Development of scenario as the key part of macroeconomic forecasting

Structural macroeconomic forecasting requires implementation
of definite scenario

scenario 1			forecast 1
scenario 2	1 or 2…or n - ?	Macroeconomic model	forecast 2
scenario n			forecast 3

Implemented variant should meet one crucial requirement – the consistency of exogenous variables.

The rconsistency of exogenous variables (or the consistency of scenario) means that combination of exogenous variables is apriori feasible in the future. Although, interconsistency of scenario doesn't mean that scenario will necessary come true.

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Scenario worked out by Russian Ministry of economic development, base variant (2a) (date of publication – October 1 of 2009)

Indicator	2007	2008	2009	2010	2011	2012
	actual		estimation	forecast		
World oil price, Urals, $/barrel	69.3	94.4	57	58	59	60
World GDP growth, %	2.2	1.1	-1.8- -2.7	0.6	2.6	2.8
Ruble/dollar exchange rate (annual average), rubles per one US dollar	25.5	24.9	32.7	33.9	34.8	36.4
Trade balance, billion US dollars	130.9	179.7	94.7	107.0	101.9	97.4
Crude oil and oil products export, million tons	370	361	368.2	367.1	366.4	364.8
Crude oil and oil products export, billion US dollars	187.6	248.8	153.2	155.4	157.8	159.8

Source: Russian Ministry of economic development

The easiest solution of scenario problem – implementation of scenario prepared by authoritative organization – is not a guarantee for interconsistency of exogenous variables

