Nowcasting growth: Indonesia

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Empirical Economics, September 2018, Volume 55, Number 2, Page 597-619.

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Outline

- Why are we doing this?
- How we are doing it
- Was it any good?
- How it can be useful

Why are we doing this?

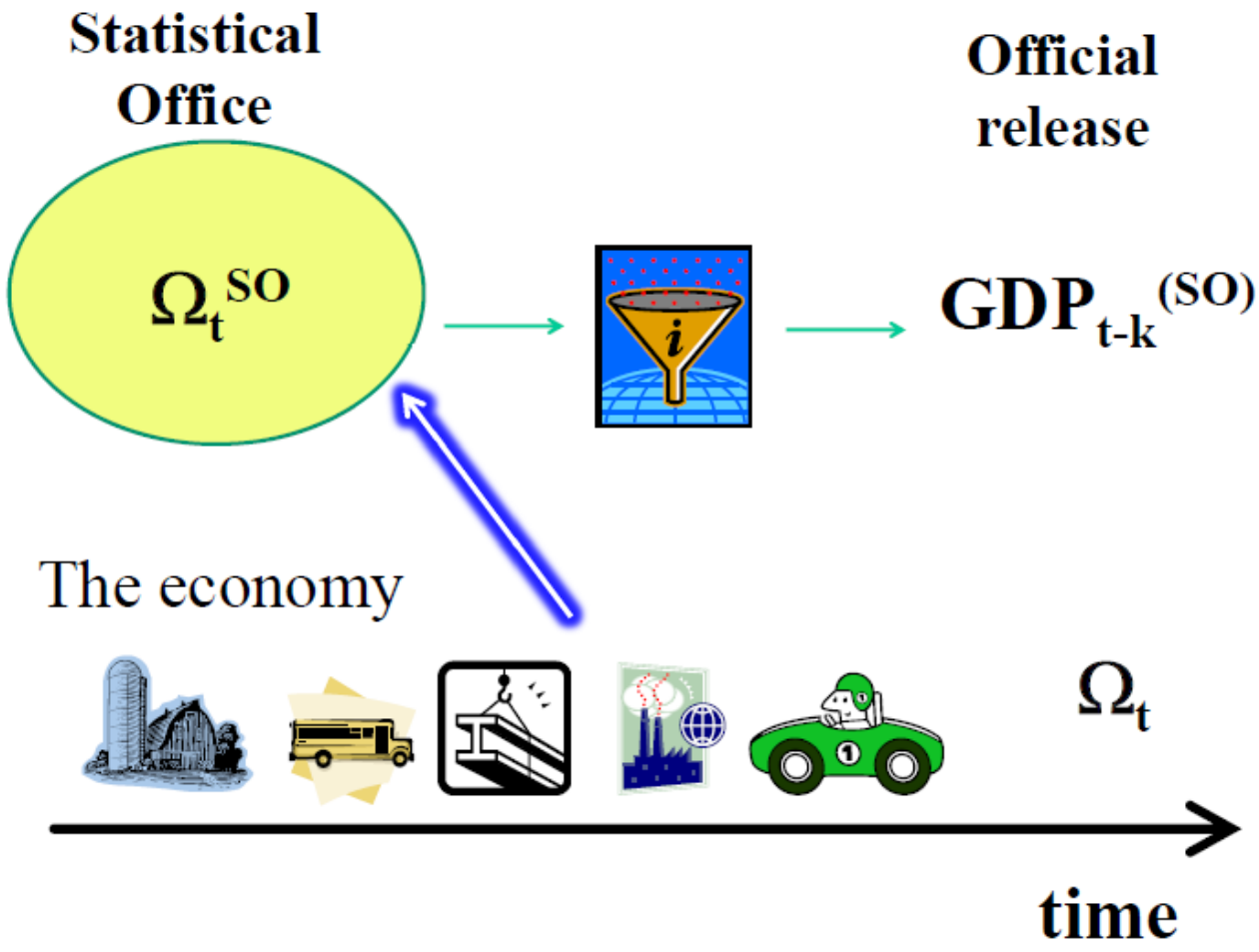
- Decision making relies on forecasts, which hinges on initial conditions that come with lags.
  - Market players and policy makers periodically update their views (forecasts/nowcasts) for decision making
  - Real time monitoring of economic activity helps to check if a particular forecast is still on track, or has become outdated i.e. implausible
- Plenty of information available to gauge the most current state of economic activity.
- Lack of personnel and resources to do the monitoring.

How we are doing it

How we are we doing it

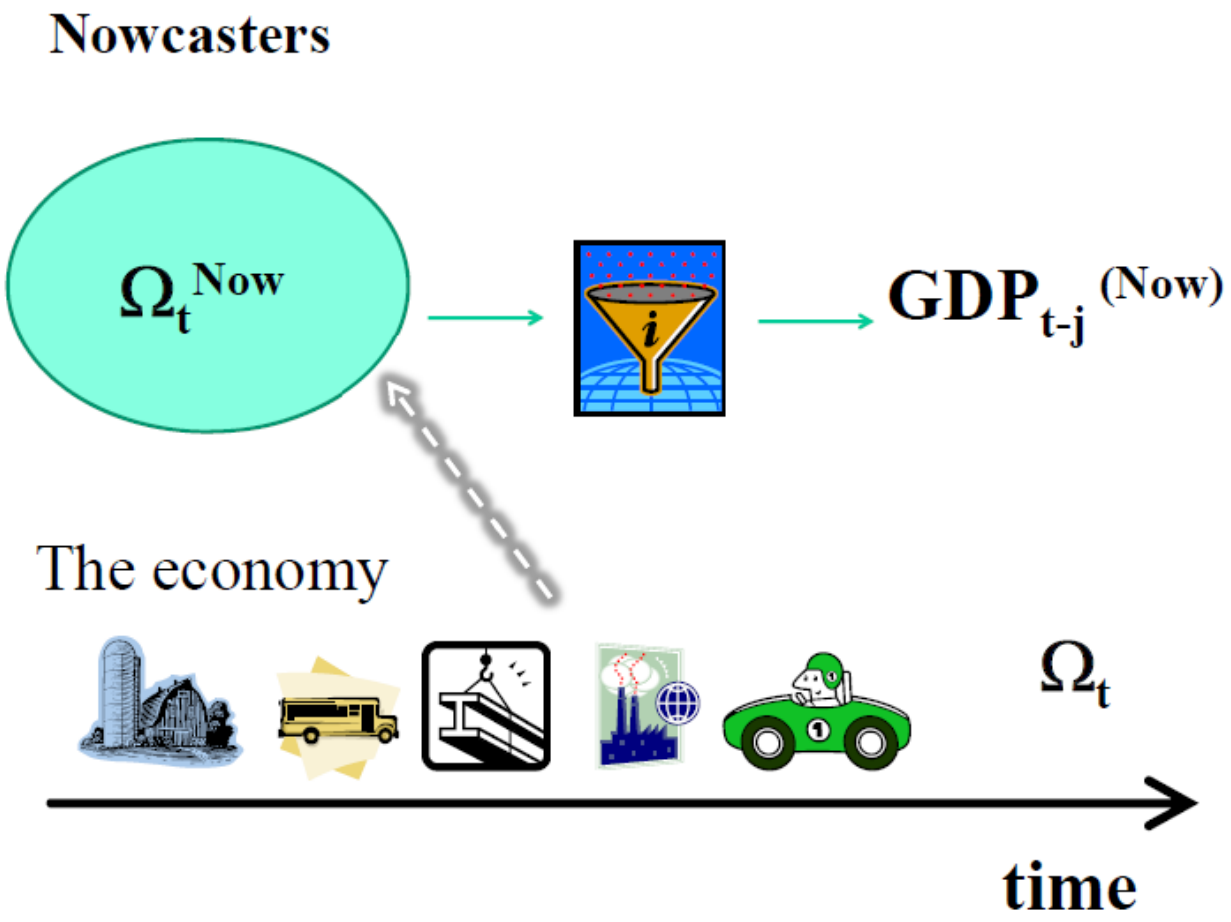
- Collect relevant available information with mixed frequency.
- Predict Economic Activity with mixed-frequency DFM in a pseudo Real-Time manner.
  - Assume that the common factors follow a VAR process
  - Apply an Expectation-Maximization algorithm (the one proposed by Banbura and Mondugno, JAE 2014) to fill up missing values, then maximize the likelihood
- Setting up an excel interface to make it user friendly.

