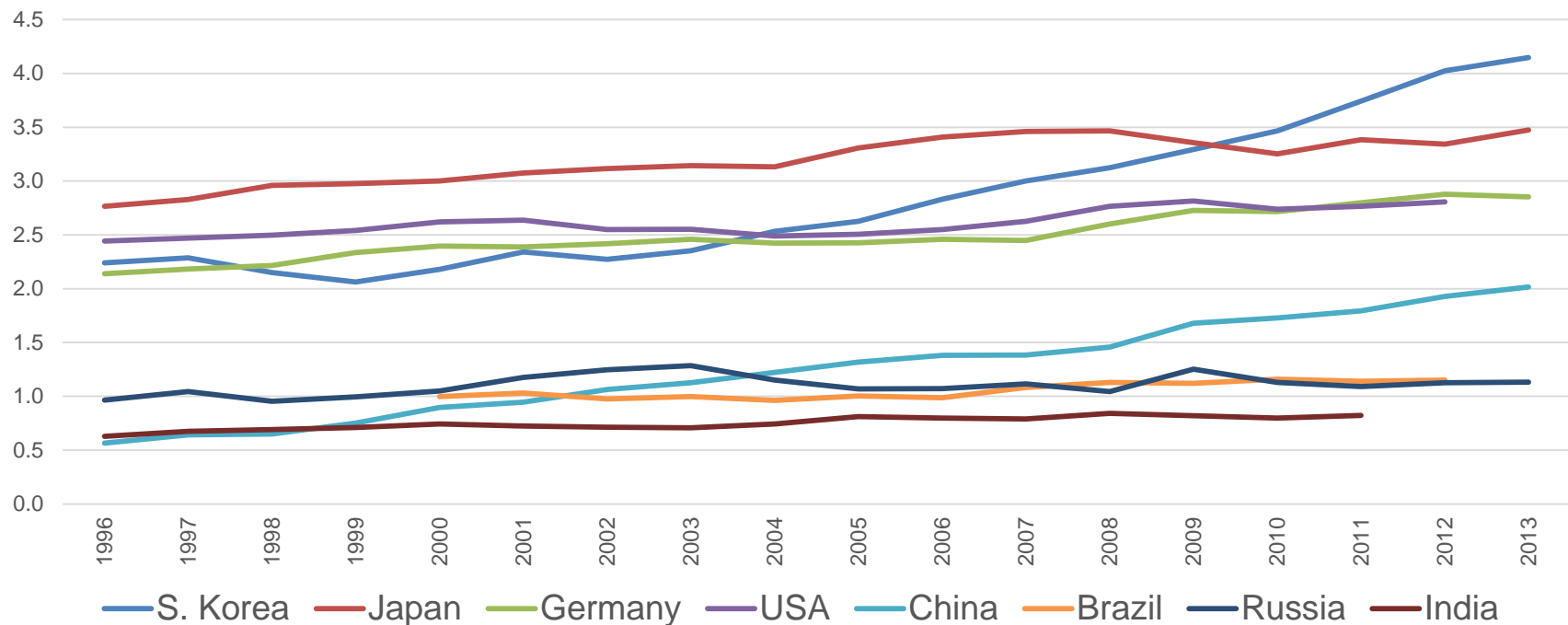




Interrelation of economic growth and research and development expenditures

Direct R&D expenditures in % of GDP



• From the theoretical point of view the combination of high growth rates of GDP and steadily low R&D expenditures is possible only with an economic growth mainly due to involvement in to economy more and more resources without essential quality changes.

• In our opinion, it is explained by the fact that the statistics of R&D expenditures in the certain countries is incomplete, and developing states actually consume more results of R&D, than it follows from direct statistical data of the certain countries.



- ***Direct domestic R&D expenditures*** - the volume of resources spent in the country for innovative activity and fixed by official statistics;
- ***Indirect R&D expenditures*** - the share of expenses which is contained in the import used in intermediate consumption and final demand;
- ***Total R&D expenditures*** - sum of direct and indirect R&D expenditures.



