Do global output gaps help forecast inflation in Russia?

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February 17, 2022

Overview

Key goal

assess the role of **global output gap** in **forecasting** CPI in Russia.

General approach

- **pairwise comparison** of **domestic** and **global** Hybrid New Keynesian **Phillips curve** specifications in terms of their
  1. Root Mean Square Error
  2. absolute error at each date of out-of-sample forecasts
- robustness to **model specification** and the choice of **proxies** for **global** and **domestic output gaps**

Globalisation and inflation: some intuitive channels

Rogoff (2003):

"globalization - interacting with deregulation and privatization - has played a strong supporting role in the past decade's disinflation."

Bean (2006):

globalisation $\Rightarrow$ competition and outsourcing in world labour market
$\Rightarrow$ decreased wage bills $\Rightarrow$ *inflation* $\downarrow$
OR
$\Rightarrow$ cheapening imports $\Rightarrow$ income effect $\Rightarrow$ domestic spending $\uparrow \Rightarrow$ *inflation* $\uparrow$

Globalisation and the Philips curve as the policymakers' research agenda *(Bean, 2006; Fisher, 2006; Kohn, 2006; Yellen, 2006; Yellen and Gang, 2008; White, 2008)*

Globalisation and inflation: literature

- **"Global gap matters"**
  Panel studies: Borio and Filardo (2007), Forbes (2019), Jašová, Moessner, Takáts (2020), Manopimoke et al (2015), A. Auer, Levchenko, and Sauré (2019) *(industry-level)*
  VAR: Bobeica and Jarocinski (2017)(EU and US), Milani (2009) (US),
- **"Global gap useless"**
  Panel studies: Ball(2006), Ihrig et al. (2010), Mikolajun and Lodge (2016)
  Single country study (Poland): Łyziak (2019)

Specifications of the Philips curve in the literature

Borio and Filardo (2007) (panel study)

$$\pi_t - \pi_t^{trend} = c + \gamma^{dom} gap_{t-1}^{dom} + \gamma^{world} gap_{t-1}^{world} + \sum_{i=1}^{n} \delta_i external_{i,t-1} + \epsilon_t \quad (1)$$

Mikolajun and Lodge (2016) (panel study)

$$\pi_t = \alpha + \beta \pi_t^e + \gamma^{dom} gap_t^{dom} + \gamma^{world} gap_t^{world} + \sum_{i=1}^{n} \delta_i external_{i,t} + \epsilon_t \quad (2)$$

Łyziak (2019) (Poland study)

$$\pi_t = \alpha + \beta \pi_t^e + \gamma^{dom} gap_t^{dom} + \gamma^{world} gap_t^{world} + \epsilon_t \quad (3)$$

Methodology: my specifications

The family of specifications

$$\pi_{t+h} = \alpha + \sum_{i=1}^{l+h} \beta_i^{inf} \pi_{t+h-i} + \sum_{i=1}^{l+h} \beta_i^{exp} \pi_{t+h-i}^{e} + \sum_{i=1}^{l+h} \beta_i^{\pi\ imp} \pi_{t+h-l}^{imp} + \sum_{i=1}^{l+h} \gamma_i^{dom} gap_{t+h-i}^{dom} + \sum_{i=1}^{n} \delta_i ext_{i,t-1} + \epsilon_t$$

- only complete lag polynomials

Methodology: assessment of forecast improvement

All analysis is based on the comparison of pairs

Formation of pairs

$$\pi_{t+h} = \alpha + \sum_{i=1}^{l+h} \beta_i^{inf} \pi_{t+h-i} + \sum_{i=1}^{l+h} \beta_i^{exp} \pi_{t+h-i}^{e} + \sum_{i=1}^{l+h} \beta_i^{\pi\ imp}\ \pi_{t+h-l}^{imp} + \sum_{i=1}^{l+h} \gamma_i^{dom} gap_{t+h-i}^{dom} + \sum_{i=1}^{n} \delta_i ext_{i,t-1} + \sum_{i=1}^{l+h} \gamma_i^{glob} gap_{t+h-i}^{glob} + \epsilon_t$$

- total number of models = number of domestic models × number of global gap measures × *maxlag*

