0.33

Source: ICN, NBB.

GDP forecast accuracy in scenario 6: 2 months after the end of the target quarter

(based on a bridge model with 7 predictors, percentage changes compared to the previous quarter)



Source: ICN, NBB.

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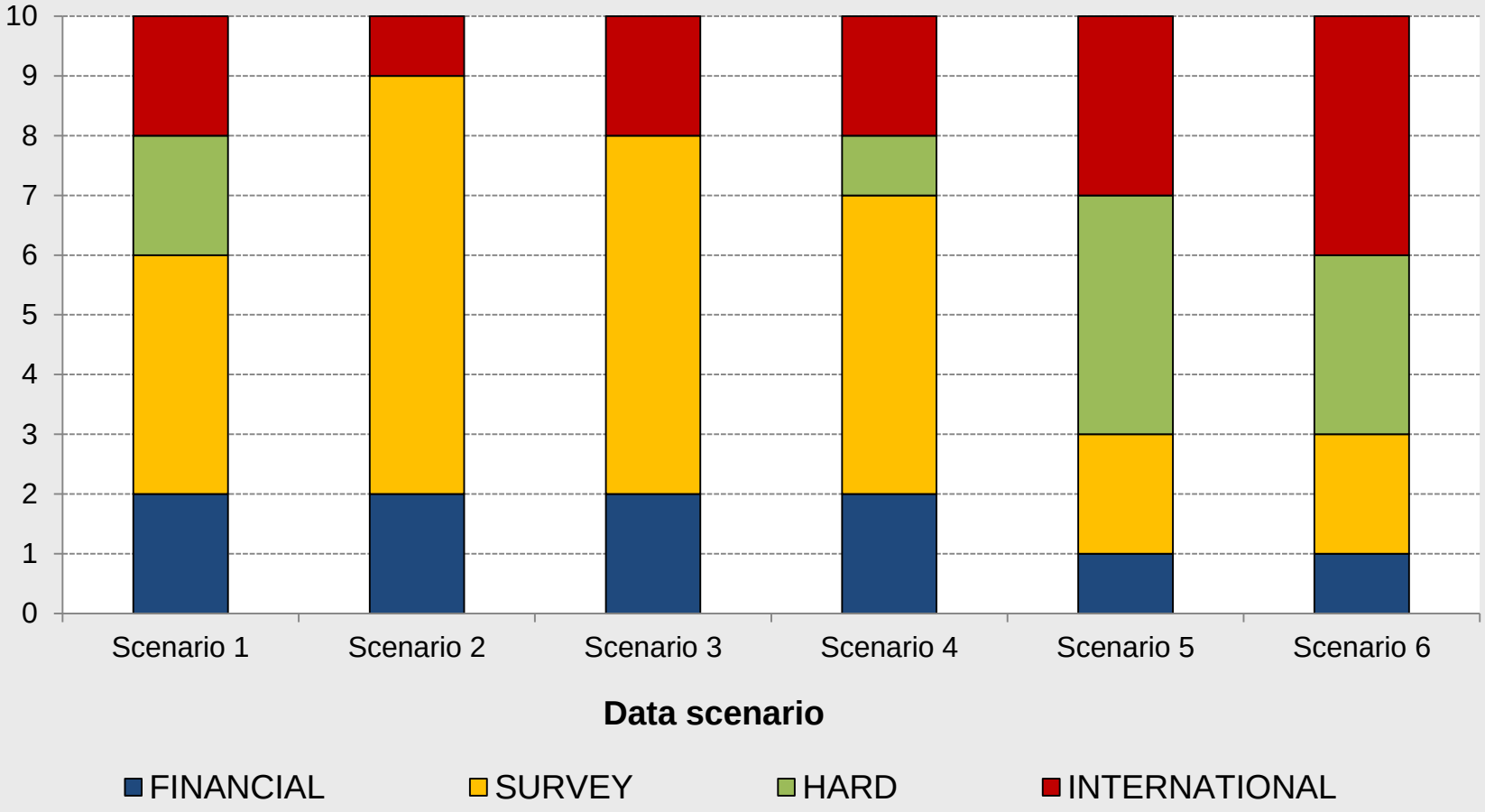
Importance of different data types for each data scenario

(number of appearances among the 10 top-ranked predictors)



