Assessing contribution of a sector to GDP: Input-Output approach

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Methodology: simple output multiplier effect assessment

1. Single output multiplier effect: $\Delta x = (I - A^d)^{-1} \cdot \Delta f^d$

where A^d is the matrix of technical coefficients (excluding imports in intermediate consumption)

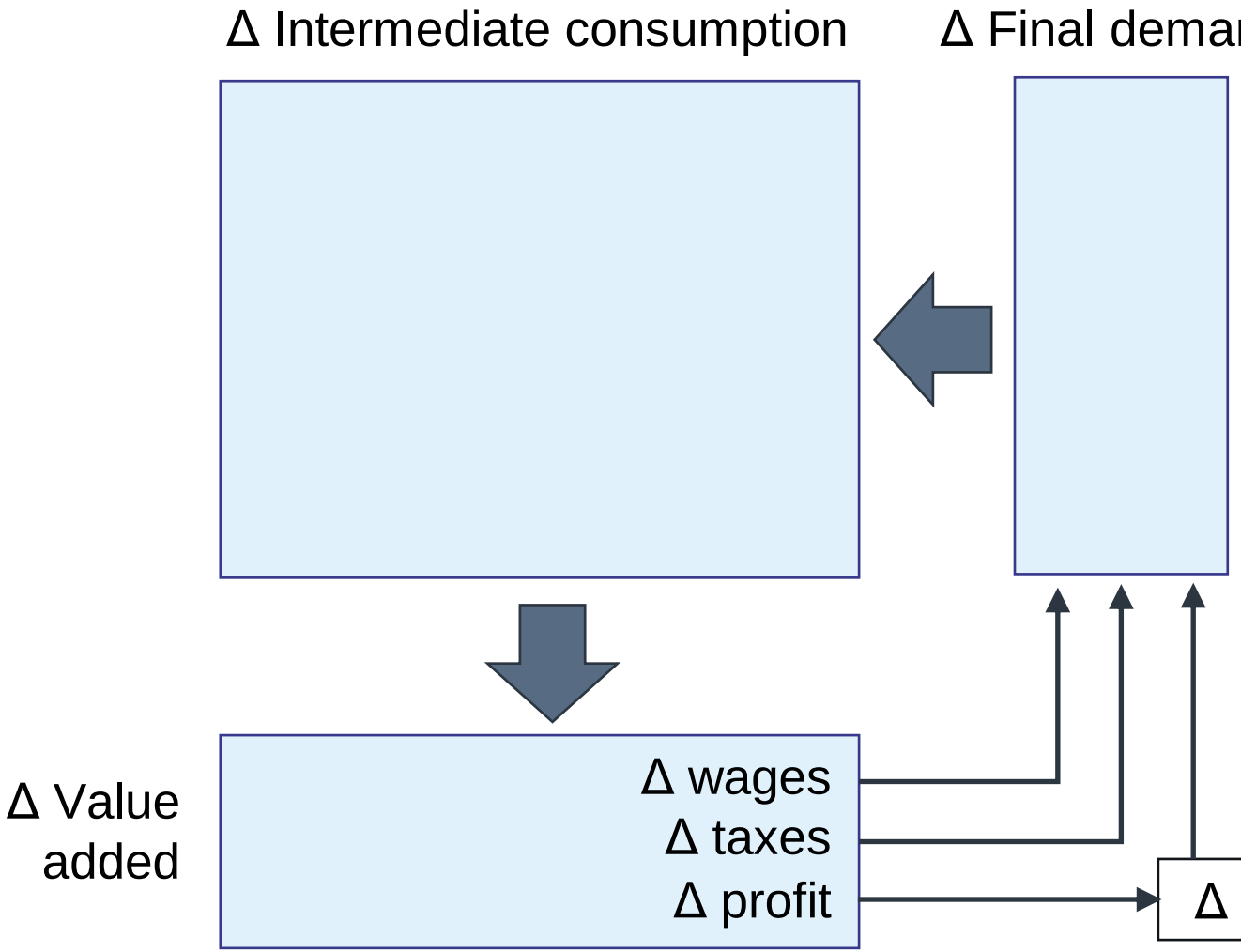
$$A^d = \begin{pmatrix} a_{11} \cdot (1 - imp_{11}) & a_{12} \cdot (1 - imp_{12}) & \dots & a_{1n} \cdot (1 - imp_{1n}) \\ a_{21} \cdot (1 - imp_{21}) & a_{22} \cdot (1 - imp_{22}) & \dots & a_{2n} \cdot (1 - imp_{2n}) \\ \dots & \dots & \dots & \dots \\ a_{n1} \cdot (1 - imp_{n1}) & a_{n2} \cdot (1 - imp_{n2}) & \dots & a_{nn} \cdot (1 - imp_{nn}) \end{pmatrix}$$