Methodology: estimation using OLS on 2002 Q2 - 2020 Q2

- Expanding window one-step-ahead forecast from 2009 Q4
- Rolling window one-step-ahead forecast
  - from 2007 Q2 (20 obs. length)
  - from 2009 Q4 (30 obs. length)
  - from 2013 Q3 (45 obs. length)

Methodology: assessment of forecast improvement

Graphical analysis:

- the distributions of RMSE, computed in an expanding window starting from 30 obs, model re-estimated at each step
- the distributions of models' errors in time

Regressional analysis:

- Romer and Romer (2000) test - a nested simplified version of Diebold-Mariano test
- dummy regressions of the models' errors on the models' variables to single out each one's marginal contribution

Domestic data

- **Inflation** (π_t) SA quarter-on-quarter CPI
- **Inflationary expectations** (π_t^e) survey of entrepreneurs by the Bank of Russia [1].
- **Imported inflation** (π_t^{imp}) HP-filter gap of real broad effective exchange rate [2].
- **Domestic output gap** (gap_t^{dom})
  - HP-filter GDP gap
  - Cargo index
  - Capacity utilisation
  - PMI Composite Russia

[1] http://old.cbr.ru/dkp/surveys/inflation
[2] https://fred.stlouisfed.org/series/RBRUBIS

Measures of the global output gap

1. **OECD gap** interpolated from annual to quarterly using cubic splines (as in the literature)

2. **Trade-weighted gap** (à la Borio and Filardo (2007)) .

$$trade\ gap_t = \sum_{i=1}^{countries} w_{it} gap_{it}^{real\ GDP\ HP\ filter} \tag{4}$$

3. **Kilian Index of Global Economic Activity**[3] derived from global bulk dry cargo shipping rates - a proxy for the volume of shipping in global industrial commodity markets
4. **Baltic Exchange Dry Index (BDI)** [4] proxy for dry bulk shipping stocks as well as a general shipping market bellwether

[3] https://www.dallasfed.org/research/igrea
[4] https://www.bloomberg.com/quote/BDIY:IND

Trade gap composition: annual share used for each quarter

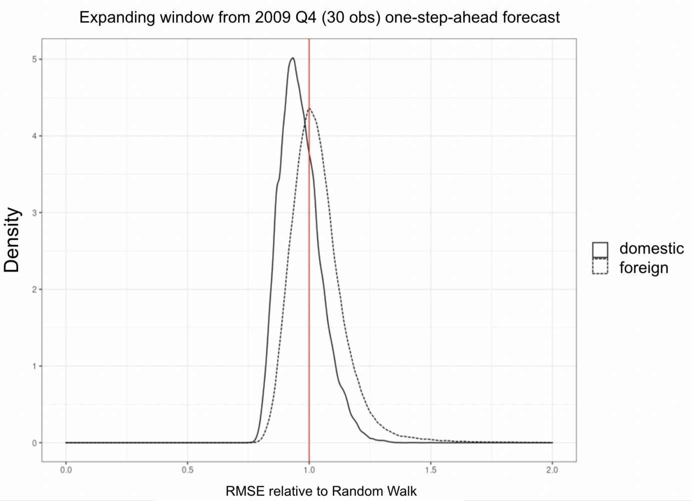
trade partner	average share of trade			
	2002-2008	2009-2015	2016-2019	2002-2019
China	13,69%	11,91%	12,03%	13,95%
Germany	10,33%	12,28%	9,87%	12,63%
Netherlands	9,25%	14,16%	21,80%	10,99%
Italy	9,33%	8,30%	5,69%	8,12%
Belarus	8,43%	6,53%	2,98%	7,07%
Ukraine	7,91%	6,14%	7,24%	6,48%
Turkey	5,16%	5,58%	5,24%	5,34%
US	4,10%	5,09%	4,50%	5,26%
Japan	4,79%	4,38%	4,07%	4,57%
Poland	5,27%	5,04%	5,61%	4,47%
France	4,52%	3,53%	3,19%	4,05%
Kazakhstan	4,19%	3,80%	4,06%	4,01%
UK	4,28%	4,05%	3,63%	3,84%
Korea	4,38%	3,11%	2,92%	3,76%
Finland	2,77%	4,10%	4,89%	3,56%
Belgium	1,59%	1,98%	2,29%	1,90%