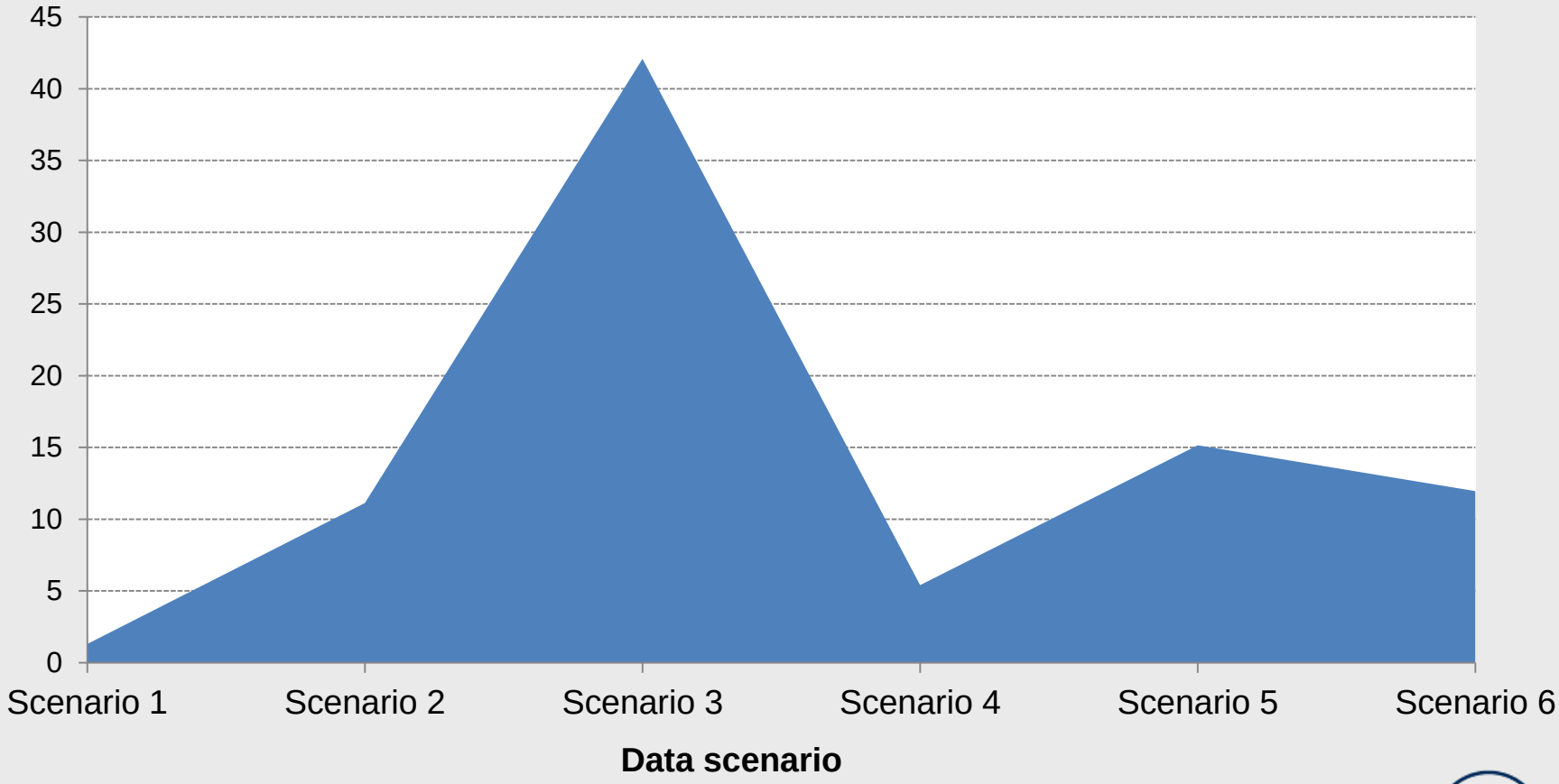
Best predictors for GDP

(predictors appearing at least once in the top 5 for one of the 6 scenarios, rankings under the 10th position not reported)

	Data scenario					
	1	**2**	**3**	**4**	**5**	**6**
Financial indicators						
Commodity import prices in international markets, excluding energy	6	3	2	3	9	10
Brussels All Shares Index	5	5	6	9		
Survey indicators						
Consumer survey - expectations for unemployment in Belgium		2	4	1	2	3
Manufacturing industry - demand expectations		4	8	4	7	5
Consumer survey - financial situation of households (with 1 lag)	4					
Manufacturing industry - trend in export orders			1	8		
Construction - trend in prices			3	7		
Hard data						
Production of intermediate goods					8	1
Total turnover					5	6
Work volume of temporary workers	2			5	3	7
Indicators related to the international context						
Industrial production in the euro area	3			6	1	2
Trade in the euro area						4
Industrial production in the emerging economies	1	1	10	2	4	8
Industrial production in the advanced economies			5			

