

# Distinctive Features of the RIM Model of Russia

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## RIM sectors 1-44

|    |                                   |    |  |    |  |
|----|-----------------------------------|----|--|----|--|
| 1  | Agriculture                       | 16 | Ferrous metals                                 | 31 | Trade                                    |
| 2  | Petroleum extraction              | 17 | Non-ferrous metals                             | 32 | Hotels and restaurants                   |
| 3  | Natural gas extraction            | 18 | Fabricated metal products                      | 33 | Transport and storage                    |
| 4  | Coal mining                       | 19 | Machinery                                      | 34 | Communication                            |
| 5  | Other fuels, incl. nuclear        | 20 | Computers, office machinery                    | 35 | Finance and insurance                    |
| 6  | Ore and other mining              | 21 | Electrical apparatus                           | 36 | Real estate                              |
| 7  | Food, beverages, tobacco          | 22 | Radio, television, communication<br>equipment  | 37 | Equipment rental                         |
| 8  | Textiles, apparel, leather        | 23 | Medical, optical, and precision<br>instruments | 38 | Computing service                        |
| 9  | Wood and wood products            | 24 | Automobiles, highway transport<br>equipment    | 39 | Research and development                 |
| 10 | Paper and printing                | 25 | Ships and repair                               | 40 | Other business services                  |
| 11 | Petroleum refining                | 26 | Airplanes, rockets, and repair                 | 41 | Government, defense, social<br>insurance |
| 12 | Chemicals                         | 27 | Railroad equipment and its repair              | 42 | Education                                |
| 13 | Pharmaceuticals                   | 28 | Recycling                                      | 43 | Health services                          |
| 14 | Plastic products                  | 29 | Electric, gas, and water utilities             | 44 | Other social and personal<br>services    |
| 15 | Stone, clay and glass<br>products | 30 | Construction                                   |    |  |

## RIM embodied technological progress



$$Q(t) = f(L(t), K(t), t)$$
$$(1) \quad Q_t = Ae^{rt} L_t^\alpha K_t^{1-\alpha}$$

Q - output  
L - employment  
K - capital stock

$e^{rt}$  - «disembodied» technical change

Divided both sides of (1) by K

$$Q_t/K_t = Ae^{rt} (L_t/K_t)^\alpha$$

solve for (L/K)

