Multiregional I-O Model: Baseline Scenario and Checking of Results Accuracy
Main principles of regional economic dynamics forecasting

• The macroeconomic dynamic of Russia and external economic conditions are taken into account

• The system of interregional and interindustry interactions is used

• Taking into account the specific features of regional industry

• Balancing of indicators at country level, Federal Districts and regions
Federal Districts of Russian Federation
Stages of the forecast of the Russian economy development

Forecast of Russian Ministry of Economic Development

- World economy
- Russian economy
- Interindustry structure of economy
- Regional economy

- System of production functions for world’s main economies
- Macroeconomic model of Russia
- Russian Interindustry model (RIM)
- System of regional models

Additional scenario conditions
The scheme of interrelations of macroeconomic indicators (regional level)

- GDP estimation at national level
- Investment by industries at national level
- Capital intensity by industries at national level
- Investment by industries at Federal Districts level
- Capital intensity by industries at Federal Districts level
- Investment by industries at regional level
- Capital intensity by industries at regional level

**GRP calculation**
- GRP for regional level: \( GRP = \sum (\text{investment}_i / \text{capital intensity}_i) \)
- GRP at Federal Districts level: \( GRP = \sum (\text{investment}_i / \text{capital intensity}_i) \)

**Decrease of capital intensity gap**
- Between national and Federal Districts levels
- Between Federal Districts and regions

**Balancing**
- Exogenous indicators
  - Calculation at national level
  - Calculation at regional level

**Structure of investment distribution**
- Between Federal Districts
- Between regions
Evaluation of GRP by production method and GDP by using method

**GRP by production method**

1. Changes of GRP structure by industries at Federal Districts level
2. GVA by industries at Federal Districts level
3. Gross output by industries at Federal Districts level
4. Gross output by industries at regional level
5. GVA by industries at regional level
6. Changes in GRP structure by industries at regional level

**GRP at Federal Districts level**

- Households consumption at Federal Districts level
- Investment at Federal Districts level
- Government expenditures at Federal Districts level
- Social transfers at Federal Districts level
- Export-Import Balance at Federal Districts level

**GRP by using method**

- Transportation of goods by railway transport
- Transportation of goods by cargo transport
- Output of Agriculture
- Output of Construction
- Output of Mining
- Industrial Production Index
- Personal disposable incomes and expenditures per capita
- Retail trade turnover
- Passengers transportations by buses

**GRP at regional level**

- Households consumption at regional level
- Investment at regional level
- Government expenditures at regional level
- Social transfers at regional level
- Export-Import Balance at regional level
Main estimated indicators

• GDP by economic activity
• GDP by expenditure (household consumption, public consumption, capital formation, net export)
• Gross output by industry (industrial economic activities)
• Personal incomes and expenditures
• Employment
• Balance of Electricity production and use
• Other indicators
Update and correction of forecast results

Forecast of Ministry of Economic Development

Update of macroeconomic and industry data (Russian Federal State Statistics Service - ROSSTAT)

Correction of regional data

New scenario conditions of forecast of Ministry of Economic Development

Correction of forecast indicators by industry made in year t-1

Update forecast of Ministry of Economic Development

Forecast estimations of industry indicators for national and regional levels

New forecast estimations of industry indicators for national and regional levels
Method of evaluation of “tolerant” levels of errors

**Tolerant level of forecast error = RST + AVERAGE (K1; K2; K3; K4), where:**

- RST – indicator defining accuracy of statistic data (difference between the first and the last estimations for each indicator for the same period published by ROSSTAT)

- K1 и K2 – the volatility of the estimated indicators on reporting data for 2008-2018:

  \[
  K1 = (\text{maximum} – \text{average})/ \text{average} \\
  K2 = (\text{average} – \text{minimum}) / \text{average}
  \]

- K3 for 1 year – value of error for the first estimated year (for model version of 2016)
- K3 for 2 years – value of error for the second estimated year (for model version of 2016)

- K4 for 1 year – value of error for the first estimated year (for model version of 2017)
- K4 for 2 years – value of error for the second estimated year (for model version of 2017)

<table>
<thead>
<tr>
<th>Retail trade turnover, real growth % to the previous year</th>
<th>RST</th>
<th>K1</th>
<th>K2</th>
<th>K3</th>
<th>K3</th>
<th>K4</th>
<th>Acceptable error level (for the 1\textsuperscript{st} estimated year)</th>
<th>Acceptable error level (for the 2\textsuperscript{nd} estimated year)</th>
</tr>
</thead>
</table>
## Acceptable level of forecasting accuracy