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World oil price forecast
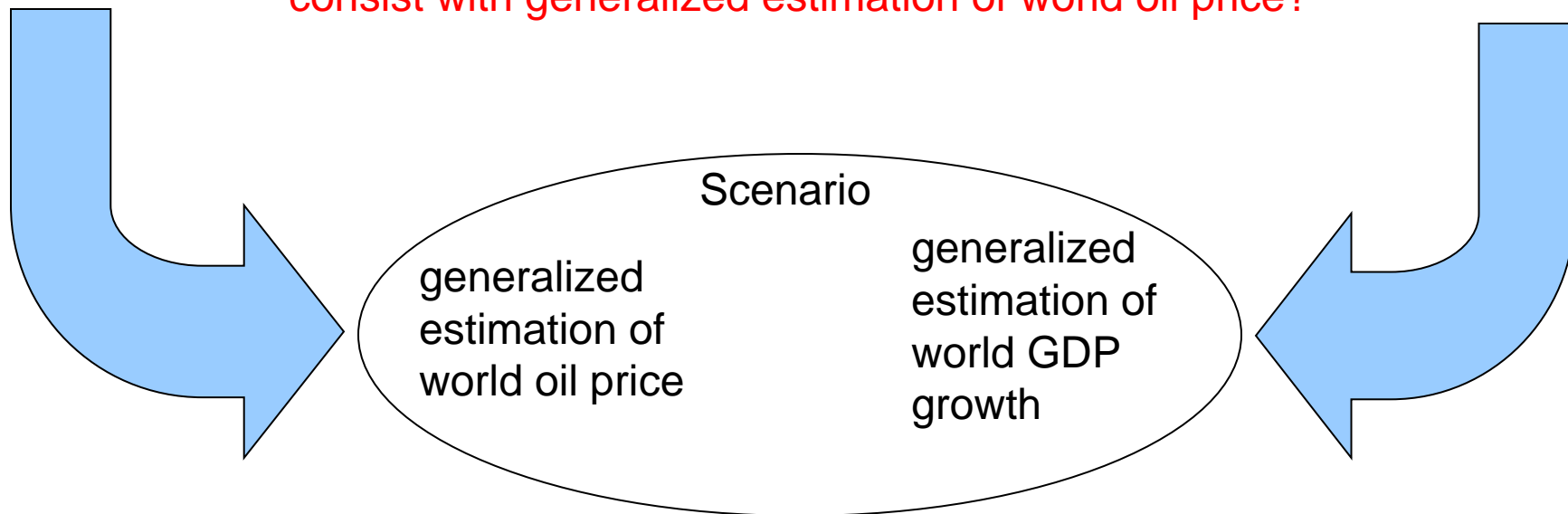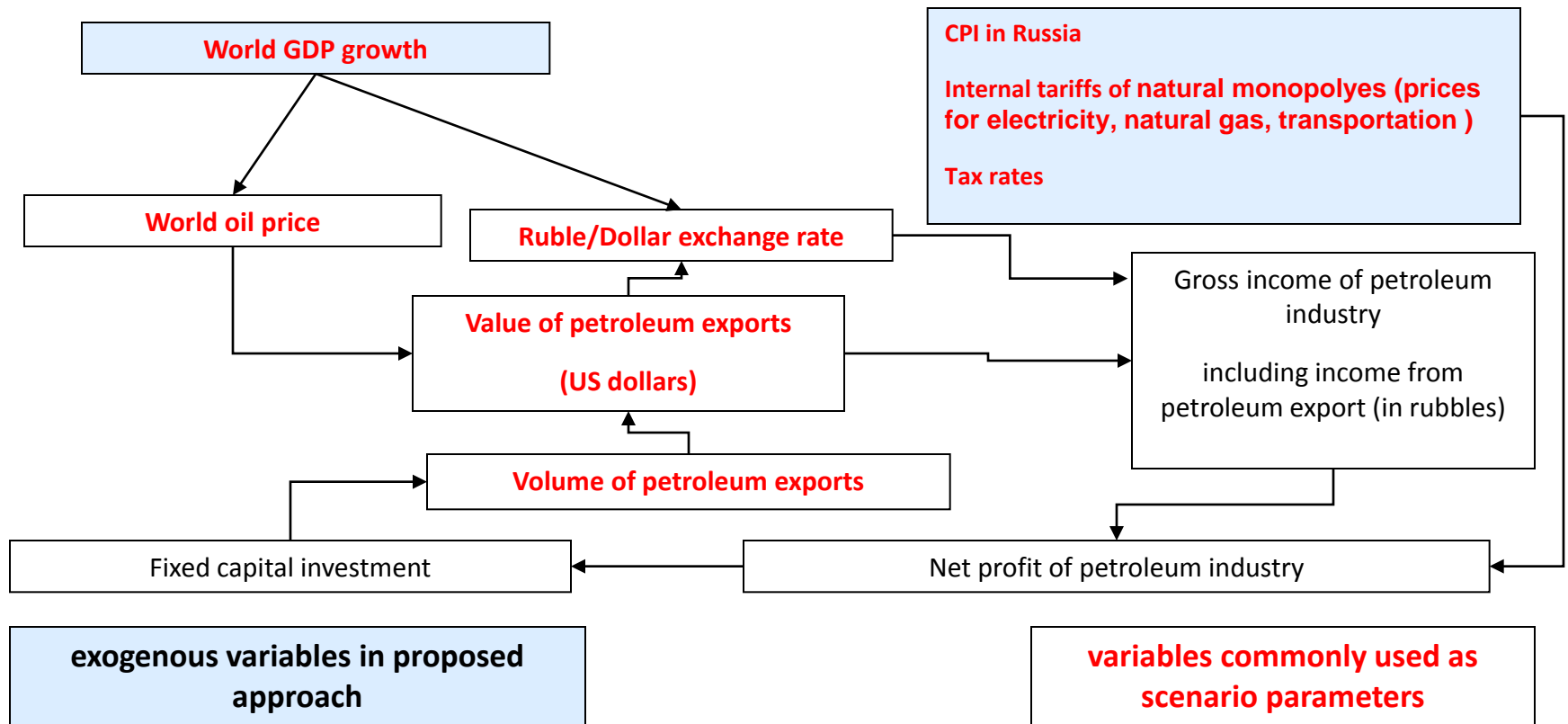
source 1