Single output multiplier of sector j: $m(o)_j = \sum_{i=1}^{n} l_{ij}$ **(impact on gross output)**

where l_{ij} are the coefficients of the total requirements matrix L: $L = (I - A^d)^{-1}$

2. Single output multiplier of sector j: $m(va)_j = \sum_{i=1}^{n} (l_{ij} \cdot va_i / x_i)$ **(impact on GDP)**

Methodology: induced effects assessment



$$\Delta f^{d} \rightarrow \Delta x \rightarrow \Delta va$$

Assessing induced final demand

$$\Delta va \rightarrow \Delta wages \rightarrow \Delta c \rightarrow \Delta c^{d}$$

$$\Delta va \rightarrow \Delta taxes \rightarrow \Delta gc \rightarrow \Delta gc^{d}$$

$$\Delta va \rightarrow \Delta profit \rightarrow \Delta inv \rightarrow \Delta gfcf \rightarrow \Delta gfcf^{d}$$

$$\Delta f^{d}_{induced} = \Delta c^{d} + \Delta gc^{d} + \Delta gfcf^{d}$$

Assessing induced value added

$$\Delta f^{d}_{induced} \rightarrow \Delta x_{induced} \rightarrow \Delta va_{induced}$$

$$\Delta va_{total} = \Delta va + \Delta va_{induced}$$

* for domestic goods and services

Methodology: investment multiplier effects assessment

1. **Assessing increase in gross fixed capital formation**: $\Delta gfcf = T \cdot \Delta inv$

   where T is the gross fixed capital formation matrix

2. **Assessing increase in final demand for domestic investment goods**: $\Delta gfcf \rightarrow \Delta gfcf^{d}$

3. **Assessing indirect and induced effects of output increase in fund-creating sectors**:

$$\Delta gfcf^{d} \rightarrow \Delta x = (I - A^{d}) \cdot \Delta f^{d} \qquad \Delta x \rightarrow \Delta va$$

$$\Delta va \rightarrow \Delta f_{induced} \rightarrow \Delta f^{d}_{induced} \rightarrow \Delta x_{induced} \rightarrow \Delta va_{induced}$$

$$\Delta va_{total} = \Delta va + \Delta va_{induced}$$

Methodology: some issues

1. **Need to normalize multipliers since data on total output in agriculture and food production are only available**

   For example: 1 ruble of output in food industry in 2000 resulted in 2.4 rubles of total output, including 1.4 rubles of

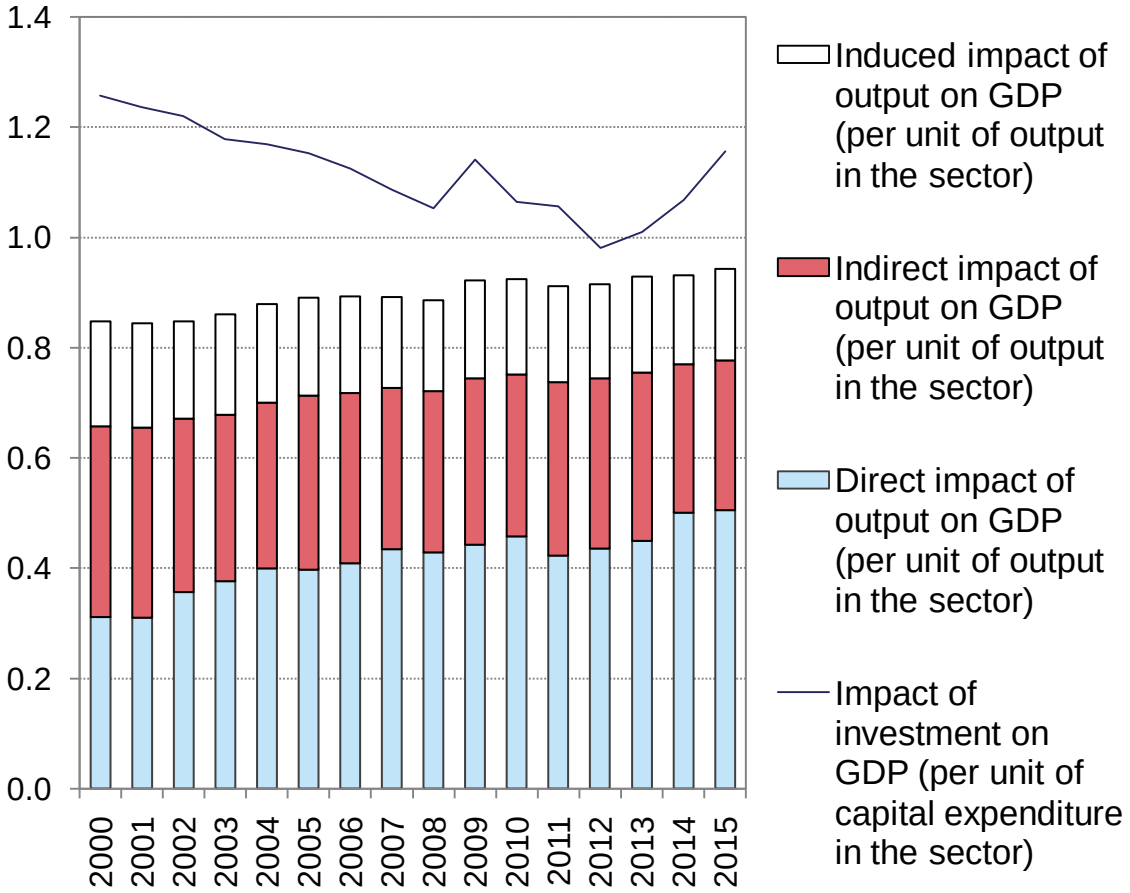
   output in food industry ⟶ impact of output in food industry on total output is (2.4 / 1.4) = 1.7