The nowcasting process:
by the statistical agency



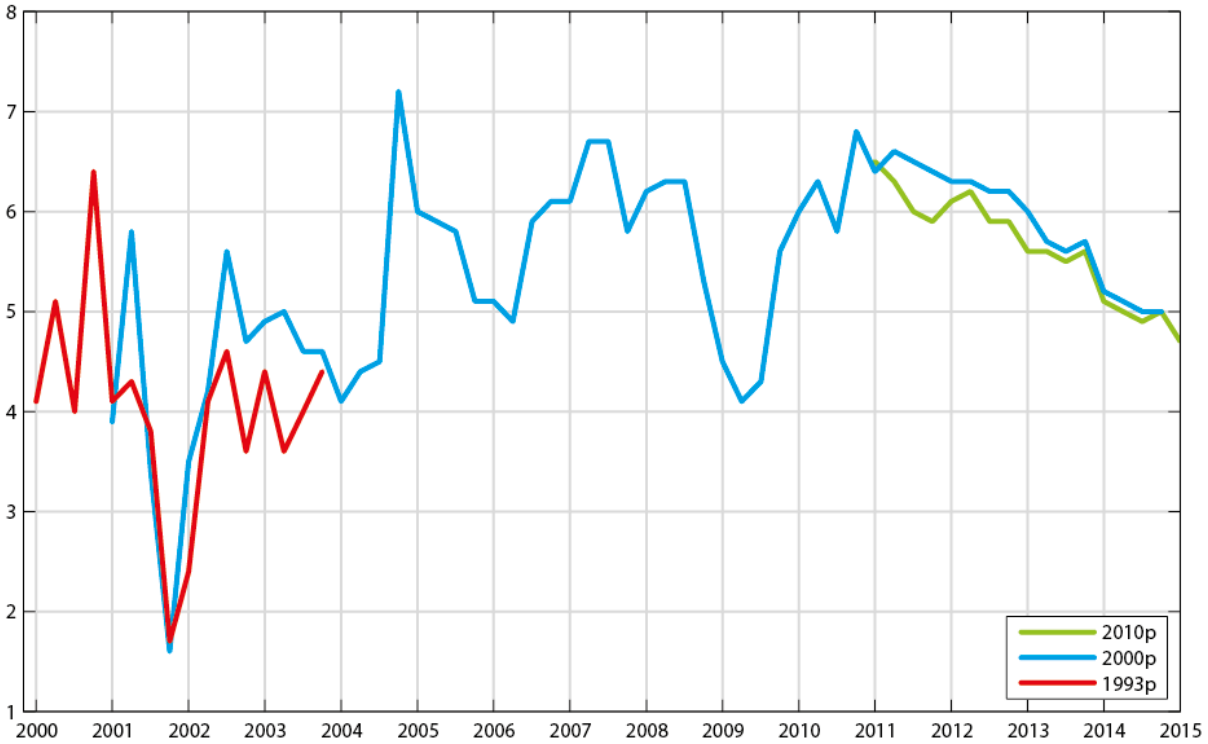
The nowcasting process:

by the rest, i.e. nowcasters = private and public analysts



How does Ω_t^{SO} relate to Ω_t^{Now}?

Tracking Indonesia's GDP



- Following the AFC, GDP fell dramatically in Indonesia
- Growth stabilized somewhat only in 2002
- Post-GFC, growth picked up but decelerating since then

Issues with the GDP data

- Documentation on inputs, methodology and coverage is lacking
  - Detailed information on sources of data, proxies, surveys used is not readily available
  - No clear information on data adjustments and corrections
- GDP data released with a delay of 5 weeks. Not bad compared to some other economies, but still insufficient for monitoring
- Data suffers from a number of deficiencies
  - No available long series
  - No official seasonally adjusted series

What variables to select?

Bloomberg Calendar: follow the market revealed preferences (Banbura, et.al, 2013)

Variable	Source	Reference period	Release date	Freq	Rel.
Bank Indonesia Reference Rate	Bank Indonesia	17-Mar	Mar-17	D	95
CPI y-o-y	Statistics Indonesia	Jan	Mar-6	M	86
Foreign Reserves	Bank Indonesia	Dec	Mar-3	M	86
PMI Mfg Markit	Markit	Mar	Apr-4	M	82
GDP YoY	Statistics Indonesia	4Q	Feb-2	Q	64
Consumer Confidence Index	Bank Indonesia	Feb	Mar-4	M	64
GDP q-o-q	Statistics Indonesia	4Q	Feb-2	Q	59
CPI Core y-o-y	Statistics Indonesia	Feb	Mar-6	M	55
Local Auto Sales	Gaikindo	Feb	Mar-16	M	50
Imports y-o-y	Statistics Indonesia	Feb	Mar-15	M	50
Net Foreign Assets IDR	Bank Indonesia	Feb	Mar-28	M	45
Danareksa Consumer Confidence	Danareksa	Feb	Mar-5	M	36
Motorcycle Sales	Bank Indonesia	Feb	Mar-16	M	32
Money Supply: M2 y-o-y	Bank Indonesia	Feb	Mar-28	M	32
Money Supply M1 y-o-y	Bank Indonesia	Jan	Mar-28	M	32
CPI NSA m-o-m	Statistics Indonesia	Feb	Mar-6	M	27
Exports y-o-y	Statistics Indonesia	Feb	Mar-15	M	27
Trade Balance	Statistics Indonesia	Feb	Mar-15	M	23
BoP Current Account Balance	Bank Indonesia	4Q	Mar-15	Q	14

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What variables to select?