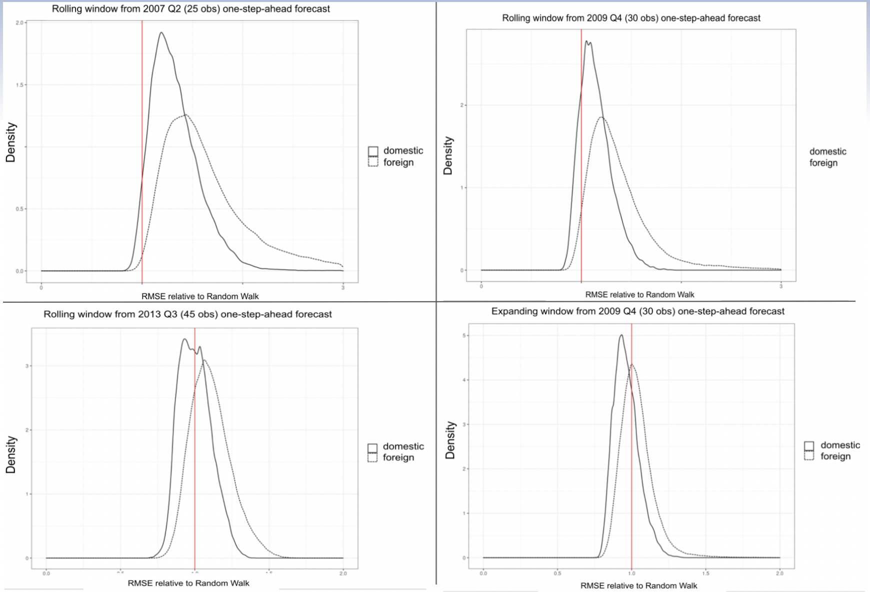
Conventional global variables apart from the global gap

Conventional global variables such as those commonly encountered in open-economy Philips curves. My choice of measures:

- Urals oil price
- Bloomberg Commodity Index (BCOM)

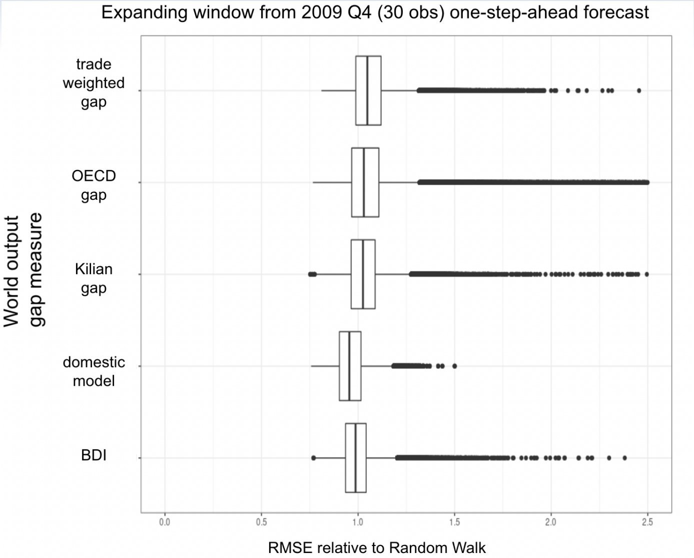
Total RMSE: domestic vs global, expanding from 2009 Q4