2. **Need to avoid double counting when assessing multipliers for agriculture and food production separately**

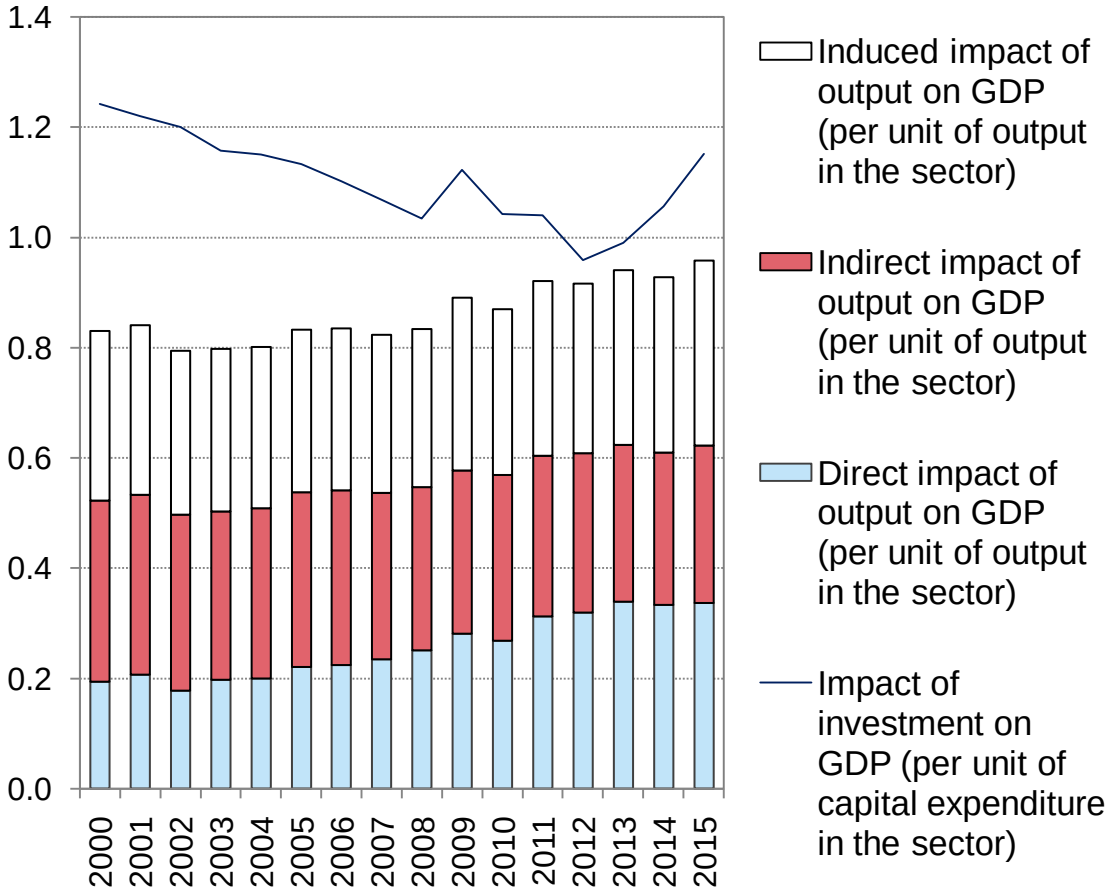
   Since agriculture output impact on GDP is estimated with the help of multipliers for agriculture, it is necessary to exclude this sector when assessing multipliers for food production. For this, the matrix of technical coefficients is adjusted (the row of coefficients for agriculture is set to zero).
   Similarly, food production is excluded when assessing multipliers for agriculture.