Bloomberg Calendar plus Judgment

Variable	Freq.	Source	Start	Delay	Trans.
Central Bank policy rate	M	Bank Indonesia	Jan-93	1	
PMI developing economies	M	JP Morgan	Apr-04	4	
Cement, domestic consumption	M	Statistics Indonesia	Jan-94	10	y-o-y
Exports	M	Statistics Indonesia	Jan-93	15	y-o-y
Imports: Consumption Goods	M	Statistics Indonesia	Mar-01	15	y-o-y
Imports: Capital Goods	M	Statistics Indonesia	Mar-01	15	y-o-y
Imports: Raw materials	M	Statistics Indonesia	Mar-01	15	y-o-y
Car sales	M	PT Astra	Jan-93	16	y-o-y
Gross Domestic Product	Q	Statistics Indonesia	Q1 1993	36	y-o-y
Business Tendency Index	Q	Bank Indonesia	Q2 2000	38	
M2	M	Bank Indonesia	Jan-93	28	y-o-y

Root Mean Squared Error

What variables to select?

Comparing Different Selection Strategies

	Month	Automatic	Bloomberg	Our Approach
Forecast	1	0.916	0.591	0.587
	2	0.805	0.526	0.516
	3	0.724	0.531	0.444
Nowcast	1	0.725	0.541	0.449
	2	0.541	0.424	0.325
	3	0.483	0.434	0.287
Backcast	1	0.486	0.409	0.288

The Dynamic Factor Models

- Let $\mathbf{x}_t \sim I(0)$ be a vector of n variables observed at month t:

$$\underset{n\times 1}{\mathbf{x}_t} = \underset{n\times r}{\boldsymbol{\lambda}}\ \underset{r\times 1}{\mathbf{f}_t} + \underset{n\times 1}{\mathbf{e}_t}$$

$\mathbf{f}_t$ are the common factors

capture the comovement in the data, *i.e.* the business cycle

$$\mathbf{f}_t = \sum_{s=1}^{p} \mathbf{A}_s \mathbf{f}_{t-s} + \mathbf{u}_t$$

$$e_{it} = \rho_i e_{it-1} + \varepsilon_{it}$$

- Estimation: Maximum Likelihood (EM algorithm), Kalman Filter
- The model can be used for real-time applications since the Kalman Filter allows to handle
  - missing data
  - mixed frequencies, *i.e.* monthly and quarterly variables jointly

Dynamic Factor Models in Real-Time

Factor models are used in real-time as follows:

- Suppose that we are at day d.
- At date d it is available a given vintage of data: $\mathbf{X}^d$
- On the basis of $\mathbf{X}^d$ we constructed our prediction:

  $\hat{x}_{it}^d = \widehat{\boldsymbol{\lambda}}_i \hat{\mathbf{f}}_t^d + \hat{\mathbf{e}}_t$

- At day $d+1$ a new data is released (*eg.* Exports).
- We have a new vintage: $\mathbf{X}^{d+1}$
- Therefore we can:
  1. update our estimate of the factors, $\hat{\mathbf{f}}_t^{d+1}$
  2. and hence update our prediction:

     $\hat{x}_{it}^{d+1} = \widehat{\boldsymbol{\lambda}}_i \hat{\mathbf{f}}_t^{d+1} + \hat{\mathbf{e}}_t$

