Long-term forecast of Russian Economy
(using Russian Interindustry Model RIM)

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Institute of Economic Forecasting
September, 2014
Outline

- Index – About RIM model
- Data and statistical base
- Current progress in RIM
- General structure of Model
  1. Budget and fiscal block
  2. Investments and capital stock
  3. Employment
- Some forecast results

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Russian Interindustry Model

- 44 sectors
- I-O data are available for 1980-2010
- Real and nominal sides
- Using G7 and PortableDyme
- Model construction hasn’t been finished yet
Data base prepared by Marat Uzyakov and researches from the Institute of Economic Forecasting:

- Input-Output Tables: 1980-2010 (constant and current prices)
- Matrixes of trade and transport margins
- Tax matrix
- Import matrix
- Production capacity balances and sector investment
Data base - 2

Data from Russian Statistics Service, Ministry of Finances, the Central Bank etc.:

- National accounts (2002-2012)
- Institutional accounts (2002-2009)
- Consolidated budget data (including Pension fund)
- Demography and employment indicators
- Balance of payments
- Energy resources production data
- Prices data
- Exchange rates and money statistics
Current progress in RIM

Present version:
Real side:
• personal consumption
• government consumption
• investment and capital stock
• exports and imports
• energy block
• employment
Nominal side:
• budget and fiscal block
• value-added by sectors
• prices by sectors

Under construction:
• financial block
• balance of payments
• modeling of demography indicators
What’s new from the last INFORUM Conference?

Real side of Model:

✓ Personal consumption estimates with use of saturation level

✓ Elaborated investment regressions

✓ Two-bucket system for calculation of capital stock

✓ New estimates for sector employment with use of production functions

Nominal side of Model:

✓ Calculations of net taxes on production and taxes on products used by sector
General structure of Model

Estimation of final demand in constant prices
FD = PerCons + PubCons + Invest + Inventories + Exports - Imports

Estimation of gross output by solving Leontief model
A*OUT + FD = OUT

Solution of Leontief price model
p*(A*OUT) + VA = p*OUT

Nominal side: estimation of incomes of population, business and government. Calculating of deflators to obtain consumption in current prices

Estimation of value added
VA = f (OUT in current prices, …)
Budget and fiscal block - 1

Main identity:
net taxes on products used = taxes paid - subsidies

Regression:
net taxes_{i} = a \times (A_{7i} + A_{11i} + A_{24i}) + b \times export_{i} + \\
+ c \times (import \ used_{i}) + \\
+ d \times \text{VAT}_{i} + e \times \text{BudgetExpenses}

i – sector number
(A_{7i} + A_{11i} + A_{24i}) – intermediate consumption of excise goods by sector i

import \ used_{i} = \sum_{k} \text{ImportMatrix}_{ki}

\text{VAT}_{i} = \text{VATReceived}_{i} - \text{VATpaid}_{i} = \text{VATrate}_{i} \times \text{OUT}_{i} - \\
- (\sum_{k} \text{VATrate}_{k} \times \text{OUT}_{ki}) - \text{VATrate}_{i} \times \text{Export}_{i}
### 1 Agriculture - Net taxes on products used

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Reg-Coef</th>
<th>Mexval</th>
<th>Elas</th>
<th>NorRes</th>
<th>Mean</th>
<th>Beta</th>
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<tbody>
<tr>
<td>0 tax1</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>1 A7,1 + A11,1 + A24,1</td>
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<td>1.02</td>
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<td>5 import used1</td>
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<td>0.28</td>
<td>1.00</td>
<td>57565.08</td>
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</table>

**Taxes on products used**

1 Agriculture

![Graph showing predicted and actual values](image-url)
Main identity:

net taxes on production = taxes paid – subsidies

Regression:

\[ \text{net taxes}_i = a \times \text{OUT}_i + b \times \text{capstock}_i \times \text{GDP deflator} + c \times \text{BudgetExpenses} \]

\( i \) – sector number (except \( i = 2, 3 \))