Contribution of the survey data to short-run GDP estimates

(increase in the RMSFE if all Belgian survey data are excluded, in percentage points; based on bridge models with 7 predictors)



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Best predictors for value added in manufacturing

(predictors appearing at least once in the top 5 for one of the 6 scenarios, rankings under the 10th position not reported)

	Data scenario					
	1	**2**	**3**	**4**	**5**	**6**
Financial indicators						
Commodity import prices in international markets, excluding energy		6	4	6		
Survey indicators						
Manufacturing industry - trend in export orders		3	1	1	2	3
Manufacturing industry - demand expectations		5	7			
Hard data						
Production of intermediate goods					4	4
Work volume of temporary workers	5		3	5	5	5
Indicators related to the international context						
Trade in the euro area	2		5	3	3	1
Industrial production in the euro area	3			4	1	2
Industrial production in the advanced economies		1	2	2	7	7
Industrial production in France		4				8
Industrial production in the emerging economies	1	2			10	
Industrial confidence in the euro area (with 1 lag)	4					

Best predictors for value added in construction

(predictors appearing at least once in the top 5 for one of the 6 scenarios, rankings under the 10th position not reported)

	Data scenario					
	1	**2**	**3**	**4**	**5**	**6**
Survey indicators						
Construction - assessment of order book	3			1	1	1
Construction - trend in activity			2	2	2	2
Construction - trend in prices			3	3	3	3
Civil engineering and roadworks - trend in prices		6	5	4	4	4
Civil engineering and roadworks - assessment of order book		4	4	7	7	7
Construction - assessment of order book (with 1 lag)	1					
Civil engineering and roadworks - trend in number of contracts concluded (with 1 lag)	2	2				
Civil engineering and roadworks - trend in amount of work to be done (with 1 lag)	4		10			
Construction - price expectations		1	1			
Civil engineering and roadworks - trend in number of contracts concluded		5				
Hard data						
Permits for new residential buildings (in m2)		8		5	5	5
Unemployed job seekers (with 1 lag)	5					
Lagged dependent		3	6	6	6	6

Best predictors for value added in market services

(predictors appearing at least once in the top 5 for one of the 6 scenarios, rankings under the 10th position not reported)

	Data scenario					
	1	**2**	**3**	**4**	**5**	**6**
Survey indicators						
Business-related services - employment expectations		2	2	1	1	1
Retail trade - intentions of placing orders	10	3	3	2	2	2
Business-related services - activity expectations	1	1	1	4	5	5
Business-related services - trend in activity		5	4	7	8	6
Consumer survey - expectations for unemployment in Belgium		6	8	5	6	9
Business-related services - general demand expectations	2		6			
Consumer survey - expecations for saving of households (with 1 lag)	3	9	10			
Retail trade - assessment of the level of stocks	4	10				
Business-related services - price expectations (with 1 lag)	5					
Hard data						
Turnover in services		7		3	3	3
Work volume of temporary workers					4	4
Lagged dependent		4	5	6	7	7

Best predictors for private consumption

(predictors appearing at least once in the top 5 for one of the 6 scenarios, rankings under the 10th position not reported)

	Data scenario					
	1	**2**	**3**	**4**	**5**	**6**
Survey indicators						
Retail trade - trend in prices (with 1 lag)	4	1	1	1	4	4
Consumer survey - expectations for unemployment in Belgium	3	7	6	3	6	5
Consumer survey - expectations for the financial situation of households		5	5	5	9	
Retail trade - employment expectations	7		3		10	
Retail trade - assessment of sales				4		
Consumer survey - expectations for the economic situation in Belgium			4			
Retail trade - price expectations (with 1 lag)	2	3	10			
Retail trade - assessment of the level of stocks	6	4				
Consumer survey - expectations for saving of households	5	10				
Retail trade - trend in prices	1					
Hard data						
Turnover in retail trade			7		3	1
Work volume of temporary workers				7	1	2
Registration of new private cars	8	5	8	6	7	10
Lagged dependent		2	2	2	2	3