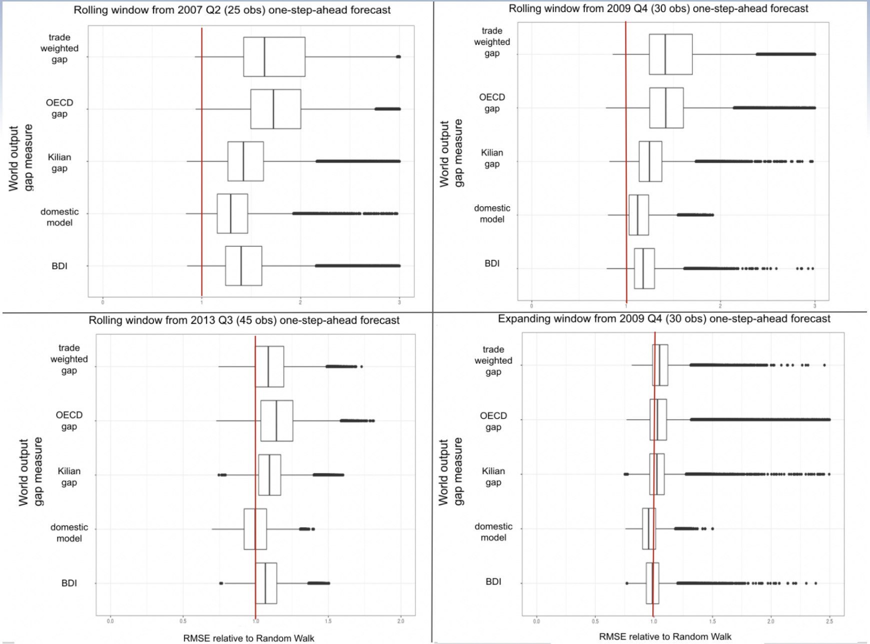


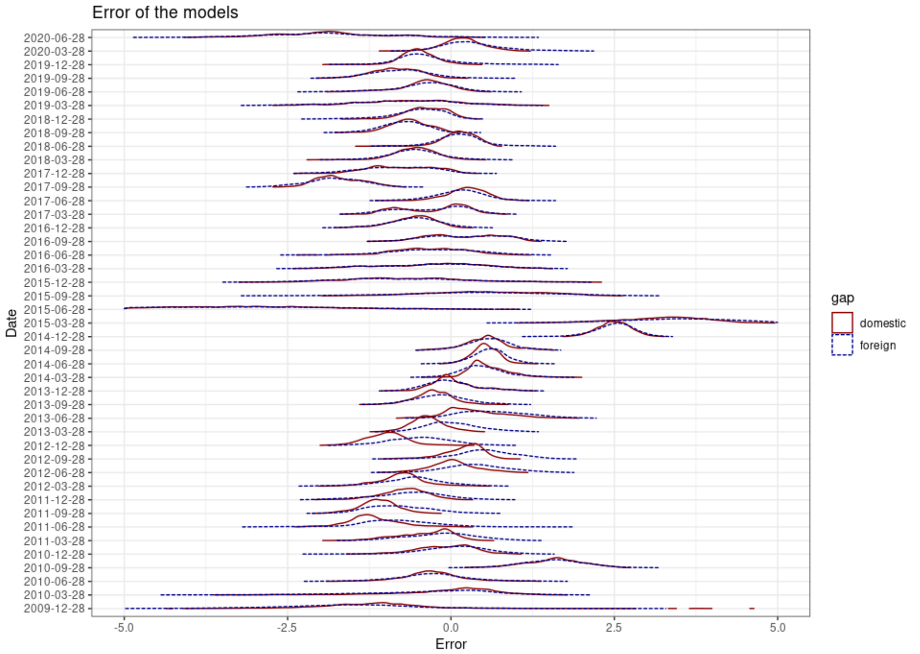


Rolling window from 2007 Q2 (25 obs) one-step-ahead forecast
Density
domestic
foreign
RMSE relative to Random Walk
Rolling window from 2009 Q4 (30 obs) one-step-ahead forecast
Density
domestic
foreign
RMSE relative to Random Walk
Rolling window from 2013 Q3 (45 obs) one-step-ahead forecast
Density
domestic
foreign
RMSE relative to Random Walk
Expanding window from 2009 Q4 (30 obs) one-step-ahead forecast
Density
domestic
foreign
RMSE relative to Random Walk

RMSE by gap type: expanding from 2009 Q4




Rolling window from 2007 Q2 (25 obs) one-step-ahead forecast
Rolling window from 2009 Q4 (30 obs) one-step-ahead forecast
Rolling window from 2013 Q3 (45 obs) one-step-ahead forecast
Expanding window from 2009 Q4 (30 obs) one-step-ahead forecast
World output gap measure
trade weighted gap
OECD gap
Kilian gap
domestic model
BDI
RMSE relative to Random Walk


Error of the models
Date
2020-06-28
2020-03-28
2019-12-28
2019-09-28
2019-06-28
2019-03-28
2018-12-28
2018-09-28
2018-06-28
2018-03-28
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2011-03-28
2010-12-28
2010-09-28
2010-06-28
2010-03-28
2009-12-28
-5.0
-2.5
0.0
2.5
5.0
Error
gap
domestic
foreign