For \( i=2 \) (Petroleum extraction):
\[ \text{taxes}_2 = a \times \text{tax rate}_2 \times \text{oil extraction} \]
\[ \text{tax rate}_2 = 493 \times (\text{Urals Crude Oil price -15}) \times \text{rateusd}/261 \]

For \( i=3 \) (Natural gas extraction):
\[ \text{taxes}_3 = a \times \text{tax rate}_3 \times \text{gas extraction} \]
\[ \text{tax rate}_3 = 700 \text{ rubles/1 billion m}^3 \]
19 Machinery – Net taxes on production

SEE = 109.43  RSQ = 0.9682  RHO = -0.57  Obser = 6 from 2003.000
SEE+1 = 88.83  RBSQ = 0.9470  DW = 3.13  DoFree = 3 to 2010.000
MAPE = 2.95

<table>
<thead>
<tr>
<th>Variable name</th>
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<th>Mexval</th>
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<th>NorRes</th>
<th>Mean</th>
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<tr>
<td>0 b.taxo19</td>
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<td>2746.53</td>
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<tr>
<td>1 intercept</td>
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<td>2 out19</td>
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<td>3 capstock19*def</td>
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<td>922.50</td>
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capinv_i = a \times \left( \frac{output_i}{capstock_i} \right) + 
+ b \times profit_i + c \times credits_i + 
+ d \times capinv_i \ [t-1] + 
+ e \times @pos (OUT_i – peakOUT_i)

output/capstock – ratio of usage of capital stock
credits – cumulative credits received divided by GDP deflator (level of debt load)
peakOUT – maximum sector output for years 1,…,t-1
### Agriculture - Investments in capital stock

**SEE** = 23.96  **RSQ** = 0.9330  **RHO** = 0.15  **Obser** = 9 from 2002.000

**SEE+1** = 24.22  **RBSQ** = 0.8928  **DW** = 1.70  **DoFree** = 5 to 2010.000

**MAPE** = 7.15

<table>
<thead>
<tr>
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<th>Reg-Coef</th>
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<th>Elas</th>
<th>NorRes</th>
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<tr>
<td>0 capinv1</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>1 OUT1 – peakOUT1</td>
<td>0.00038</td>
<td>59.0</td>
<td>0.12</td>
<td>58.50</td>
<td>97090.67</td>
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<tr>
<td>2 profit</td>
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<td>109.2</td>
<td>0.77</td>
<td>3.56</td>
<td>133.18</td>
<td>1.071</td>
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<tr>
<td>3 OUT1 / capstock1</td>
<td>0.01457</td>
<td>38.0</td>
<td>0.20</td>
<td>1.15</td>
<td>4160.60</td>
<td>0.103</td>
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<tr>
<td>4 (credits)/def</td>
<td>-42.88828</td>
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<td>-0.09</td>
<td>1.00</td>
<td>0.65</td>
<td>-0.248</td>
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Investment and capital stock - 3

Расчет объема используемого основного капитала будем производить на основе системы “cascading two-bucket system”:

- **Investment**
  - capstock1
    - capstock1 – undepreciated capital
    - Depreciation1 = depreciation ratio * capstock1
  - capstock2
    - capstock2 – equipment in use after it’s depreciated
    - Depreciation2 = depreciation ratio * capstock2
Two-bucket system for estimating capital stock by sector:

\[
\text{ub1} = @\text{cum}(\text{ub1}, 1, R_i)
\]
\[
\text{a} = @\exp(\text{embTech}_i(t))
\]
\[
\text{capstock1}_i = @\text{cum}(\text{cuminv1}_i, a, \text{capinv}_i, R_i) / \text{ub1}
\]
\[
\text{capstock2}_i = @\text{cum}(\text{cuminv2}_i, \text{capstock1}_i, R_i)/\text{ub1}
\]
\[
\text{capstock}_i = \text{capstock1}_i + \text{capstock2}_i
\]