$$(L_t/K_t)^\alpha = (1/A) e^{-rt} (Q_t/K_t)$$

and take logarithms of both sides

$$\alpha \log(L_t/K_t) = -\log A - rt + \log(Q_t/K_t)$$

and divide both sides to  $\alpha$  to get

$$\log(L_t/K_t) = -\log A/\alpha - (r/\alpha)t + \log(Q_t/K_t)/\alpha$$

# RIM embodied technological progress

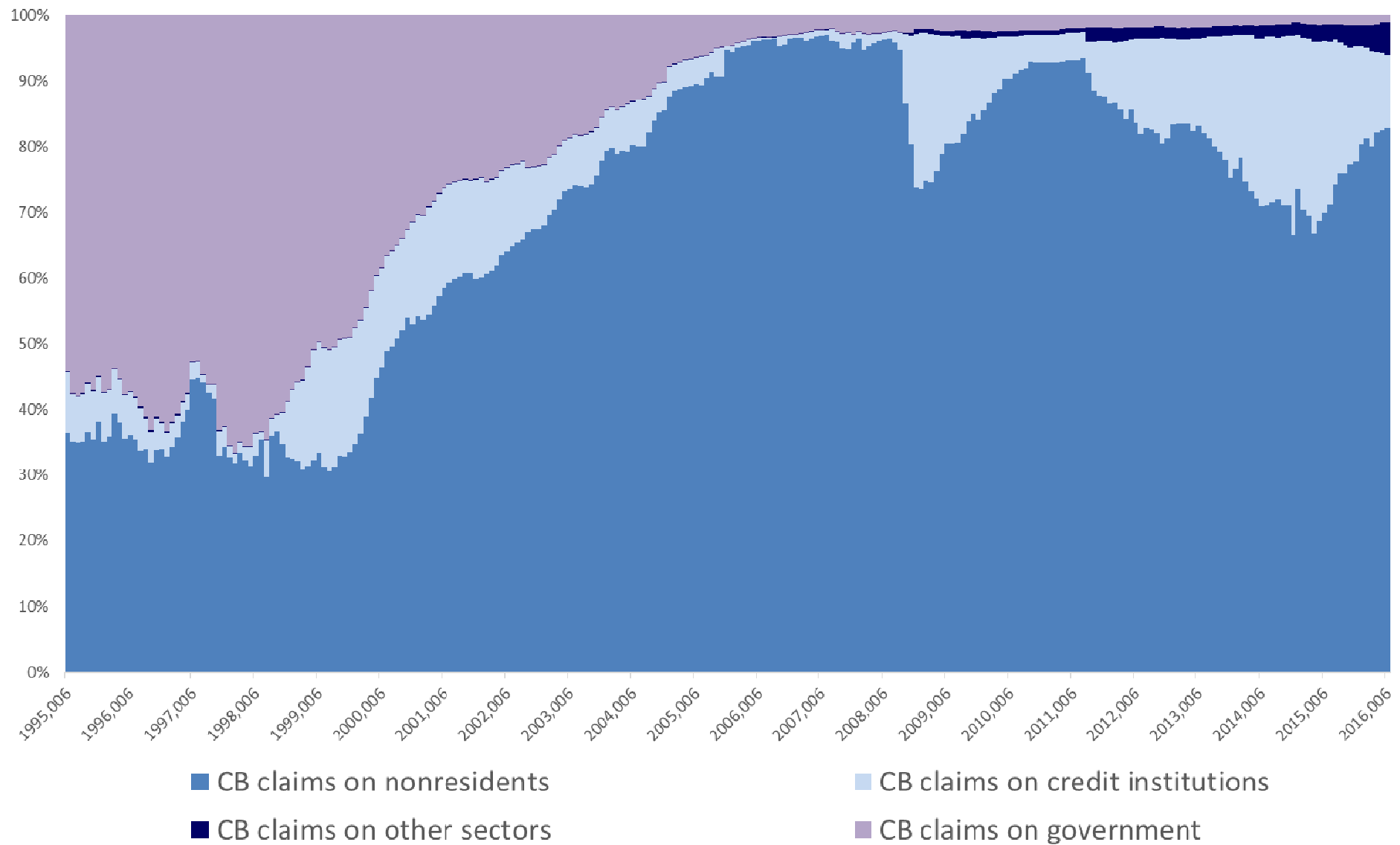


The second column is the rate of change of embodied technical change

The third column is the rate of depreciation in each bucket of capital

|    |     |     |  |    |     |     |   |
|----|-----|-----|--|----|-----|-----|---|
| 1  | .05 | .15 | Agriculture                                | 23 | .00 | .15 | Medical, optical, and precision instruments |
| 2  | .05 | .15 | Petroleum extraction                       | 24 | .10 | .15 | Automobiles, highway transport equipment    |
| 3  | .00 | .15 | Natural gas extraction                     | 25 | .05 | .15 | Ships and repair                            |
| 4  | .05 | .15 | Coal mining                                | 26 | .05 | .15 | Airplanes, rockets, and repair              |
| 5  | .05 | .15 | Other Fuels, incl. nuclear                 | 27 | .00 | .15 | Railroad equipment and its repair           |
| 6  | .00 | .15 | Ore and other mining                       | 28 | .00 | .15 | Recycling                                   |
| 7  | .05 | .15 | Food, beverages, tobacco                   | 29 | .00 | .15 | Electric, gas, and water utilities          |
| 8  | .05 | .15 | Textiles, apparel, leather                 | 30 | .05 | .15 | Construction                                |
| 9  | .05 | .15 | Wood and wood products                     | 31 | .05 | .15 | Trade                                       |
| 10 | .00 | .15 | Paper and printing                         | 32 | .07 | .15 | Hotels and restaurants                      |
| 11 | .00 | .15 | Petroleum refining                         | 33 | .00 | .15 | Transport and storage                       |
| 12 | .05 | .15 | Chemicals                                  | 34 | .07 | .15 | Communication                               |
| 13 | .00 | .15 | Pharmaceuticals                            | 35 | .07 | .15 | Finance and insurance                       |
| 14 | .00 | .15 | Plastic products                           | 36 | .07 | .15 | Real estate                                 |
| 15 | .05 | .15 | Stone, Clay, and Glass products            | 37 | .08 | .15 | Equipment rental                            |
| 16 | .05 | .15 | Ferrous metals                             | 38 | .00 | .15 | Computing service                           |
| 17 | .07 | .15 | Non-ferrous metals                         | 39 | .00 | .15 | Research and development                    |
| 18 | .00 | .15 | Fabricated metal products                  | 40 | .07 | .15 | Other business services                     |
| 19 | .07 | .15 | Machinery                                  | 41 | .05 | .15 | Government, defense, social insurance       |
| 20 | .00 | .15 | Computers, office machinery                | 42 | .00 | .15 | Education                                   |
| 21 | .00 | .15 | Electrical apparatus                       | 43 | .00 | .15 | Health services                             |
| 22 | .05 | .15 | Radio, television, communication equipment | 44 | .05 | .15 | Other social and personal services          |