TWO WAYS FOR INDIRECT R&D EXPENDITURES ESTIMATION



FOREGEIN TRADE STATISTICS

1. Share of R&D by industries
2. Share of R&D in import by industries

MRIO

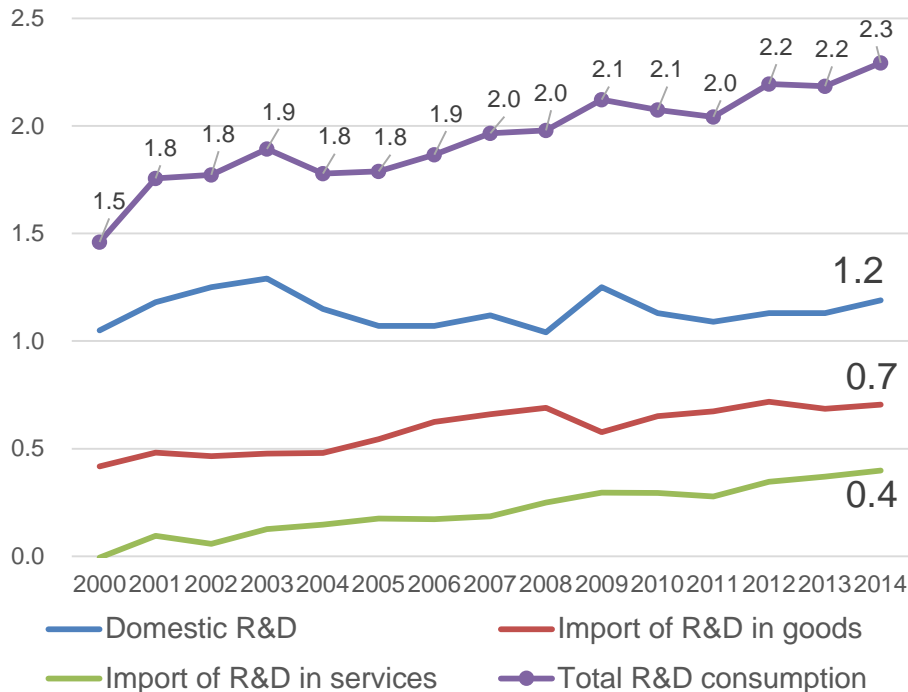
$$x_i^r = \sum_{s=1}^m \sum_{j=1}^n a_{ij}^{rs} x_j^s + \sum_{s=1}^m \bar{y}_i^{rs}, \quad (i = 1, \dots, n; r = 1, \dots, m)$$

$$c_{30,j}^{im} = \sum_{s \neq r}^m (l_{30,j}^{sr} - a_{30,j}^{sr})$$

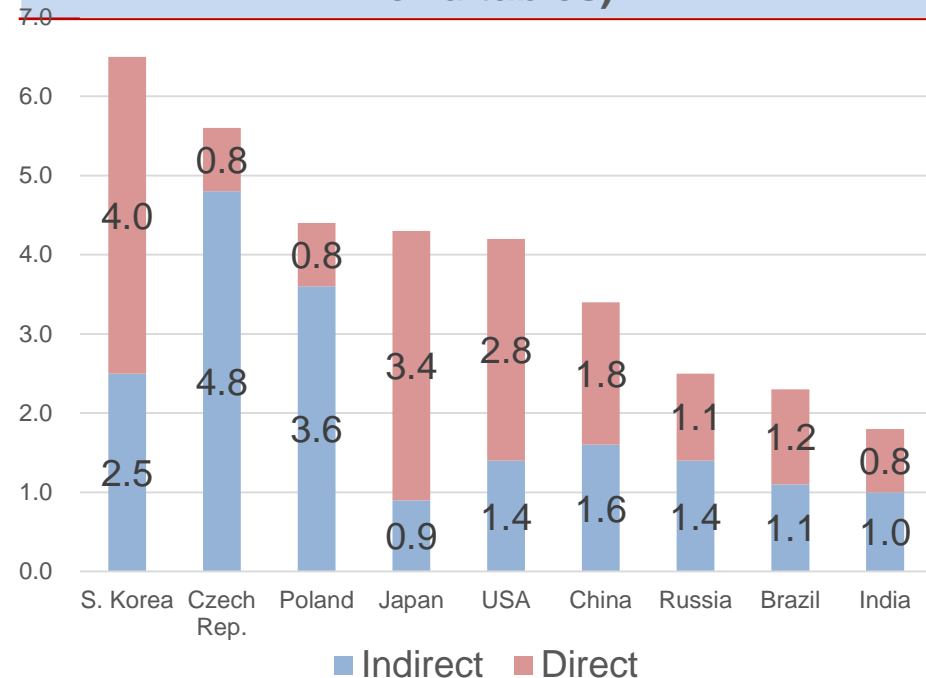


Total R&D expenditures

Total R&D expenditures in % of GDP in Russia (calculation through foreign trade)



Total R&D expenditures in % of GDP in different countries (calculation through I-O World tables)