Best predictors for employment in the private sector

(predictors appearing at least once in the top 5 for one of the 6 scenarios, rankings under the 10th position not reported)

	Data scenario					
	1	**2**	**3**	**4**	**5**	**6**
Survey indicators						
Manufacturing industry - assessment of total order book		2	2	1	1	1
Manufacturing industry - employment expectations	4	3	3	2	2	2
Retail trade - intentions of placing orders		9	4	3	3	3
Civil engineering and roadworks survey - trend in amount of work to be done	8	7	7	5	5	5
Manufacturing industry - assessment of export order book	1	1	1			
Manufacturing industry - demand expectations (with 1 lag)			5			
Construction - trend in activity		5				
Manufacturing industry - demand expectations	2					
Civil engineering and roadworks - trend in number of contracts concluded	3					
Hard data						
Unemployed job seekers	5		8	6	6	6
Lagged dependent		4	6	4	4	4

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Alt approach: bridging with factors

- Consists in replacing the monthly predictors in the bridge equation by factors:

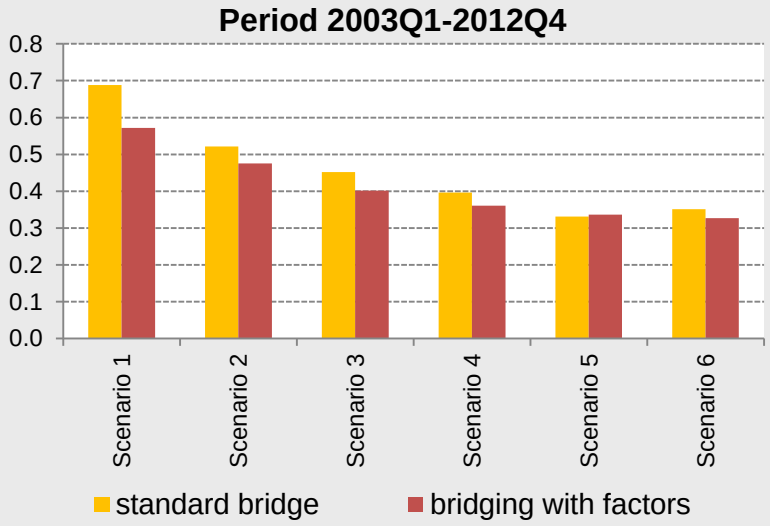
$$Y_{t+h} = \mu + \sum_{j=1}^{p} \rho_j Y_{t-j} + \sum_{k=1}^{r} \sum_{j=0}^{Q} \varphi_{i,j} F_{k,t-j}^{Q} + \varepsilon_t$$

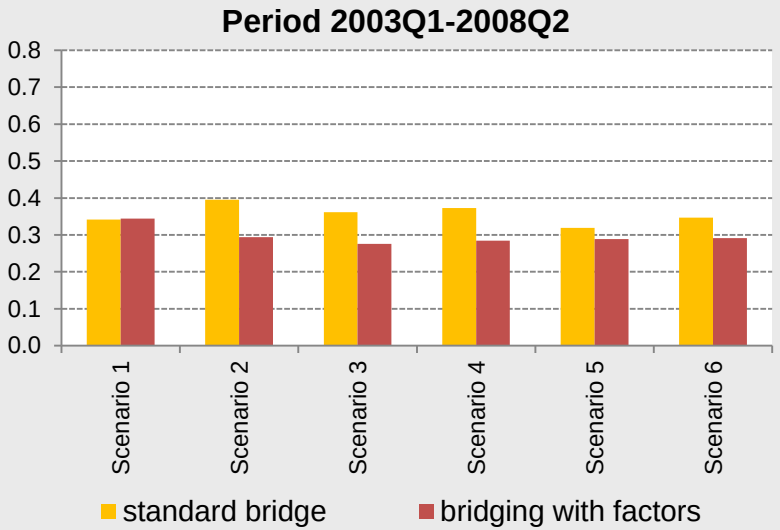
$$F_{k,t} = \sum_{i=1}^{n} w_{k,i} X_{i,t}$$