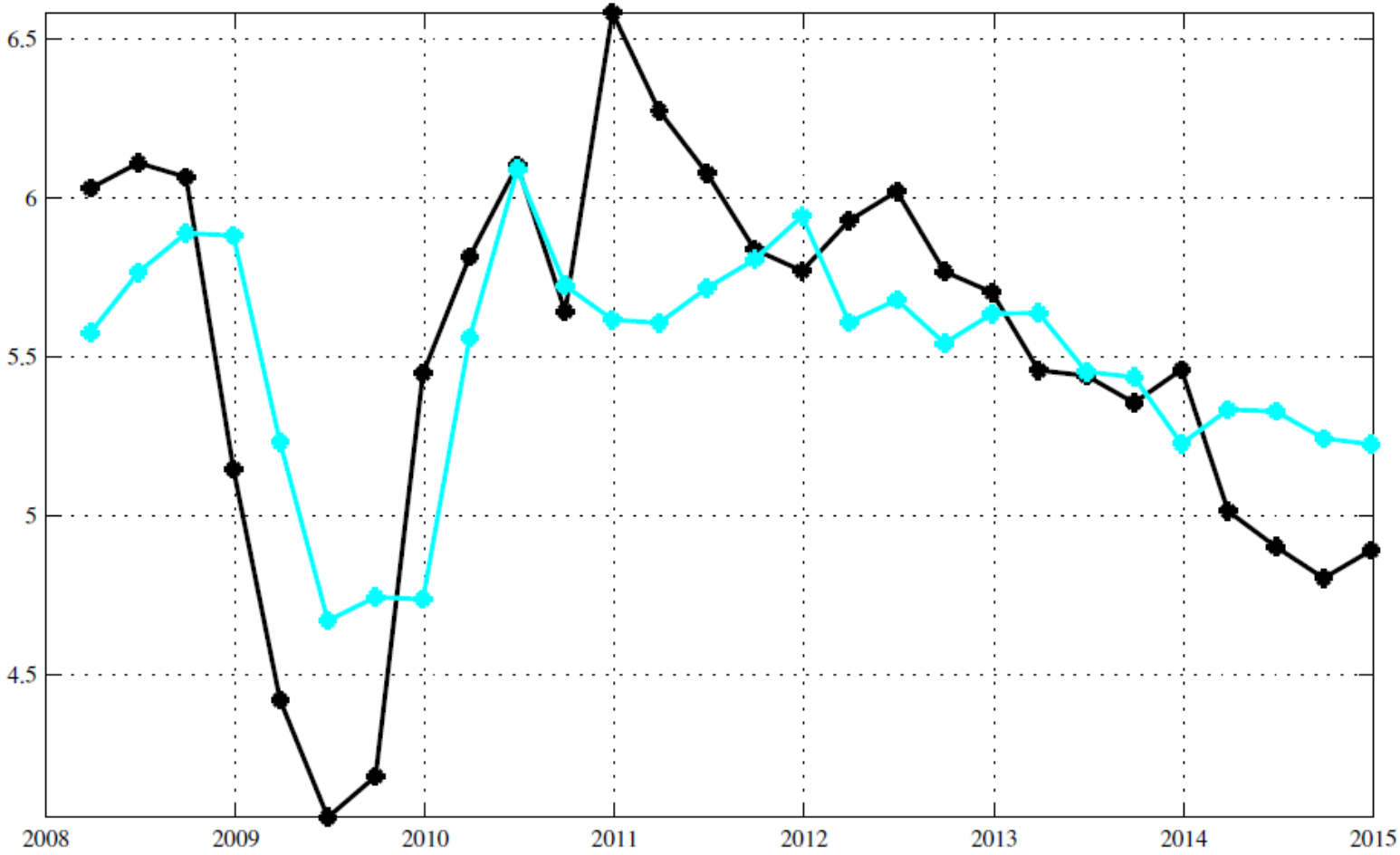
Actual Growth Rates

Data Flow

April 30, 2015

	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15
GDP	X	.	.	?	.	.	?
Policy rate	X	X	X	X	X	.	.
M2	X	X	X	.	.	.	.
Exports	X	X	X	X	.	.	.
Car sales	X	X	X	X	.	.	.
Cement	X	X	X	X	.	.	.
Imports	X	X	X	X	.	.	.
PMI	X	X	X	X	.	.	.
BTI	X	.	.	.	.	.	.

Prediction of Current Quarter



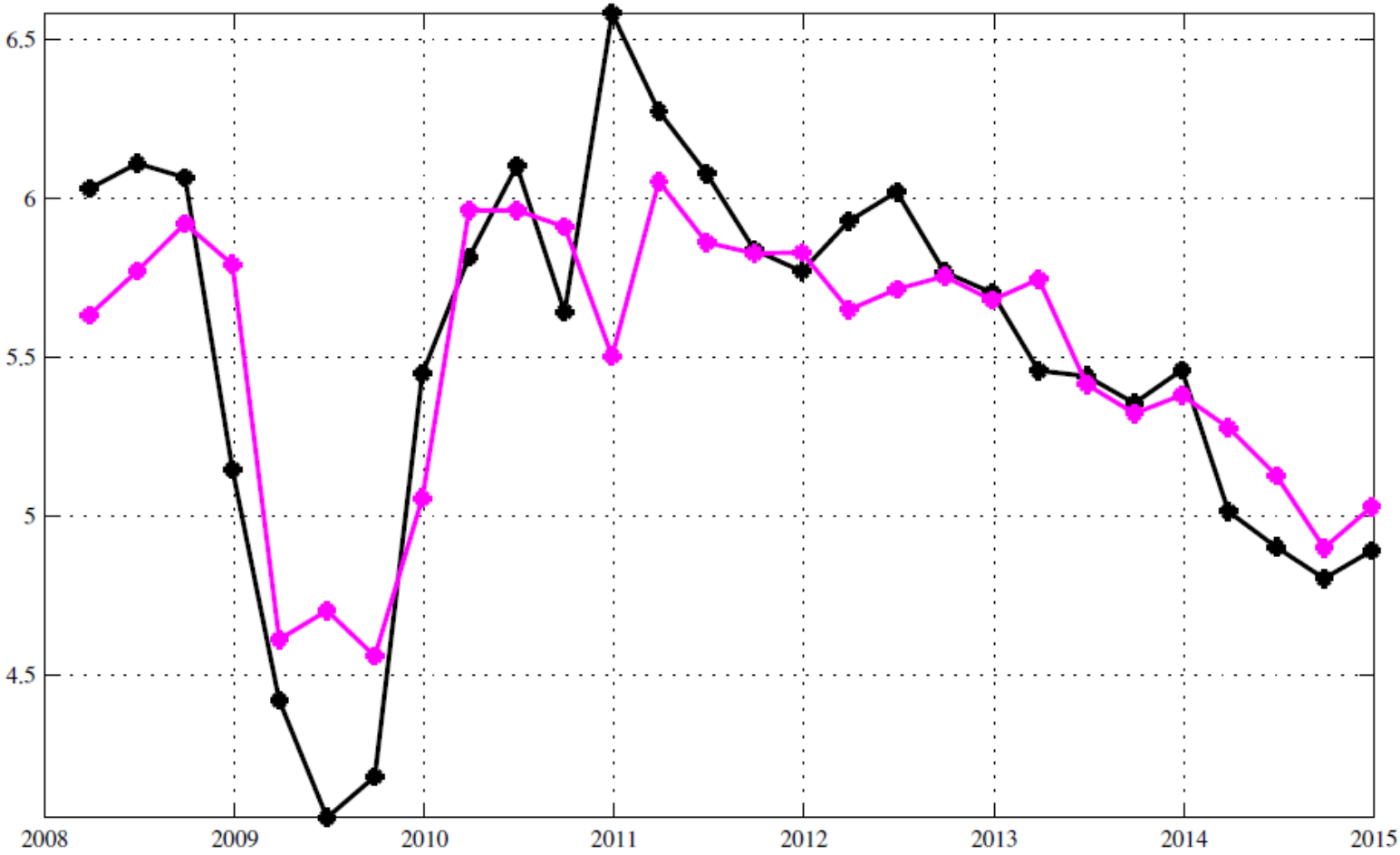
End of Month 1

Data Flow

May-31, 2015

	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15
GDP	X	.	.	X	.	.	?
Policy rate	X	X	X	X	X	X	.
M2	X	X	X	X	.	.	.
Exports	X	X	X	X	X	.	.
Car sales	X	X	X	X	X	.	.
Cement	X	X	X	X	X	.	.
Imports	X	X	X	X	X	.	.
PMI	X	X	X	X	X	.	.
BTI	X	.	.	X	.	.	.