source 2

source n

World GDP growth forecast

source 1

source 2

source n

Whether generalized estimation of world GDP growth consist with generalized estimation of world oil price?
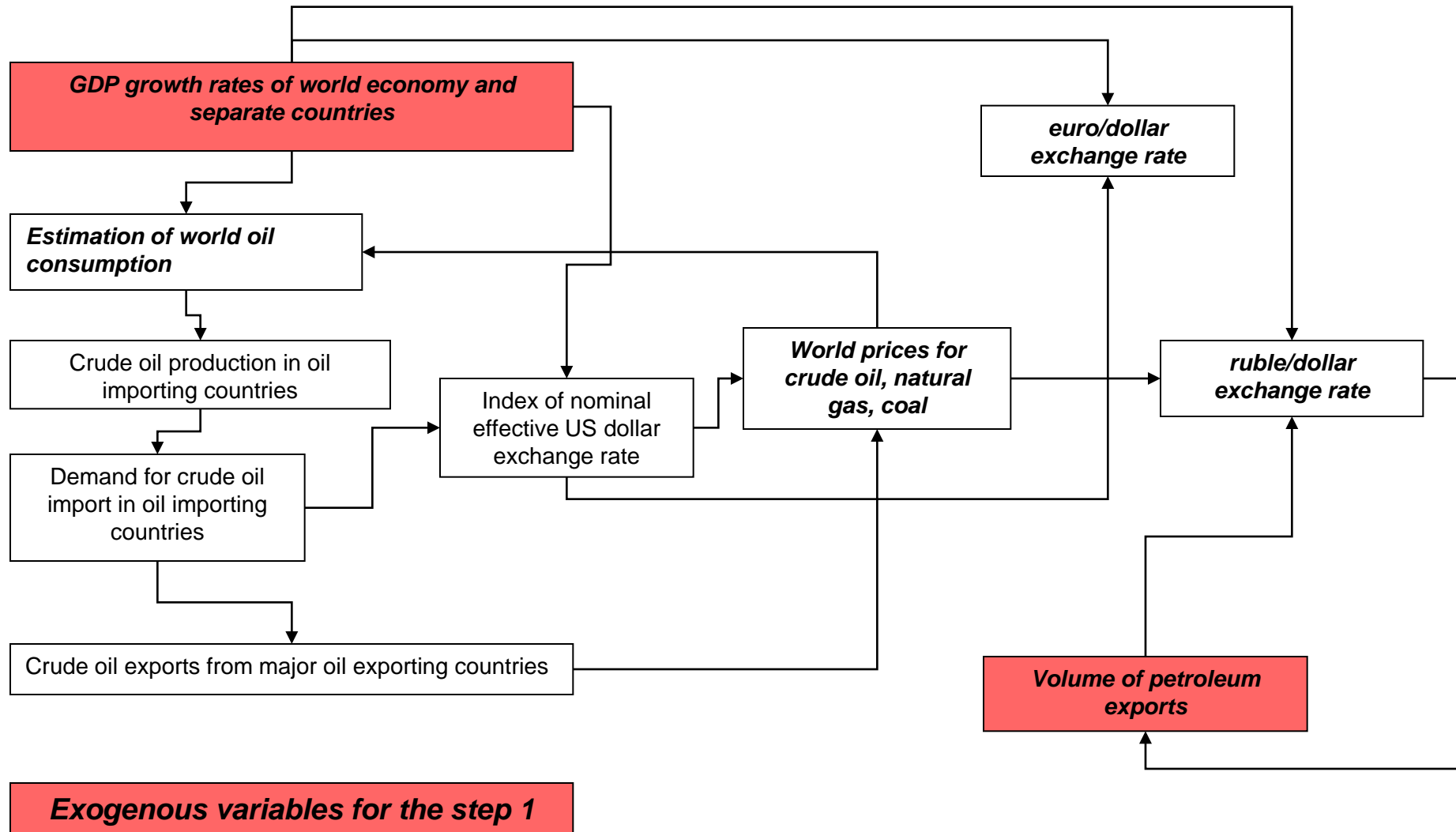
Scenario

generalized estimation of world oil price

generalized estimation of world GDP growth

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World GDP growth

World oil price

Ruble/Dollar exchange rate

CPI in Russia

Internal tariffs of natural monopolyes (prices for electricity, natural gas, transportation)

Tax rates

Value of petroleum exports

(US dollars)

Gross income of petroleum industry

including income from petroleum export (in rubbles)

Volume of petroleum exports

Fixed capital investment

Net profit of petroleum industry

exogenous variables in proposed approach

variables commonly used as scenario parameters

The consistency of scenario should be based on interdependences established between:

- World GDP growth and world oil prices;

- World oil prices, volume of petroleum export and ruble/dollar exchange rate;

- Net profit of petroleum industry and ruble/dollar exchange rate.