- The countries with the high level of development (technological leaders) as a rule have a high share of domestic R&D expenditures.
- A number of the countries with high level of total R&D have rather low share of domestic expenses (Poland, the Czech Republic)
- Total R&D in Russia not strongly differ from similar indicators of the BRICS countries.



the aggregated indicators of sectoral changes were calculated by formula

$$\Delta X_t = \sum |a_{it} - a_{i,t-1}|$$

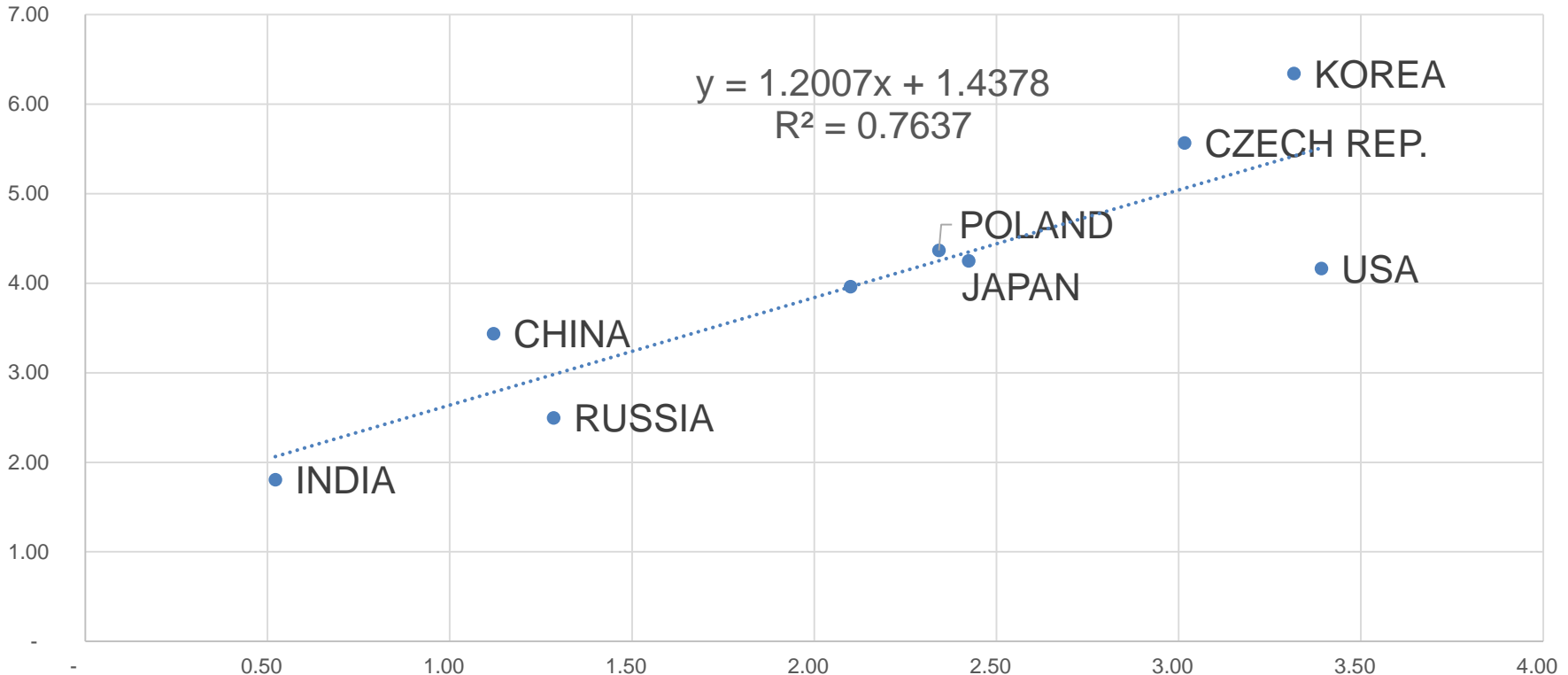
where ΔX – change in structure of economy in a year t ;

a_{it} – a share of sector i in structure of gross output in a year of t .

Adjustment on GDP per capita became through multiplication of an indicator of structural changes by a ratio of GDP per capita on PPP in this country and the leading country (USA).