Prediction of Current Quarter



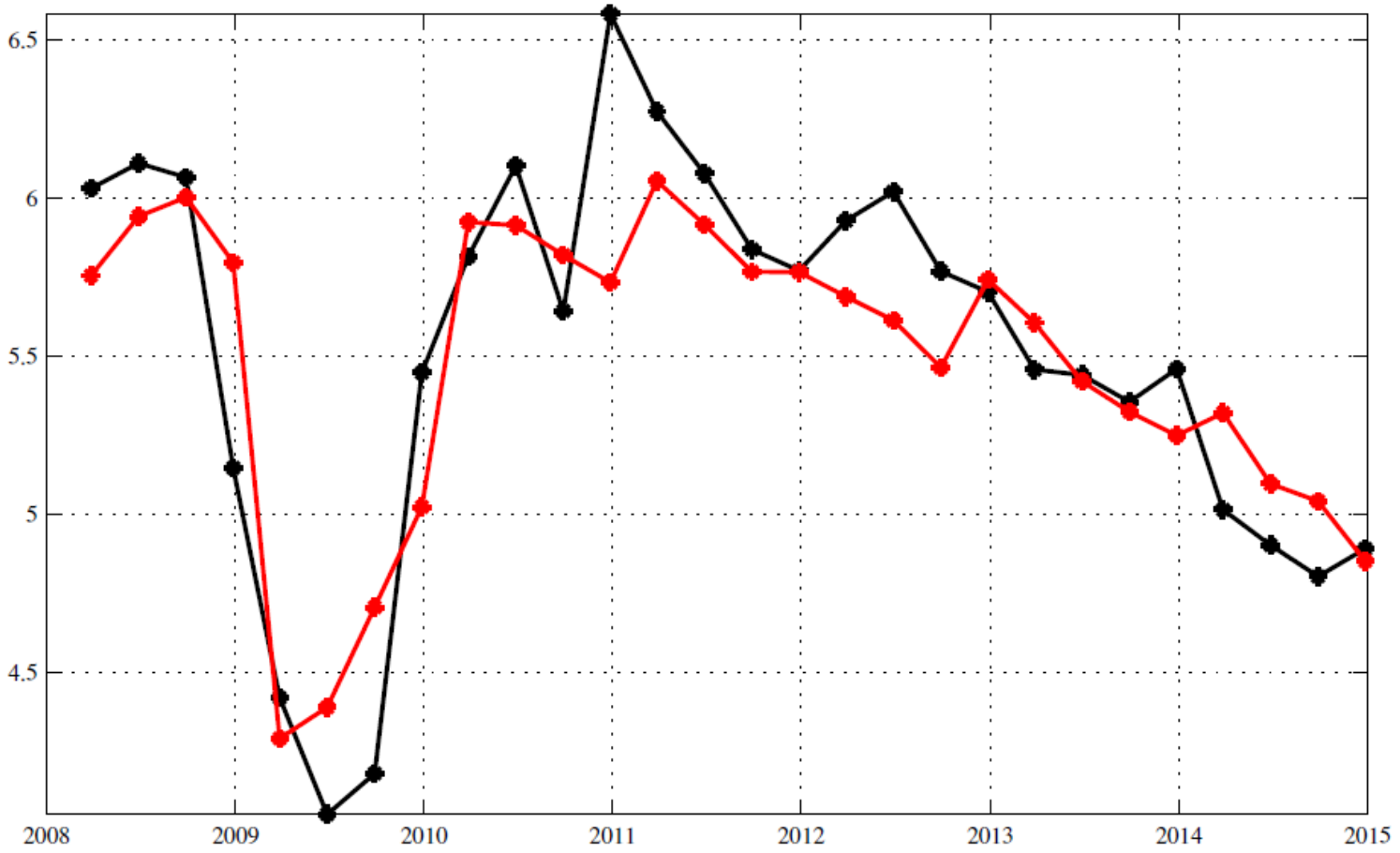
End of Month 2

Data Flow

June-30, 2015

	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15
GDP	X	.	.	X	.	.	?
Policy rate	X	X	X	X	X	X	X
M2	X	X	X	X	X	.	.
Exports	X	X	X	X	X	X	.
Car sales	X	X	X	X	X	X	.
Cement	X	X	X	X	X	X	.
Imports	X	X	X	X	X	X	.
PMI	X	X	X	X	X	X	.
BTI	X	.	.	X	.	.	.

Prediction of Current Quarter



End of Month 3

How good is it?

Root Mean Squared Error

End of month

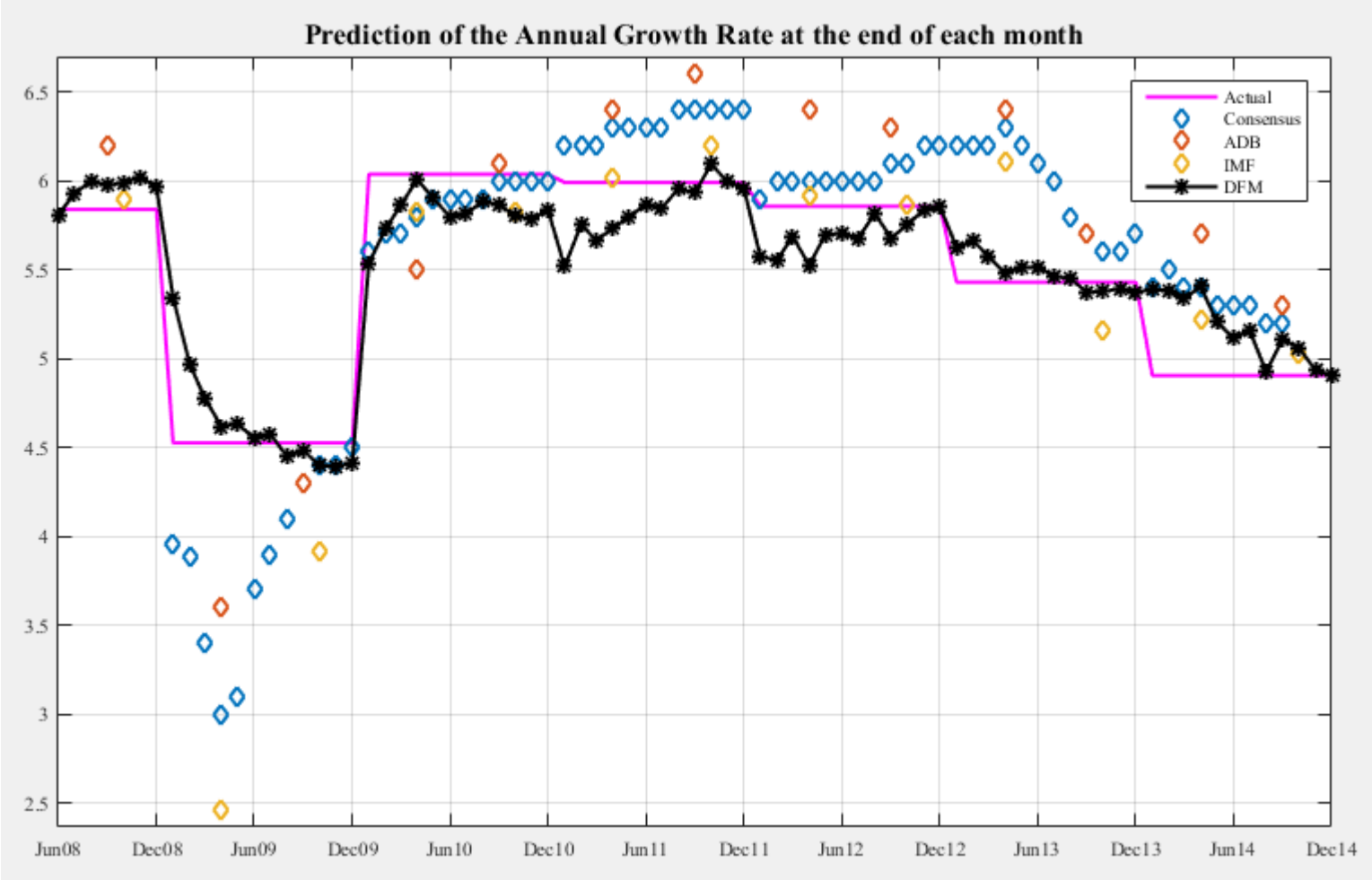
	Month	DFM	AR	RW
Forecast	1	0.587	0.692	0.847
	2	0.516	0.612	0.661
	3	0.444	0.612	0.661
Nowcast	1	0.449	0.600	0.666
	2	0.325	0.443	0.430
	3	0.287	0.443	0.430
Backcast	1	0.288	0.446	0.459