Output and investment multiplier estimates (impact on GDP)

Output and investment multiplier estimates for agriculture



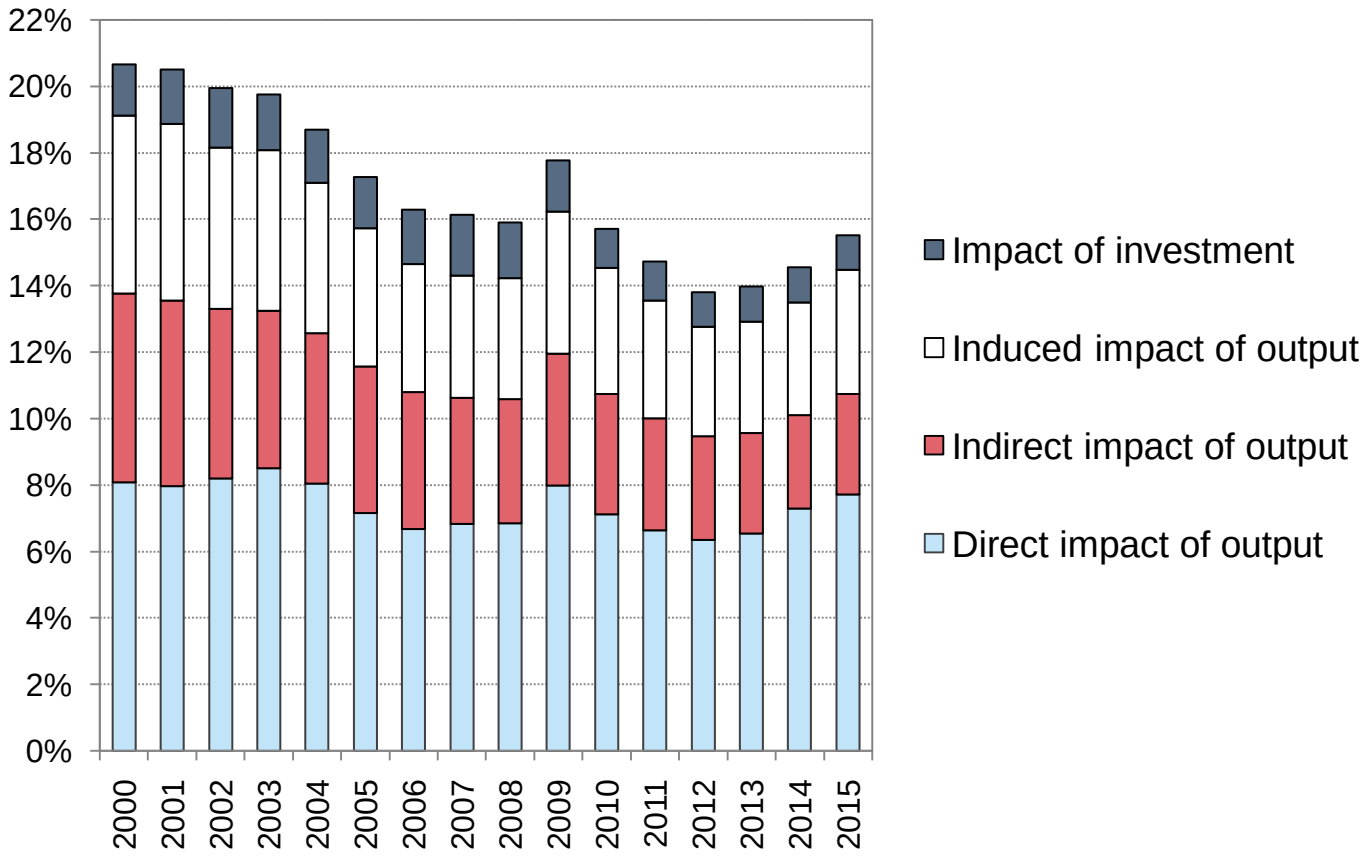
Output and investment multiplier estimates for food production