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GDP growth rates of world economy and separate countries

Estimation of world oil consumption

Crude oil production in oil importing countries

Demand for crude oil import in oil importing countries

Crude oil exports from major oil exporting countries

Index of nominal effective US dollar exchange rate

World prices for crude oil, natural gas, coal

euro/dollar exchange rate

ruble/dollar exchange rate

Volume of petroleum exports

Exogenous variables for the step 1

Primary energy consumption

World primary energy consumption, thousand BTU per 1 dollar of GDP at constant 2000 prices

GDP of separate countries are converted at a constant prices via market exchange rates

BTU – British Thermal Unit, 1BTU = 1 055.05585 Joules
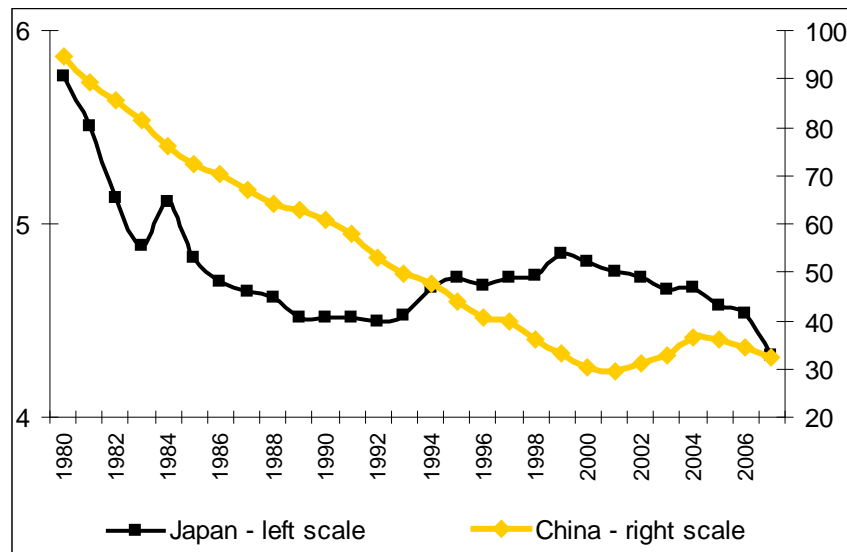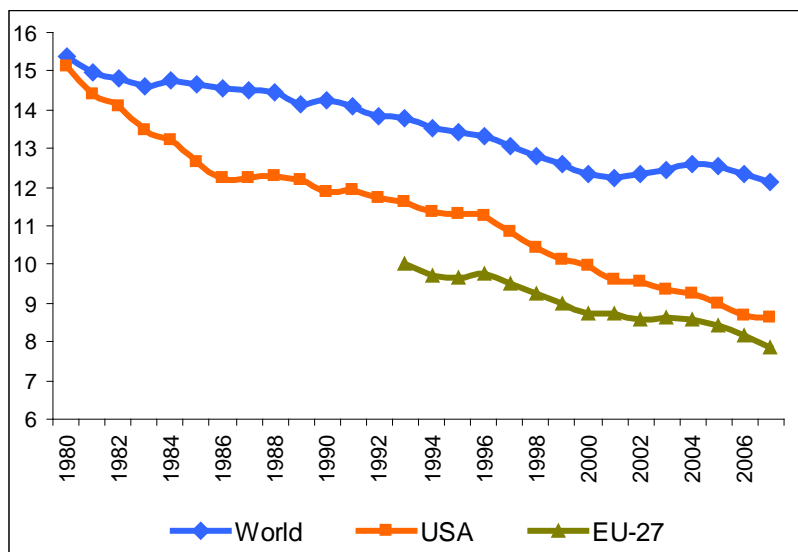
- primary energy consumption per unit of GDP for the world economy (and for majority of separate countries) is stably declining value;

- specific primary energy consumption for separate country can be represented as a function, where time and primary energy price are taken as exogenous variables;

-specific primary energy consumption in the context of different sources can be represented as function, where total specific primary energy consumption and energy prices ratios are taken as exogenous variables.