Connection between R&D expenditures and structural changes in economy

Ratio of R&D and changes in structure of economy adjusted for GDP per capita (on an axis of X-change in output structure of production during 1995-2011, on axis Y – the total volume of costs of IIR to GDP in %)



It is possible to prove a hypothesis about **direct** connection between R&D expenditures and structural changes in economy.



$$J^{DC} = (0, v^s, v^t) \begin{pmatrix} L^{rr} & L^{rs} & L^{rt} \\ L^{sr} & L^{ss} & L^{st} \\ L^{tr} & L^{ts} & L^{tt} \end{pmatrix} \begin{pmatrix} f^{rr} & +0 & +0 \\ f^{sr} & +0 & +0 \\ f^{tr} & +0 & +0 \end{pmatrix}$$

where:

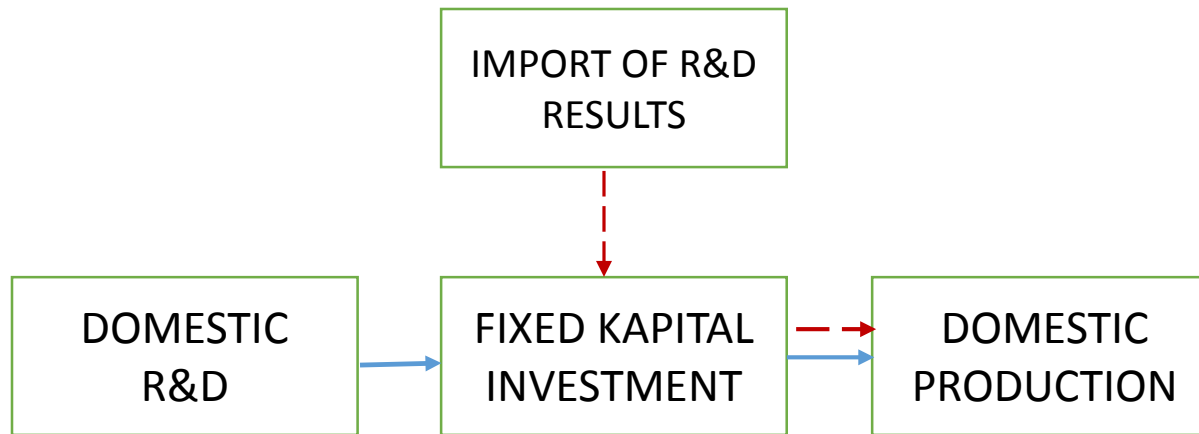
v^s and v^t - vectors of value added share in outputs by countries s and t ,
 L^{cd} ($\mathbf{c=r,s,t}$; $\mathbf{d=r,s,t}$) co-matrix of I-O coefficient in country c by output in country d,
 f^{rr} , f^{sr} , f^{tr} - vectors of final demand in Russia (r) for domestic products and import from countries s and t.

IMPORT ADJUSTED FOR R&D FLOWS

	R&D EXPENDITURES IN IMPORT, IN %		IMPORT OF MACHINERY AND EQUIPMENT, IN %	STRUCTURE OF TOTAL IMPORT, in %	
	2011	1995	2011	2011	1995
GERMANY	19.2	23.3	15.8	12.4	14.5
USA	10.8	16.6	5.1	3.0	5.6
FRANCE	8.2	9.1	2.7	3.1	3.3
ITALY	7.1	7.0	4.7	5.5	6.5
CHINA	6.4	0.5	17.9	15.9	2.5
JAPAN	6.2	3.1	9.0	5.0	2.3
UK	6.0	7.6	3.0	2.7	4.0
S. KOREA	3.5	2.1	6.4	5.6	2.6
OTHER	32.6	30.7	35.5	46.8	58.7

China has a high share in the Russian import of machinery production but real owners of R&D expenditures these goods, so and the income from import, are developed countries.





Besides increase in production and redistribution of the income, R&D possess one more channel of generation of multiplicative effects, namely technological which is connected with efficiency growth.