Source: Institute of economic forecasting of the Russian academy of sciences

Total impact of agricultural and food production on GDP

Total contribution of agriculture and food production to GDP



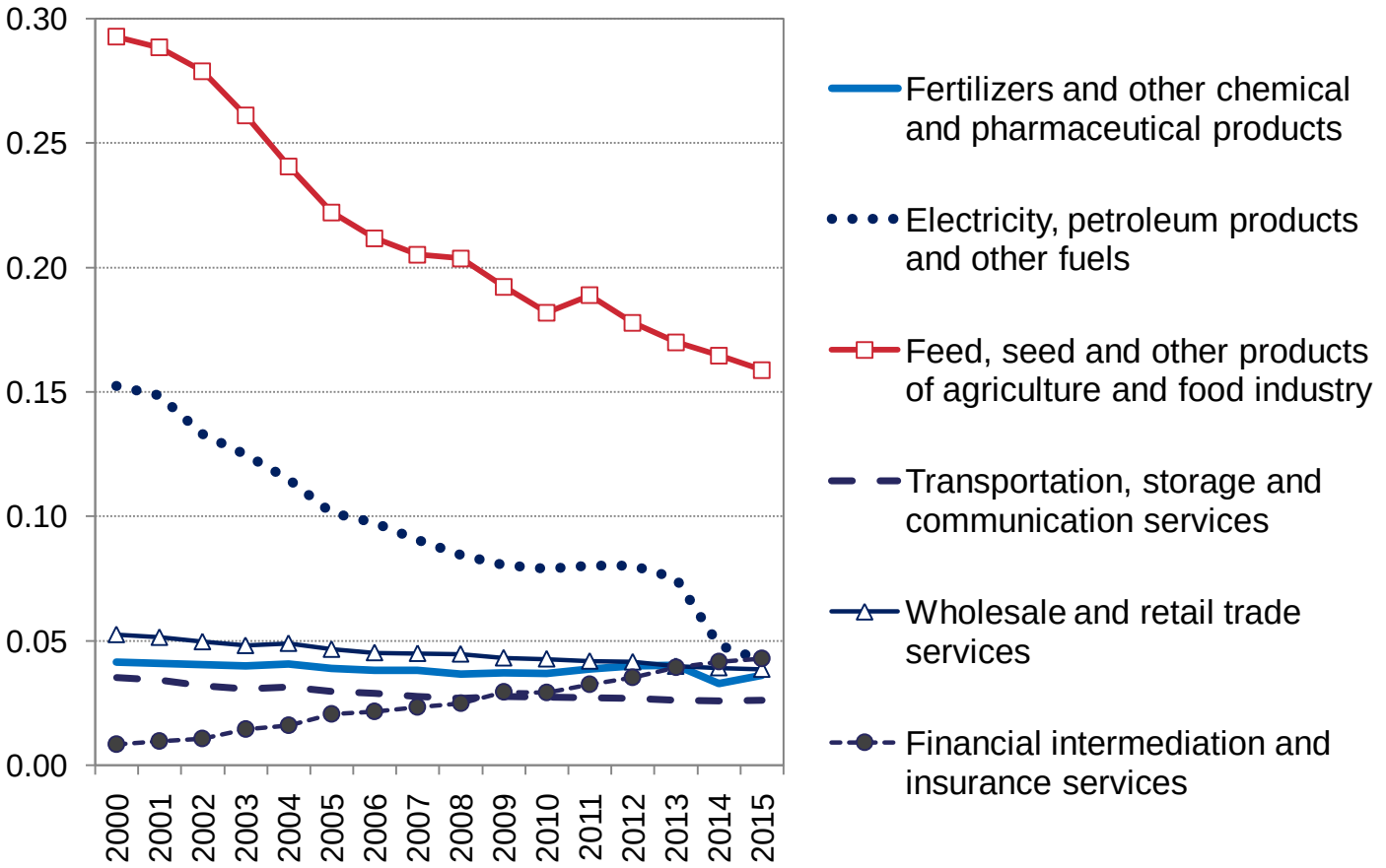
Main points:

1. Indirect and induced effects of output and investment in agriculture and food production influence significantly.
2. Total impact of agriculture and food production on Russian GDP has decreased from 20,7% in 2000 to 15.5% in 2015.
3. The bulk of this decline is due to reducing indirect and induced effects of output in agriculture (which is a result of growing productivity in the sector and in the economy).

Source: Institute of economic forecasting of the Russian academy of sciences

Growing productivity in Russian agriculture in 2000-2015

Key technical coefficients for Russian agriculture (constant 2010 prices)