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Countries share in world oil consumption in 2009, %
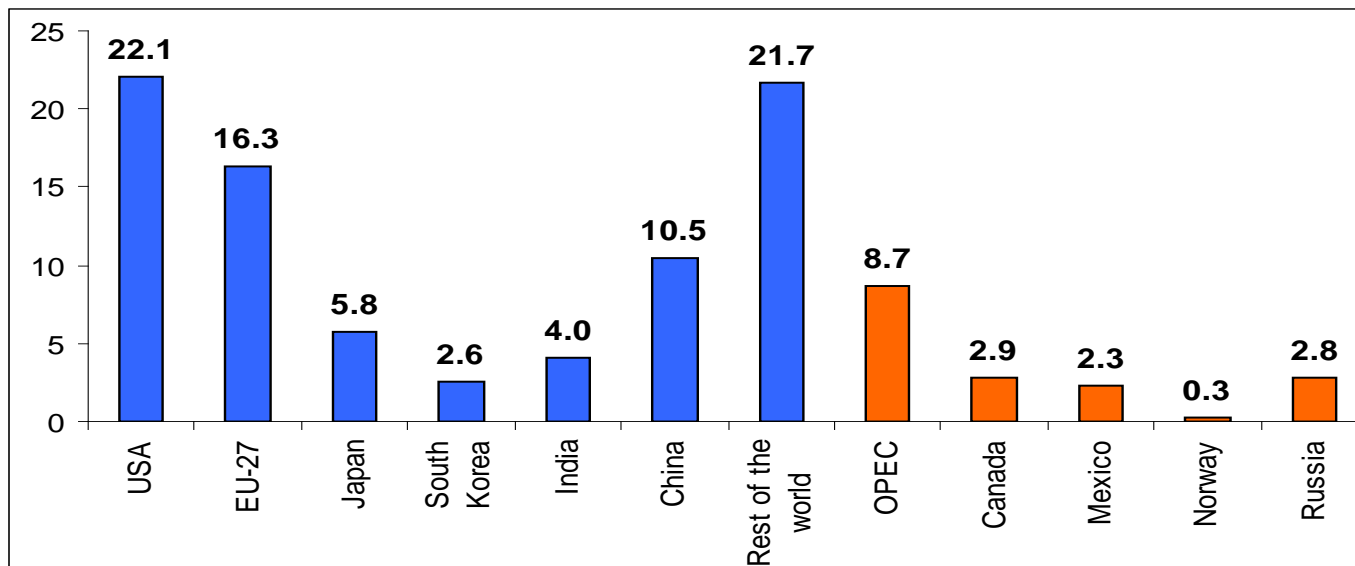
**Crude oil importers**   **Crude oil exporters**

Major oil exporters – OPEC, Russia, Canada, Mexico, Norway (oil exporters account for 64% of world oil supply and only 18% of world oil consumption).

Major oil importers – USA, EU-27, Japan, China, India, South Korea, rest of the world (oil importers account for 82% of world oil consumption and 36% of world oil supply).

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1. In mid-term run world oil supply will cover world oil consumption (the usage of world oil extraction capacities will not raise to 100%).

2. World oil demand at every point of time is equal to world oil supply.
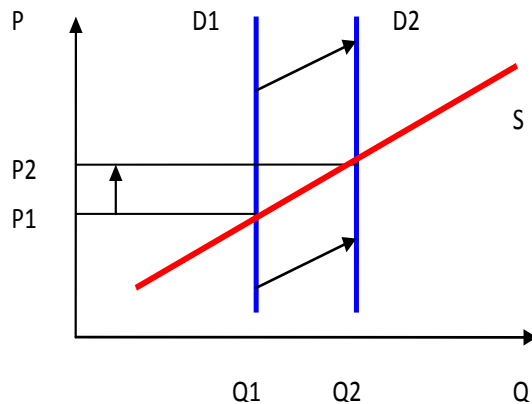
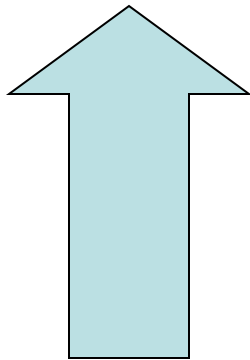P – world oil price,

D – world oil demand,

S – world oil supply.