Romer and Romer test

Used by Łyziak (2019), suggested by Faust and Wright (2013) as a simple version of Diebold Mariano for nested models

$$
\begin{aligned}
(e_t^{domestic})^2 - (e_t^{global})^2 &= \alpha + \epsilon_t \\
H_0 : \alpha &= 0
\end{aligned}
\tag{5}
$$

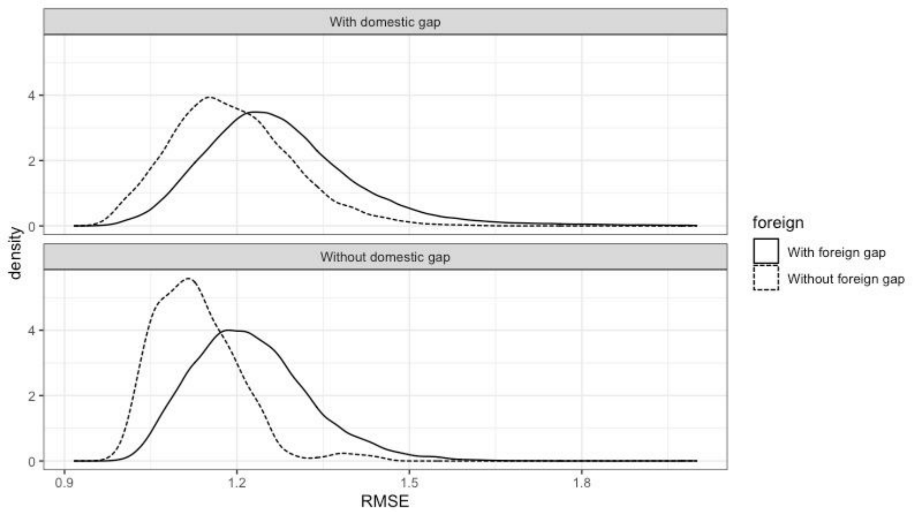
Results of Romers' test

The highest proportion of the global models that significantly outperform the domestic ones was 4.8 % for the case when

- global gap: BDI AR(3)
- commodities measure: Urals oil price
- domestic output gap: PMI Russia

Which is 100 models in total.

Total RMSE: gap or no gap?



If not the gap, then what? Dummy regression method of predictor analysis

The dummy regression

$$RMSE = \alpha + \sum_{i=1}^{l+h} dummy_i^{inf}\gamma_i^{inf} + \sum_{i=1}^{l+h} dummy_i^{exp}\gamma_i^{exp} + \sum_{i=1}^{l+h} dummy_i^{\pi\ imp}\gamma_i^{\pi\ imp} + \sum_{i=1}^{l+h} dummy_i^{dom}\gamma_i^{dom} + \sum_{i=1}^{l+h} dummy_i^{glob}\gamma_i^{glob} + \epsilon_t$$

Best predictors according to the dummy regression

predictor	coefficient
capacity utilisation AR(2)	-0.023*** (0.002)
capacity utilisation AR(3)	-0.046*** (0.002)
capacity utilisation AR(4)	-0.023*** (0.002)
real effective exchange rate (HP-filter gap) AR(2)	-0.008*** (0.001)
expectations AR(1)	-0.040*** (0.001)
expectations AR(2)	-0.034*** (0.001)
Observations	325,125
R^2	0.983
Adjusted R^2	0.983
Residual Std. Error (df = 325072)	0.169
F Statistic (df = 53; 325072)	352,747.600***

Dummy regression results when controlled for the forecast date

predictor	coefficient
capacity utilisation AR(3)	-0.002(0.004)
real effective exchange rate (HP-filter gap) AR(2)	-0.016*** (0.004)
expectations AR(1)	-0.046*** (0.004)
Observations	13,980,375
R^2	0.780
Adjusted R^2	0.780
Residual Std. Error	0.606 (df = 13980257)
F Statistic	419,497.700*** (df = 118; 13980257)

Conclusion and key findings

Do global output gaps improve CPI forecast accuracy?

- Overall, they worsen it. Yet in some years and some specifications they do improve it.
- Domestic output gaps worsen forecast accuracy, except for the capacity utililsation measure.
- Inflation expectations, real effective exchange rate gap, and capacity utilisation improve it, even in the times of crises, when the errors of all models increase dramatically.