<table>
<thead>
<tr>
<th>Category</th>
<th>Acceptable error level (for the 1&lt;sup&gt;st&lt;/sup&gt; estimated year)</th>
<th>Acceptable error level (for the 2&lt;sup&gt;nd&lt;/sup&gt; estimated year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail trade turnover</td>
<td>1,0 p.p.</td>
<td>2,3 p.p.</td>
</tr>
<tr>
<td>Output of Agriculture</td>
<td>1,0 p.p.</td>
<td>1,8 p.p.</td>
</tr>
<tr>
<td>Output of Mining</td>
<td>1,1 p.p.</td>
<td>1,1 p.p.</td>
</tr>
<tr>
<td>Population, mln. Persons</td>
<td>1,3%</td>
<td>1,4%</td>
</tr>
<tr>
<td>Transportation of goods by railway transport</td>
<td>1,4%</td>
<td>1,4%</td>
</tr>
</tbody>
</table>
The quality of forecasting is acceptable: forecast error was below the acceptable level for each version of model, except for the forecast version of May, 2018.

High forecast in May 2018 was based on the reporting data: in February-April 2018 the disposable income increased by 4% year to year.

Forecast error was caused by the incorrect statistics for January-September, 2018 (income dynamics data were revised by ROSSTAT in February 2019 decreasing by 0.9 p.p.).
Retail trade turnover
(real growth rate in % to the previous year, forecast at national level)

For the dynamics of retail turnover the forecast quality remains stably high: forecast deviation from ROSSTAT report data for 2018 was below the acceptable level, decreasing at each iteration.

Forecast error was caused by the deviation of the exogenous parameters of the dollar-to-ruble exchange rate and inflation from the actual value for 2018.
Number of regions where the forecast error exceeded the tolerant value (left scale)
Average error, p.p. (right scale)

- Number of regions for which the forecast was made: 80
- Number of regions for which the forecast exceeded the actual value: 43
- Number of regions for which the forecast was lower than the actual value: 37
- Number of regions for which the forecast exceeded the actual value by more than the acceptable error level: 1
- Number of regions for which the forecast was lower than the actual value by more than the acceptable error level: 3
- Number of regions for which ROSSTAT’s actual statistics for January-October 2018 were revised: 29

The forecast quality was increasing at each iteration: the latest version of the model contains only 4 regions with forecast error beyond the acceptable level.

The average error decreased by 1.3 p.p.

The regions where the error exceeded the acceptable level accounted only to 4% from the total value of the retail turnover in Russia.
Output of Mining
(real growth rate in % to the previous year, forecast for national level)

The forecast quality is considered acceptable: the forecast deviation from ROSSTAT report for the year 2018 was below the acceptable level in the latest version of the model.

Forecast error was caused by the increased volatility of the indicator. For example, at the 4th quarter of 2018 the output increased by 7.2% year to year, this is an absolute record for the last 15 years. Though, the dynamics during the 1st six months did not exceed 2%.
At regional level the forecast quality increased: the forecast version dated December 2018 shows a decrease in the average error and the number of regions for which the error exceeded the acceptable level.

Despite a significant number of regions where the error exceed the acceptable level, totally they account for less than 17% of the total output of Mining for the Russian Federation in general.

1/3 part of the error occurred in 7 regions which total output of the mining sector amounts to 0.1% of the total Russian output. It is a small value of mining in these regions causes the high volatility of this indicator and high forecast deviation from the fact.
Limits for forecast deviations from the actual data were not defined for the industrial production index.

However, a decrease in the average error indicates that the quality of the forecast has been improved.

In general, for 4 iterations the forecast quality has been improved in 73 regions. 25% of the average error occurred in 7 regions, where the total industrial production volume amounts to 6% of the total national output. Small production volume in most of these regions leads to the high volatility of the indicator.
• Multilevel system of the regional development allows obtaining the forecasts development for each of the federal districts and regions balanced at all levels

• Complexity of model system gave us the idea to check the forecast accuracy in order to improve the results in next model version

• Checking forecast accuracy requires a lot of efforts especially for the regional forecasts due to their amount. However, this procedure did allow us to improve the results

• The main problem that we faced – inaccuracy of the current statistics of ROSSTAT: the data was re-estimated for a number of indicators, while in some cases the changes were of a fundamental nature (for example, an increase in the dynamics of construction output by 6 p.p.). Nevertheless, we expect it is a temporary problem caused by the changes in the statistical methods
Thanks for your attention!