Price elasticity of world oil demand is low enough, when world oil demand is estimated via world GDP and energy commodity price ratios. Hence, the demand of major oil consumers for oil imports is almost independent of world oil price. At the graph of demand and supply world oil demand in this case can be represented as vertical straight line.

Since the volume of world oil exports is known and equal to world oil imports, world oil price can be estimated via function of oil supply, where world oil price depends on world oil exports.

The assumption described above make possible to estimate world oil price on a basis of GDP growth rates of separate countries
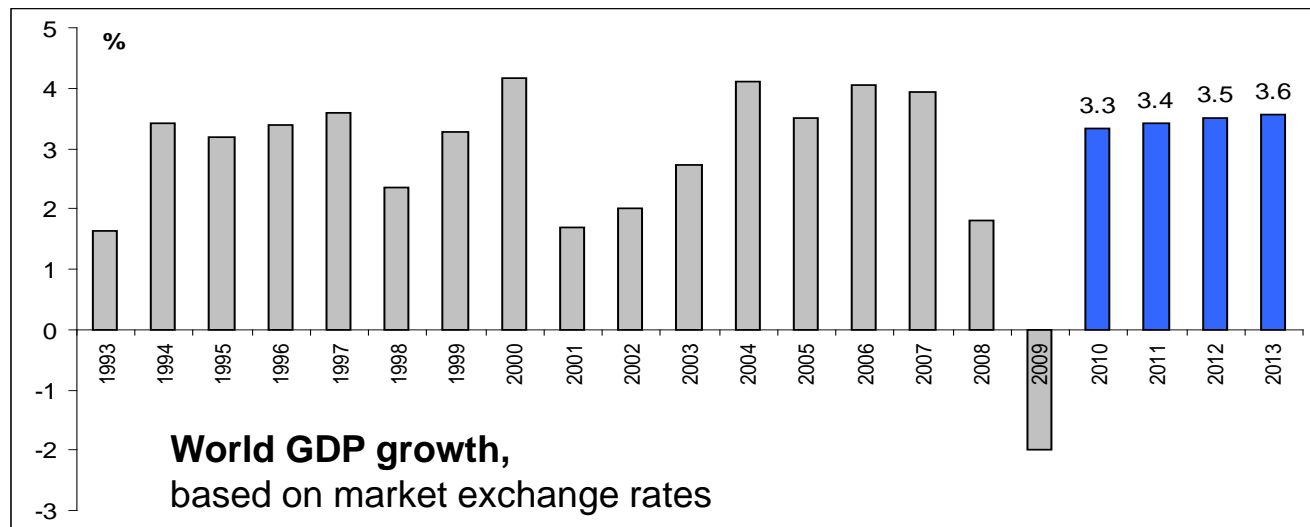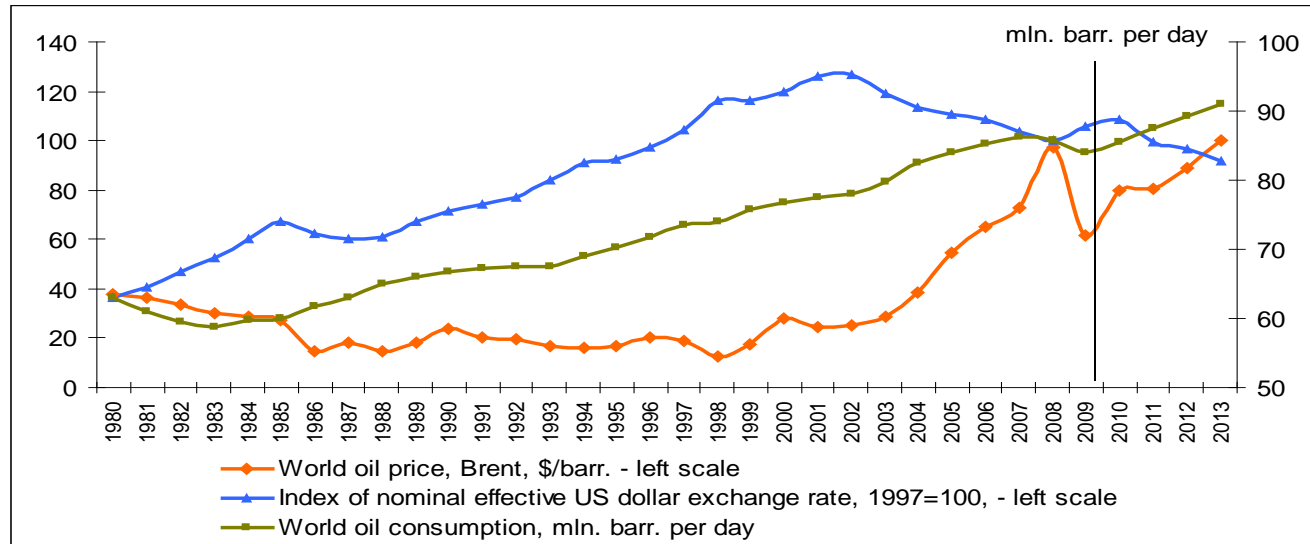
Main scenario variables, representing external conditions