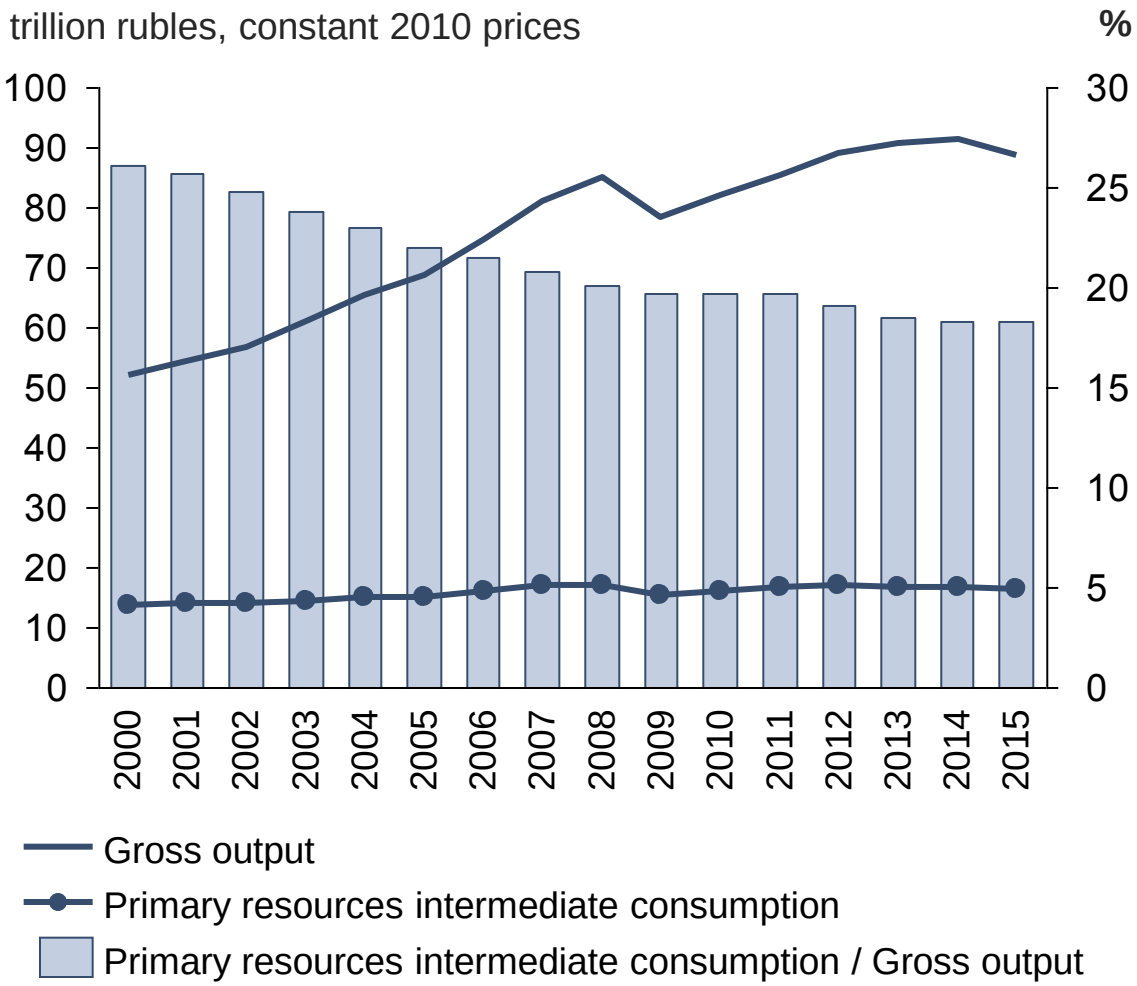


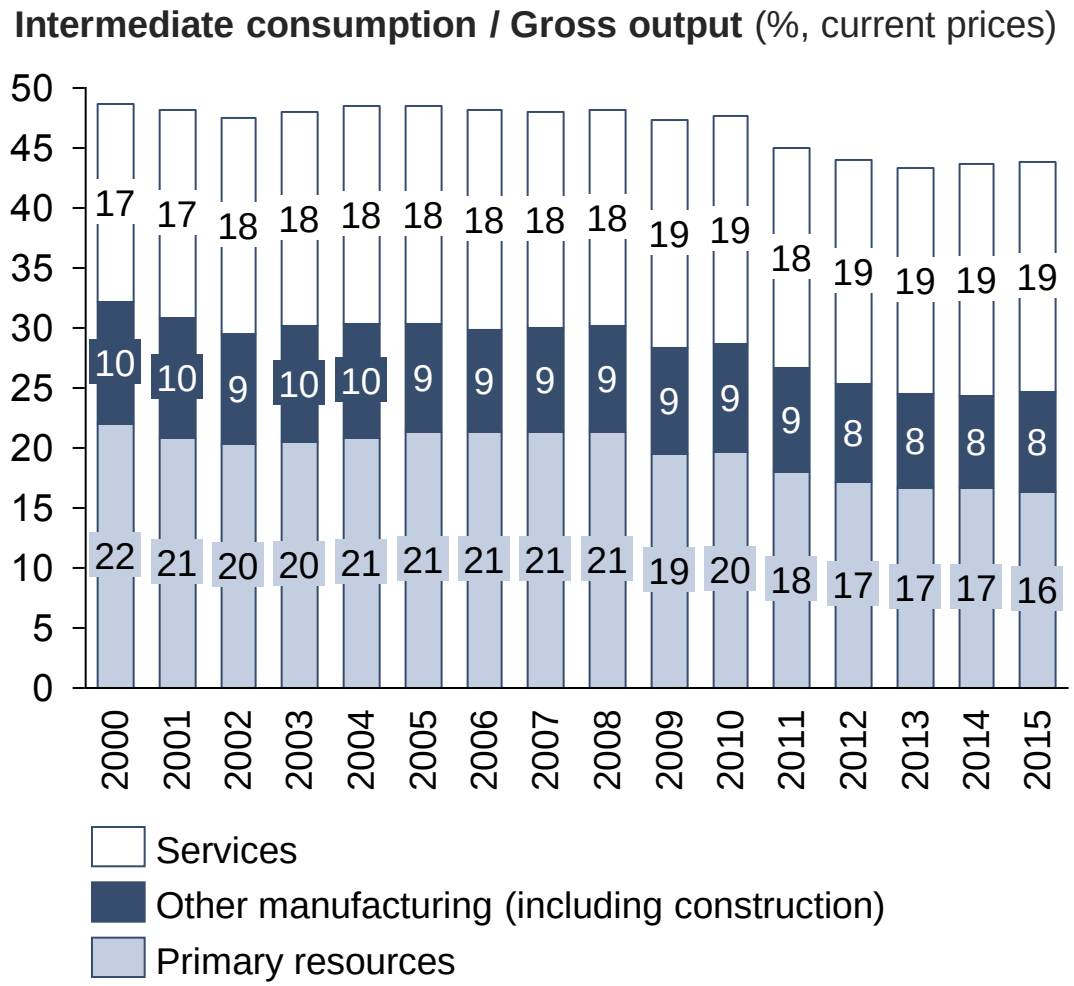
Main points:

1. Trends of changing technical coefficients for agriculture reflect shifts both in its production structure and in technologies.
2. Intermediate consumption of such inputs as feeds, seeds, petroleum products and electricity has decreased significantly.
3. Consumption of financial and insurance services was increasing due to using loans to fund investment projects in the sector.

Source: Institute of economic forecasting of the Russian academy of sciences

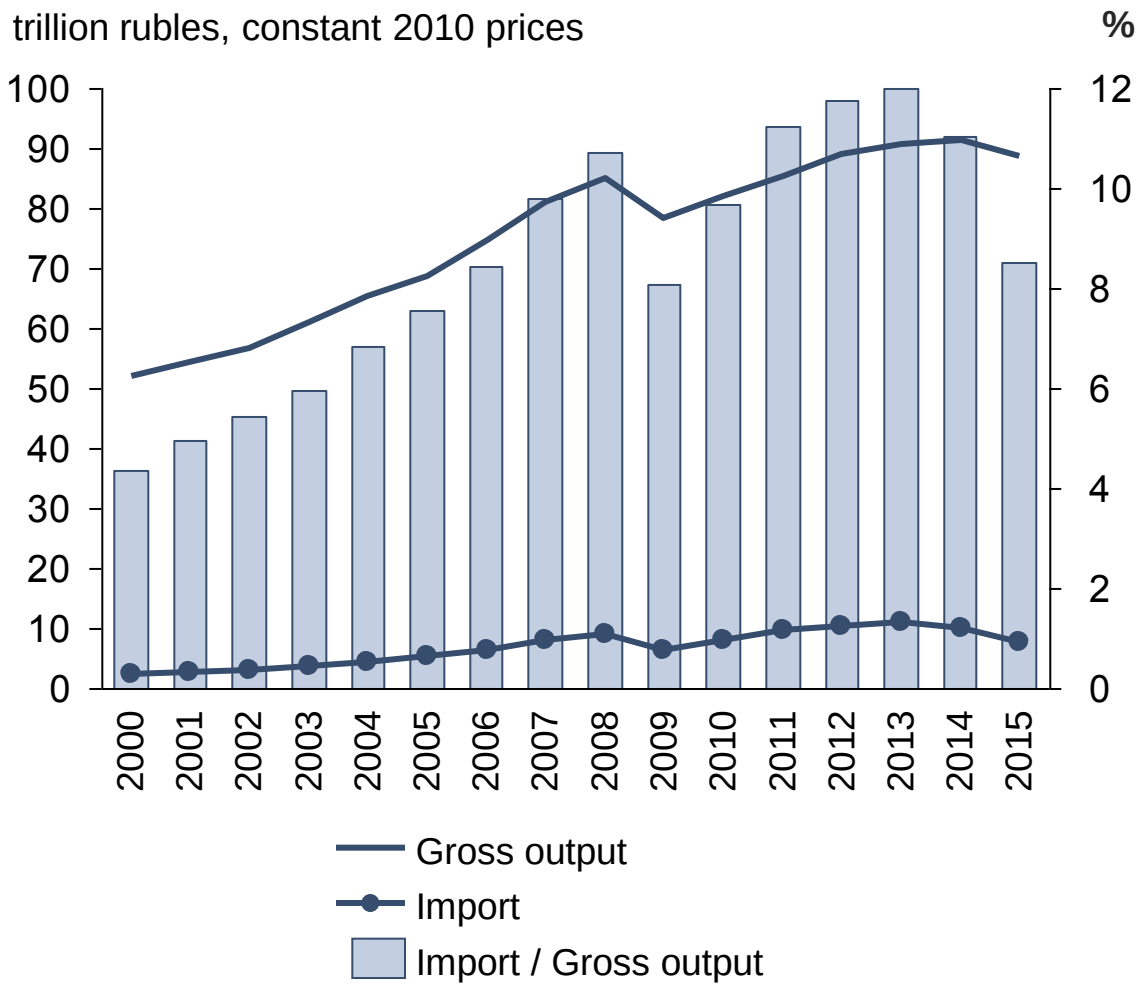
Structural shifts in the Russian economy in 2000-2015