Institutional benchmarks

We also compare the prediction obtained with the DFM with the prediction of annual growth rate published by policy institutions:

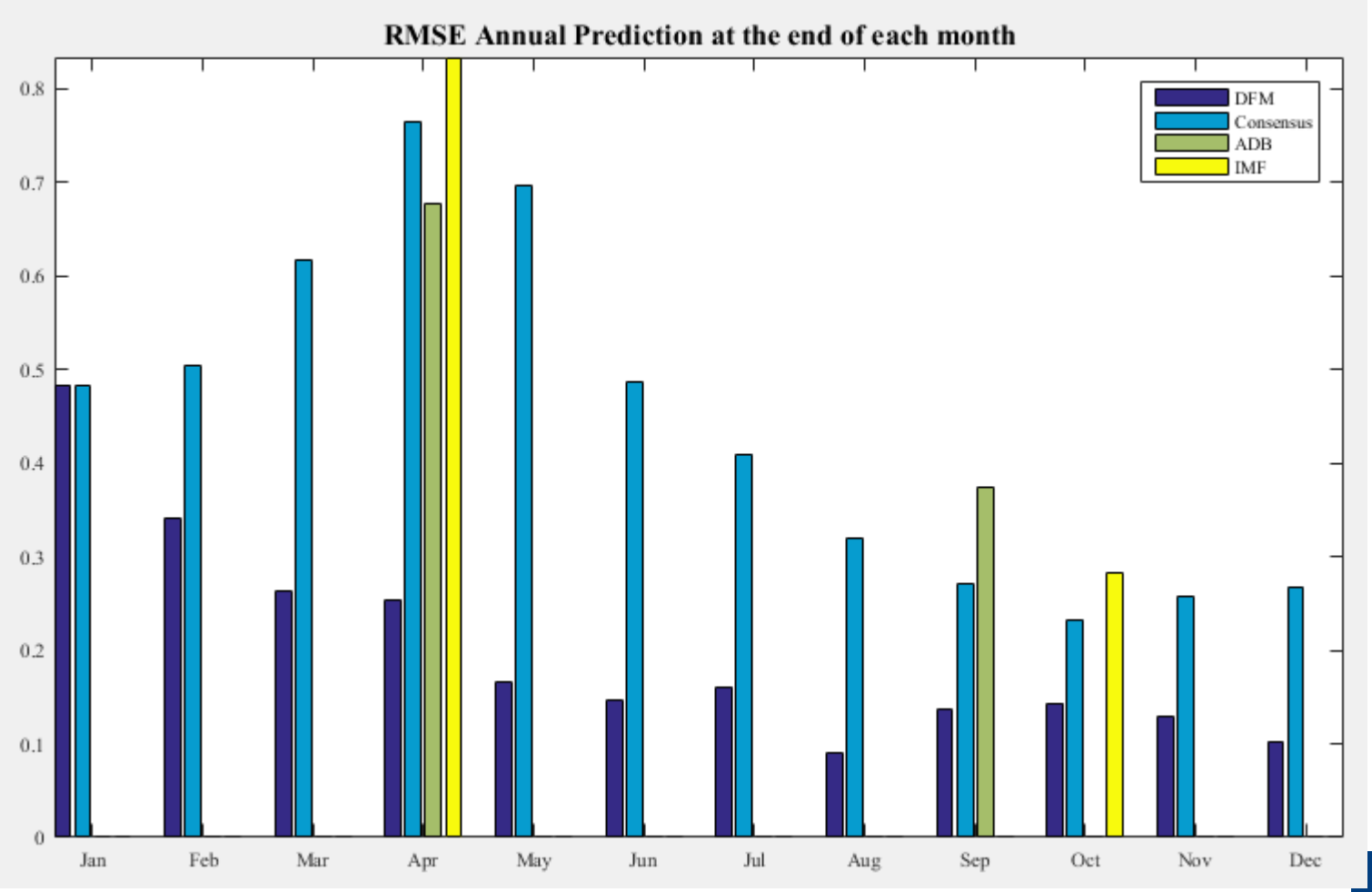
- Asian Development Bank
- International Monetary Fund
- Consensus Forecasts