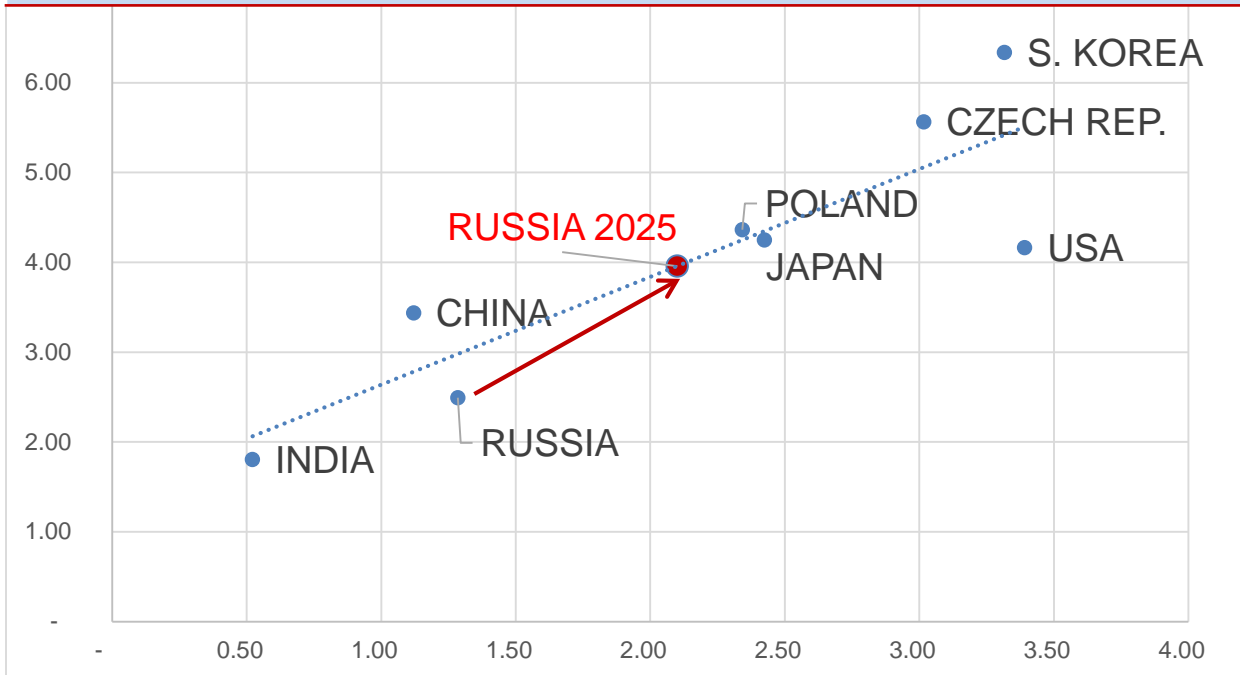
In case of domestic R&D there are multiplicative effects form in the direction : **R&D – investments – production.**

In case of import of R&D, multiplicative effects on a phase of development are absent, and at a stage of investments are minimum. At the same time at a stage of production multiplicative effects can be more significant because the more efficient technologies are imported.

The value of the direct multiplier of R&D is only 0,41, however taking into account redistribution of the incomes and change in output structure its final value for the Russian economy makes 1,75



Ratio of R&D and changes in structure of economy adjusted for GDP per capita (on an axis of X-change in output structure of production during 1995-2011, on axis Y – the total volume of costs of IIR to GDP in %)



MACROECONOMIC SCENARIO TILL 2025

- NET EXPORT IS NO LESS THEN 5% OF GDP ON THE END OF FORECAST PERIOD.
- SHARE OF MACHINERY GROWT FROM 3,2% В 2015 TO 10% IN 2025 г.
- NECESSARY STRUCTURAL CHANGES ARE POSSIBLE AT AVERAGE ANNUAL GROWTH RATES OF GDP NOT LESS THAN 4.5% IN 2016-2025.

- If we use idea about interrelations between structural changes and cumulative R&D expenditures received on the basis of intercountry comparisons, then it is possible to expect that dynamics of structural changes in the considered option of development will demand maintenance of total R&D at the level of 3,5%-4% to GDP.
- At preservation of an equal proportion of the domestic and imported R&D in the medium term there is a need to provide growth of domestic R&D not less, than for 0,5-0,75 percent from GDP



- Level of R&D expenditures is defined as the factor of direct domestic cost and imported results R&D from abroad in good, services and technologies. Our calculations show that Russian economy uses more than twice volume of total R&D. Moreover, intensity of total R&D expenditures gradually increases;
- Between the level of total R&D expenditures and structural changes in economy is direct link which can be interpreted as changes in economic structure under the influence of innovations;
- The ratio between the factor domestic and imported R&D expenditures testifies to character of economy model and its involvement into global production chains.;
- Consideration of characteristics of import of R&D expenditures can significantly expand view on structure of foreign trade, and also of formation and distribution flows of the income;
- R&D expenditures have macroeconomically significant multiplicative effects which increase in process of growth of a share domestic components in structure of total R&D;
- For achievement necessary level of production efficiency and average annual rates of economic growth in Russia at the level of 3-4,5% the total R&D in the medium term (5-10 years) have to be increased to the level of 3,5-4% of GDP. At the same time the share of domestic R&D expenditures should not be less than 50%.