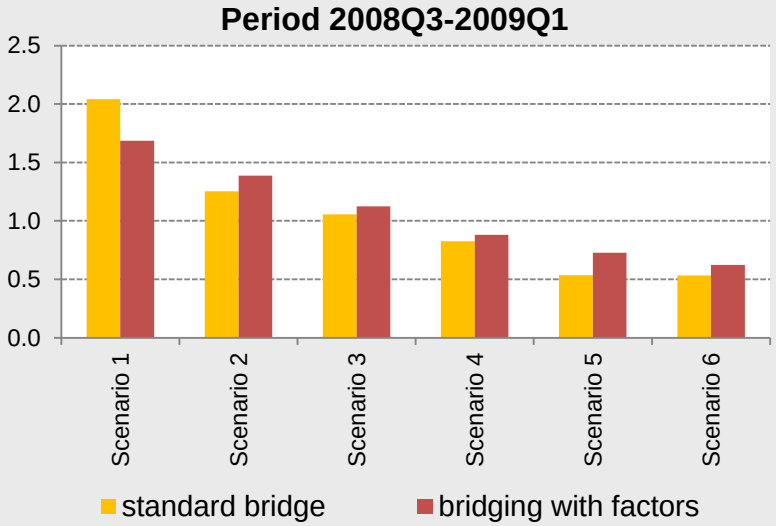
- Weights ($w_{k,i}$) calculated using principal components (Stock and Watson, 2002)

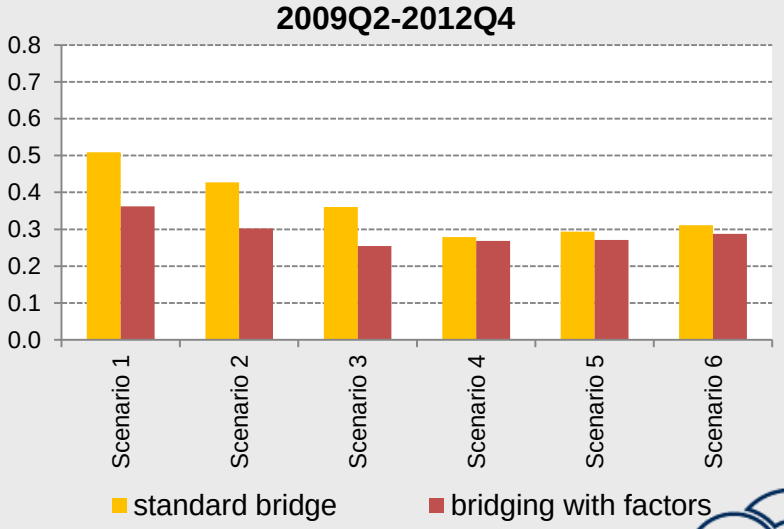
Relative accuracy: RMSFEs

(percentage points)









What about euro area GDP?

- Background: WSJ article on leading character of Belgian business sentiment for euro area GDP

  cf. Vanhaelen et al. (2000):
  - turning point analysis seems to confirm this
  - but no clear view as to *why* (openness, intermediate goods, share of SMEs?)
  - and depends on the period

  cf. Camacho and Perez-Quiros (2010): NBB confidence indicator included in short-term forecasting model for euro area (Eurosting)

- Our question: can Belgian survey data then contribute to explaining euro area GDP?

- Two-step approach:
  - first add euro area synthetic indicators
  - then add all euro area disaggregated survey data

Best predictors for euro area GDP

(predictors that appear at least once in the top 5 of the ranking in one of the 6 scenarios, rankings under the 10th position not reported)

	Data scenario					
	1	2	3	4	5	6
Survey indicators						
Estonian manufacturing survey - price expectations		5	7			8
Belgian manufacturing survey - demand expectations		4	3	5	6	
Spanish consumer survey - financial situation of households	2					
German manufacturing survey - employment expectations	3					
French construction survey - employment expectations	4					
Euro Stoxx Broad Index	5					
Belgian manufacturing survey - employment expectations		2		7		
Dutch contruction survey - price expectations		3	8			
German manufacturing survey - assessment of total order book			4	8		
German manufacturing survey - assessment of export order book			5	9		
Hard data						
Unemployment rate in the euro area		8	6	4	3	2
Industrial production in Spain		1	1	2	4	3
Unemployment rate in Spain	1		2	3	2	4
Indicators related to the international context						
Industrial production in the euro area				1	1	1
Trade in the United States						5
Trade in the emerging economies				6	5	

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Conclusion

- BREL forecasts are relatively accurate
  - in particular, the model's forecast error is similar to the flash estimate of GDP at the same point in time