R – depreciation ratio

\text{embTech} – rate of growth productivity embodied in capital
R – depreciation ratio (the 3rd column)
embTech – rate of growth productivity embodied in capital (the 2nd column)

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>embTech</th>
<th>Industry</th>
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<tbody>
<tr>
<td>1</td>
<td>0.05</td>
<td>0.15</td>
<td>&quot;Agriculture&quot;</td>
</tr>
<tr>
<td>2</td>
<td>0.05</td>
<td>0.15</td>
<td>&quot;Petroleum extraction&quot;</td>
</tr>
<tr>
<td>3</td>
<td>0.00</td>
<td>0.15</td>
<td>&quot;Natural gas extraction&quot;</td>
</tr>
<tr>
<td>4</td>
<td>0.05</td>
<td>0.15</td>
<td>&quot;Coal mining&quot;</td>
</tr>
<tr>
<td>5</td>
<td>0.05</td>
<td>0.15</td>
<td>&quot;Other Fuels, incl. nuclear&quot;</td>
</tr>
<tr>
<td>6</td>
<td>0.00</td>
<td>0.15</td>
<td>&quot;Ores and other mining&quot;</td>
</tr>
<tr>
<td>7</td>
<td>0.05</td>
<td>0.15</td>
<td>&quot;Food, beverages, tobacco&quot;</td>
</tr>
<tr>
<td>8</td>
<td>0.05</td>
<td>0.15</td>
<td>&quot;Textiles, apparel, leather&quot;</td>
</tr>
<tr>
<td>9</td>
<td>0.05</td>
<td>0.15</td>
<td>&quot;Wood and wood products&quot;</td>
</tr>
<tr>
<td>10</td>
<td>0.00</td>
<td>0.15</td>
<td>&quot;Paper and printing&quot;</td>
</tr>
<tr>
<td>11</td>
<td>0.00</td>
<td>0.15</td>
<td>&quot;Petroleum refining&quot;</td>
</tr>
</tbody>
</table>

... developed by Clopper Almon

... based on results of Ph.D. thesis by Daniel J. Wilson

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Employment - 1

Estimation of sector employment by means of production functions with use of **embodied technical change** (for taking into consideration growth of labor productivity due to appearance of new equipment):

\[ Q(t) = f(L(t), K(t), t) \]

The Cobb-Douglas production function

\[ Q_t = Ae^{rt} L_t^\alpha K_t^{1-\alpha} \]

\( \alpha = 2/3 \) (typical value)

e\( rt \)- disembodied technical change

Regressions are estimated for the following identity:

\[ \log\left(\frac{L}{K}\right) = - \frac{\log A}{\alpha} - \frac{r}{\alpha} t + \frac{1}{\alpha} \log\left(\frac{Q}{K}\right). \]
Employment - 2

1 Agriculture - LOG (L/K)

SEE = 0.08 RSQ = 0.9509 RHO = 0.48 Obser = 11 from 2000.000
SEE+1 = 0.08 RBSQ = 0.9386 DW = 1.04 DoFree = 8 to 2010.000
MAPE = 2.82

Variable name Reg-Coef Mexval Elas NorRes Mean Beta
0 LOG(L/K) - - - - - - - - - - - - - - - 2.35 - - -
1 intercept 66.54471 49.1 28.35 52.15 1.00
2 time -0.03798 63.0 -32.45 33.14 2005.00 -0.328
3 LOG (Q/K) 1.44628 475.6 5.09 1.00 8.27 0.726

Agric : l e "Agriculture"
log(L/K)
Forecast results - 1

Gross output and GDP
in prices of 2008

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Forecast results - 2

Agriculture

Employment and capital stock

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Forecast results - 3

Petro ;2 e "Petroleum extraction"
Employment and capital stock

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Forecast results - 4

Manufacturing
Employment and capital stock

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Forecast results - 5

CompServ ;38 e "Computing service"
Employment and capital stock

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Forecast results - 6

GovInd ;41 e "Government, defense, social insurance"
Employment and capital stock

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Thank you!

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