Bank of Russia assets structure mid. 1995-mid. 2016



## RIM capital investments block



Capital investments of i-sector depends on

- *increases of the i-sector peak output in the current year and two preceding years*  
 $\text{@pos}(\text{peakoutput} - \text{peakoutput}[1]) * \text{capital\_output ratio}$
- *capital replacement in i-sector*
- *profit in i-sector deflated*
- *change in total outstanding long-term credit to organizations (for periods more than 3 years) deflated*

## RIM capital investments block



| Sector  | fiR Mexval | Sector   | fiR Mexval |
|---|------------|--|------------|
| 1 Agriculture                                 | 18         | 23 Medical, optical, and precision instruments | 26         |
| 2 Petroleum extraction                        | 37         | 24 Automobiles, highway transport equipment    | 13         |
| 3 Natural gas extraction                      | 12         | 25 Ships and repair                            | 52         |
| 4 Coal mining                                 | 17         | 26 Airplanes, rockets, and repair              | 11         |
| 5 Other fuels, incl. nuclear                  | 38         | 27 Railroad equipment and its repair           | 66         |
| 6 Ore and other mining                        | 9          | 28 Recycling                                   | neg        |
| 7 Food, beverages, tobacco                    | 53         | 29 Electric, gas, and water utilities          | 37         |
| 8 Textiles, apparel, leather                  | 49         | 30 Construction                                | 57         |
| 9 Wood and wood products                      | 10         | 31 Trade                                       | 16         |
| 10 Paper and printing                         | 1          | 32 Hotels and restaurants                      | 78         |
| 11 Petroleum refining                         | 24         | 33 Transport and storage                       | 26         |
| 12 Chemicals                                  | 32         | 34 Communication                               | neg        |
| 13 Pharmaceuticals                            | 9          | 35 Finance and insurance                       | 21         |
| 14 Plastic products                           | neg        | 36 Real estate                                 | 51         |
| 15 Stone, Clay, and Glass products            | 23         | 37 Equipment rental                            | 21         |
| 16 Ferrous metals                             | 6          | 38 Computing service                           | 6          |
| 17 Non-ferrous metals                         | neg        | 39 Research and development                    | 13         |
| 18 Fabricated metal products                  | 3          | 40 Other business services                     | 0          |
| 19 Machinery                                  | 16         | 41 Government, defense, social insurance       | 91         |
| 20 Computers, office machinery                | neg        | 42 Education                                   | 49         |
| 21 Electrical apparatus                       | 99         | 43 Health services                             | 13         |
| 22 Radio, television, communication equipment | 29         | 44 Other social and personal services          | 97         |

## RIM personal consumption block



Personal consumption expenditures in real terms per-capita depends on

- + *wages (personal income for some sectors)*
- - *sector prices relative to PCE deflator*
- + *real exchange rate*
- + *personal credits*

- *Saturation variable*

$$\text{sat}[i] = 1 - (\text{pceR}[i][1] / \text{popT}[1]) / \text{pceRsaturation}[i]$$

$\text{pceRsaturation}$  = level of consumption in USA in 2011 in real terms per-capita





## Logistic function

$$C_i(y) = L_i / (1 + e^{(a_i - b_i y)})$$

where  $y$  is income per-capita

$C_i$  is consumption per-capita of product  $i$

$L_i$  is precisely the saturation level we have already calculated

and  $a_i$  and  $b_i$  are positive constants to be estimated with non-linear regression



Thank you