Prediction of Current Annual GDP Growth



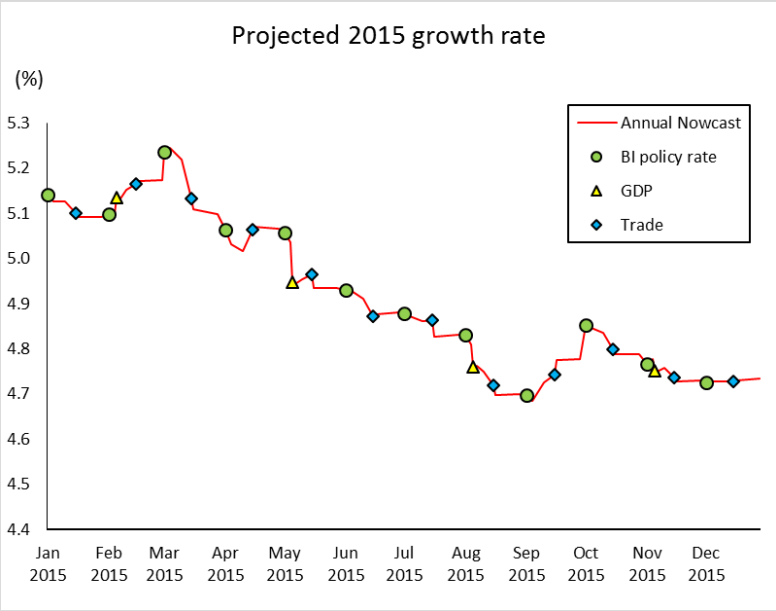
Prediction of Current Annual GDP Growth

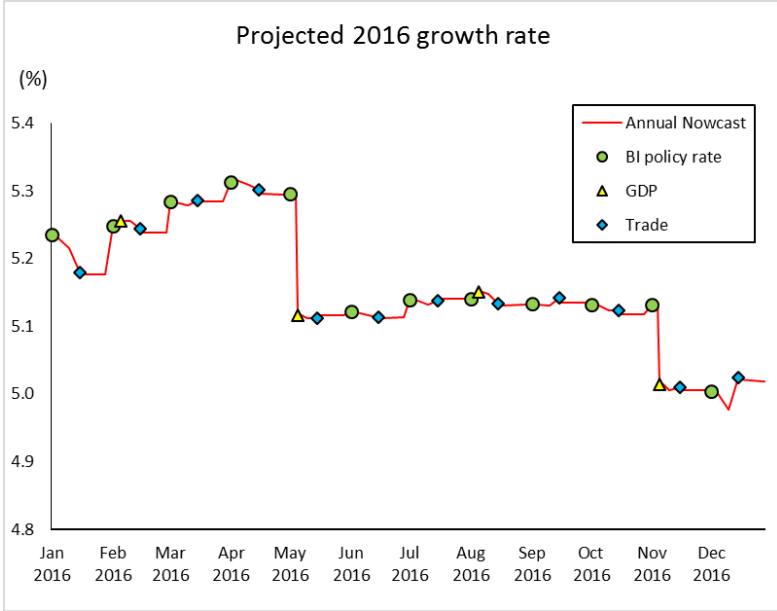
Root Mean Squared Error at each month

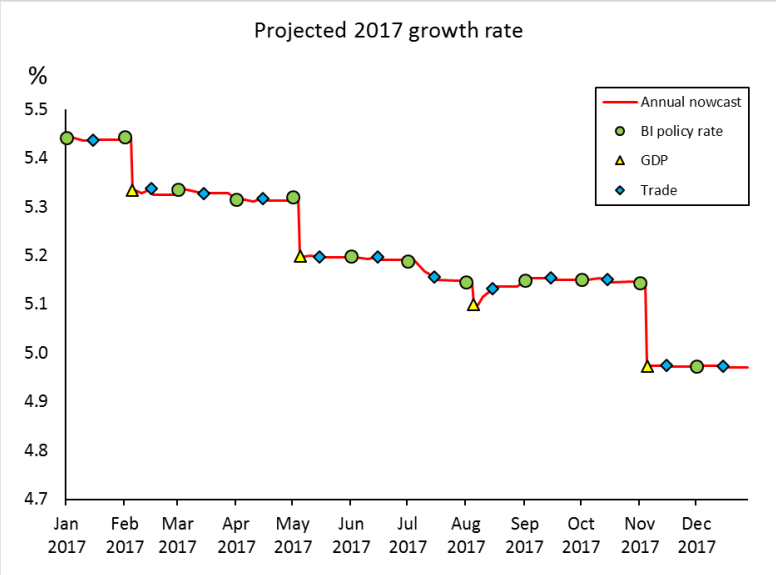


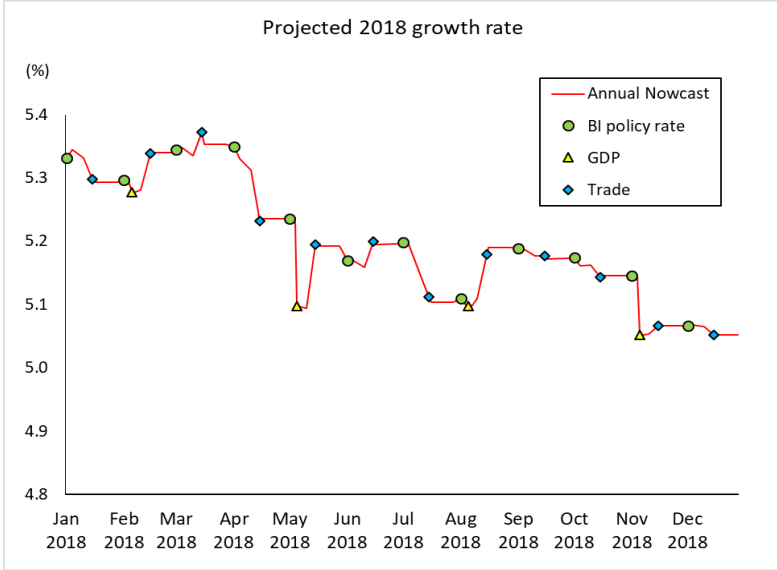
How it can be useful

Tracking changes in growth momentum

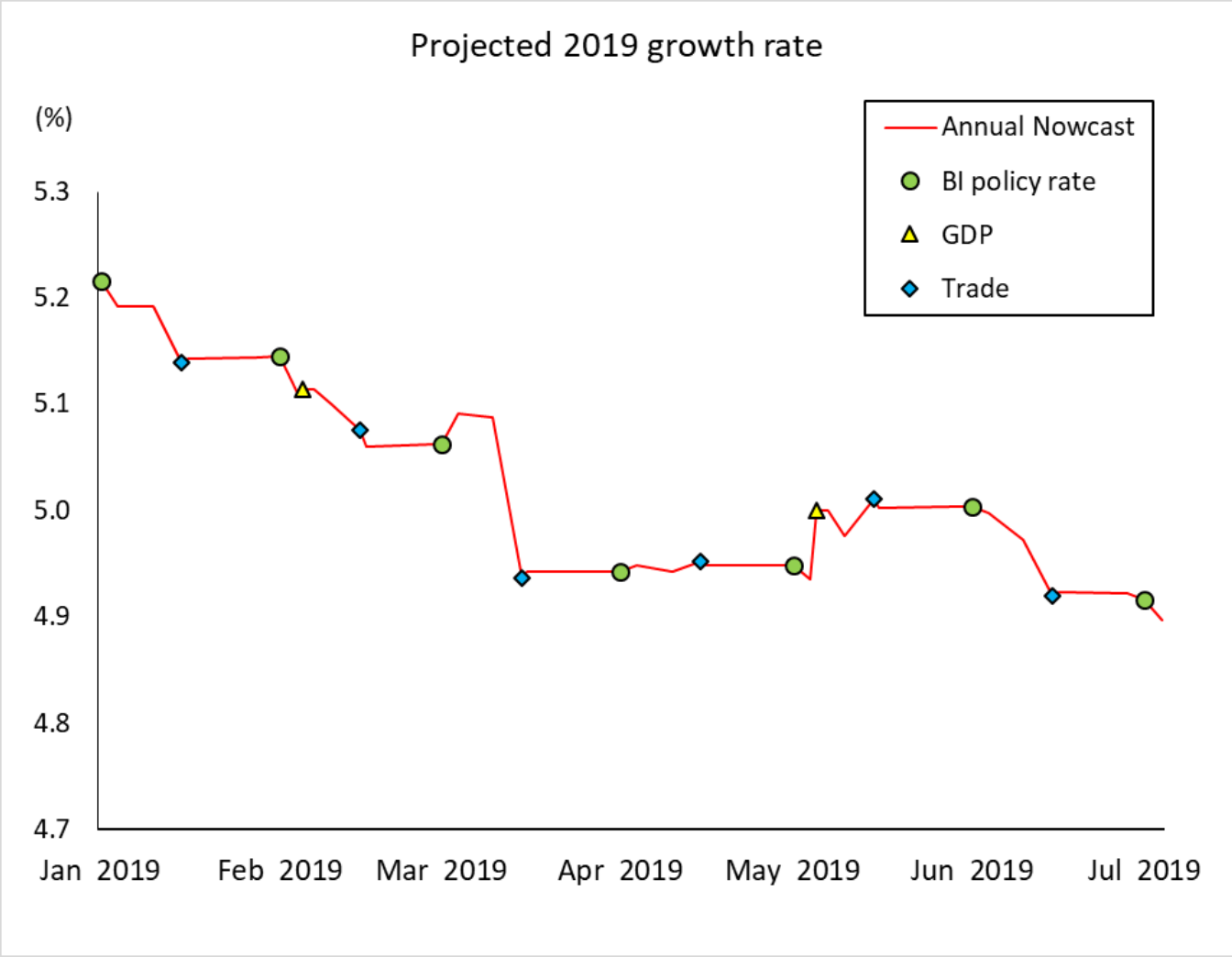








Projected growth rate: 2019



Tracking changes in the data/data revisions

Reference Quarter	Day Prediction	9 June dataset	21 June dataset	Cement	Exports	Import: Consumption on goods	Imports: Capital goods	Imports: Raw materials	Car sales	Indicator Monitored	Period
03/2017	01 Mar 2017	5.34	5.41	5.34	5.34	5.39	5.39	5.41	5.41	BI rate	02/2017
03/2017	04 Mar 2017	5.35	5.41	5.35	5.35	5.39	5.39	5.41	5.41	PMI EM	02/2017
03/2017	10 Mar 2017	5.33	5.40	5.33	5.33	5.38	5.38	5.40	5.40	Cement	02/2017
03/2017	15 Mar 2017	5.32	5.40	5.32	5.32	5.37	5.37	5.40	5.40	Trade	02/2017
03/2017	16 Mar 2017	5.33	5.40	5.33	5.33	5.37	5.37	5.40	5.40	Car sales	02/2017
03/2017	28 Mar 2017	5.33	5.40	5.33	5.33	5.37	5.37	5.40	5.40	M2	02/2017
06/2017	01 Apr 2017	5.30	5.37	5.30	5.30	5.34	5.34	5.37	5.37	BI rate	03/2017
06/2017	04 Apr 2017	5.30	5.37	5.30	5.30	5.34	5.34	5.37	5.37	PMI EM	03/2017
06/2017	10 Apr 2017	5.29	5.36	5.29	5.29	5.33	5.33	5.36	5.36	Cement	03/2017