- Our findings on survey data in line with other studies:
  - survey data found to be (very) useful in predicting GDP and other macro aggregates once you duly take account of ragged data edges
  - ... even when, in principle, most or all hard data are available (scen 5 and 6)
  - replies to individual survey questions often more informative than the synthetic (consumer and business sentiment) indicators
  - recurring predictors:
    - demand outlook in manufacturing
    - unemployment expectations in consumer survey

Avenues for further work

- More systematic assessment of data revisions (both dependent variables - flash vs final vintage - and predictors)
  - e.g. separate bridge equations for flash and final vintage GDP
- Apply the BREL methodology to short-term inflation projections
- Go beyond net balances and look at importance of other aspects of the distribution of survey replies
  - dispersion indicators may measure uncertainty (EC, ECB)
  - preliminary evidence of impact of such indexes drawn from consumer survey on consumption

Thanks for your attention !!!

Back-up slides

Business surveys of the National Bank of Belgium

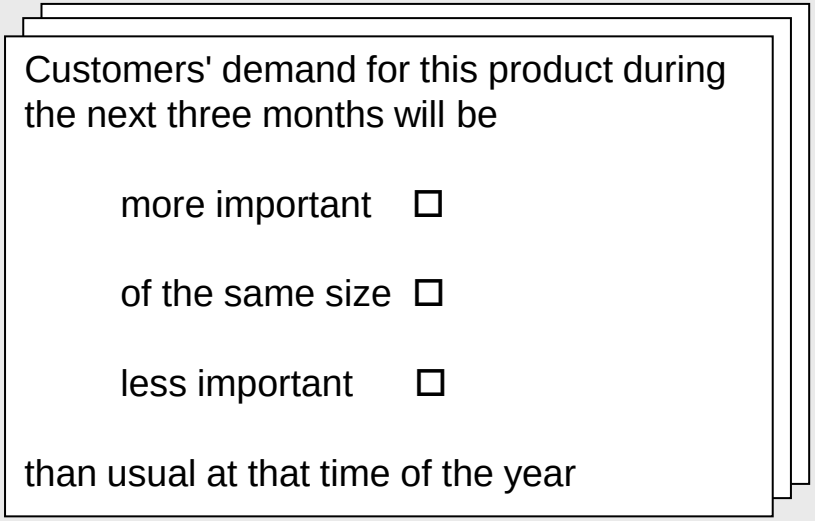
Frequency	Survey	Result	Since
Monthly	**Business sentiment survey**	**Business cycle indicator**	1954
	Consumer sentiment survey	**Consumer confidence**	1985
Quarterly	Production capacity survey in the manufacturing industry	Production capacity utilisation rate	1962
	Credit developments and credit conditions surveys (Bank Lending Survey and business survey on credit)	Results according to the supply side (banks)	2002
		Results according to the demand side (firms)[1]	2009
Semi-annual	Investment survey	Yearly growth rate of investment	1958
Yearly		General information (type of investment, financing source, investment drivers)	
p.m. Every 3 years	Household Finance and Consumption Survey (euro area)	mainly data on household financial assets and liabilities	2010

Ad-hoc surveys: e.g. price-setting behaviour of Belgian firms (March 2004), wage formation in Belgian firms (October 2007)
Confidential surveys: survey of architects (building designs), quarterly business sentiment survey in the construction sector, survey of the turnover of the trade sector in building materials

[1] Based on 2 questions (assessment of the credit conditions and their development). These questions used to be included in the investment survey (on a yearly basis since 2002), but are now included in a separate business survey on a quarterly basis.

Survey approach and indicator calculation (1)

- harmonised in the EU
- sample: fixed **panel** of firms
- written procedure at the beginning of each month (letter, fax, mail)
- **quantitative** questions covering:
  - factual information on recent developments
  - assessment of recent developments
  - expectations for the next three months
- potential answers: positive, unchanged/neutral or negative



- quantification: net balance approach

  (# positives - # negatives)*100

- weights based on firms' shares in total turnover or employment within a given sub-industry and a given product classification

Survey approach and indicator calculation (2)

- exact content of the synthetic indicator(s) determined on the basis of:
  - correlation with GDP, cyclical fluctuations
  - leading nature of the replies

Selected questions:

Manufacturing industry	Trade	Building	Business-related services
Assessment of total order book	Demand expectations	Trend in orders	Assessment of activity
Assessment of the level of stocks of finished products[1]	Intentions of placing orders	Trend in equipment	Activity expectations
Employment expectations	Employment expectations	Assessment of order book	General demand expectations
Demand expectations		Demand expectations	

[1] With reversed sign.