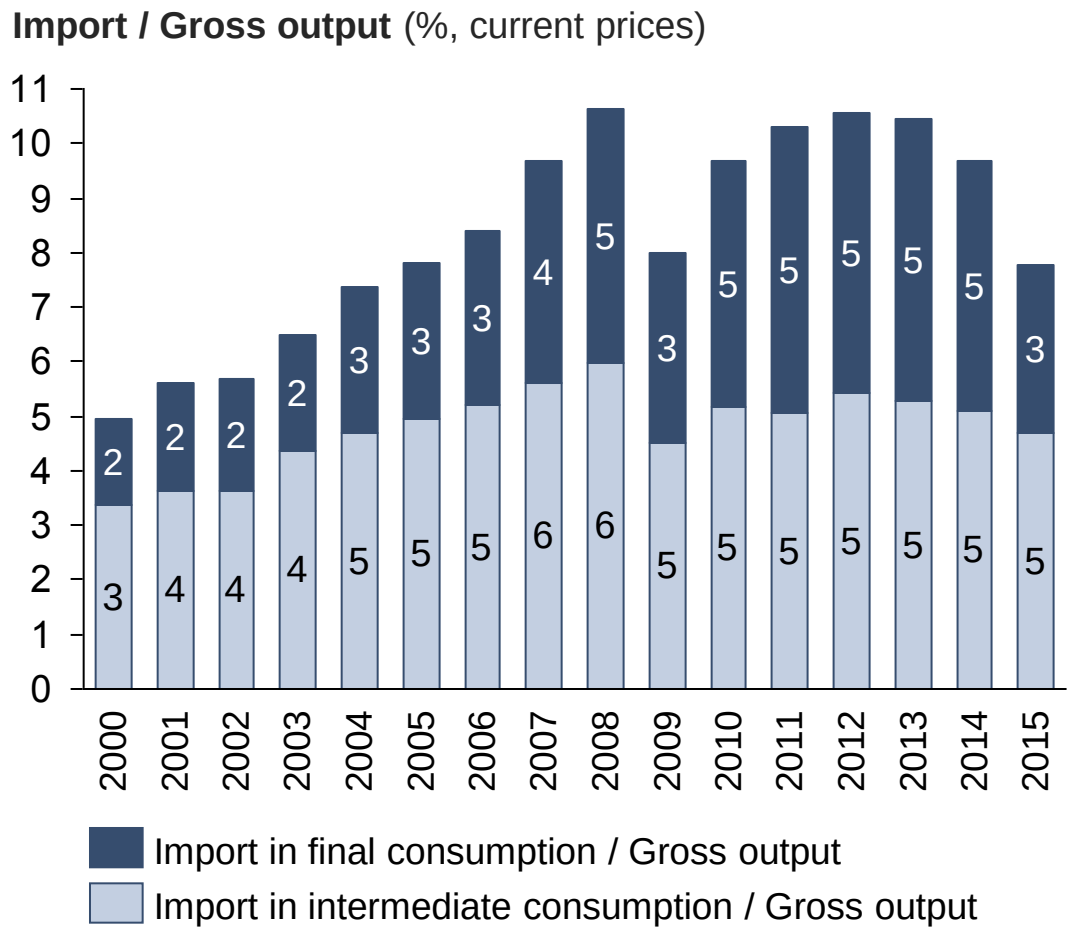




Source: Institute of economic forecasting of the Russian academy of sciences

Import in intermediate and final consumption in 2000-2015





Source: Institute of economic forecasting of the Russian academy of sciences

Summary

1. Input-Output approach can be used not only to assess macroeconomic impact of future projects, but also for various purposes of retrospective analysis.

2. Agriculture and food production remain an important part of the Russian economy.
   Direct impact of these sectors on GDP is estimated at 7-8%.
   Total impact on GDP is much higher, but decreasing (from 20.7% in 2000 to 15.5% in 2015).

3. The main factors of reducing total impact of agriculture and food production on GDP are:
   - technological modernization and growing productivity in these sectors;
   - growing productivity and structural shifts in the Russian economy;
   - increasing import shares (integration of the Russian economy into the global economy).

Thank you

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