06/2017	15 Apr 2017	5.31	5.37	5.31	5.31	5.35	5.35	5.37	5.37	Trade	03/2017
06/2017	16 Apr 2017	5.30	5.36	5.30	5.30	5.34	5.34	5.36	5.36	Car sales	03/2017
06/2017	28 Apr 2017	5.30	5.36	5.30	5.30	5.34	5.34	5.36	5.36	M2	03/2017
06/2017	01 May 2017	5.30	5.37	5.30	5.30	5.35	5.35	5.37	5.37	BI rate	04/2017
06/2017	04 May 2017	5.30	5.37	5.30	5.30	5.34	5.34	5.37	5.37	PMI EM	04/2017
06/2017	05 May 2017	5.17	5.24	5.17	5.17	5.22	5.22	5.24	5.24	GDP	03/2017
06/2017	07 May 2017	5.17	5.24	5.17	5.17	5.22	5.22	5.24	5.24	BTI	03/2017
06/2017	10 May 2017	5.18	5.24	5.18	5.18	5.22	5.22	5.24	5.24	Cement	04/2017
06/2017	15 May 2017	5.17	5.24	5.17	5.17	5.22	5.22	5.24	5.24	Trade	04/2017
06/2017	16 May 2017	5.17	5.24	5.17	5.17	5.21	5.21	5.24	5.24	Car sales	04/2017
06/2017	28 May 2017	5.17	5.24	5.17	5.17	5.21	5.21	5.24	5.24	M2	04/2017
06/2017	01 Jun 2017	5.18	5.24	5.18	5.18	5.22	5.22	5.24	5.24	BI rate	05/2017
06/2017	04 Jun 2017	5.16	5.23	5.16	5.16	5.20	5.20	5.23	5.23	PMI EM	05/2017
06/2017	10 Jun 2017		5.23	5.16	5.16	5.20	5.20	5.23	5.23	Cement	05/2017
06/2017	15 Jun 2017		5.24		5.21	5.23	5.23	5.24	5.24	Trade	05/2017
06/2017	16 Jun 2017		5.23						5.23	Car sales	05/2017

Users (nowcasting framework for Indonesia)

- ADB
- National planning agency of the Republic of Indonesia
- Ministry of Finance – Fiscal policy office

Thank you!