Legend:
- World oil price, Brent, $/barr. - left scale
- Index of nominal effective US dollar exchange rate, 1997=100, - left scale
- World oil consumption, mln. barr. per day

Growth rates of world GDP, %

2010-2013 – forecast based on IMF projections

World GDP growth, based on market exchange rates

Equation for ruble/dollar exchange rate

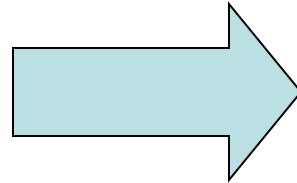**Rur_usd** = **f(-brent***(**ruex_oil**+**ruex_pet**); +(**us_gdp**/**us_gdp(-1)**)/(**ru_gdp**/**ru_gdp(-1)**))

Rur_usd – ruble/dollar exchange rate (rubles per 1 US dollar)
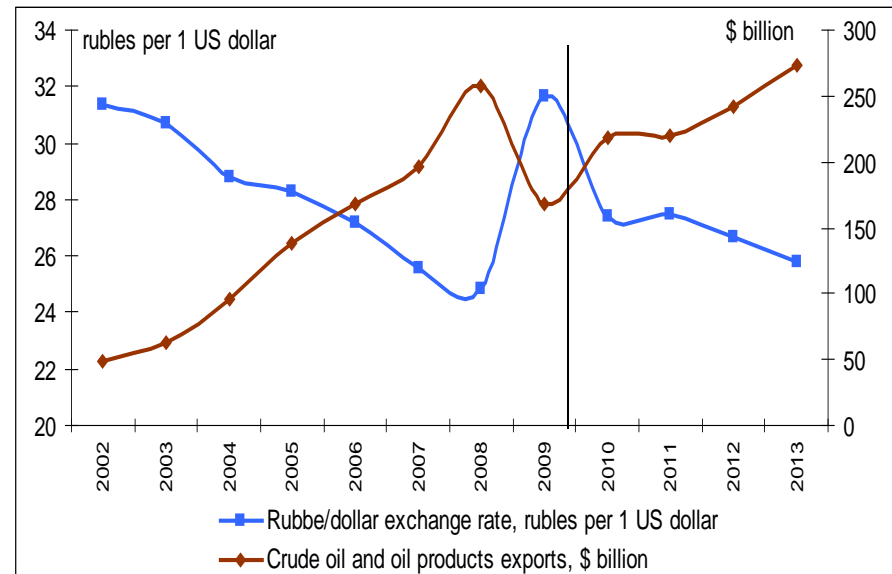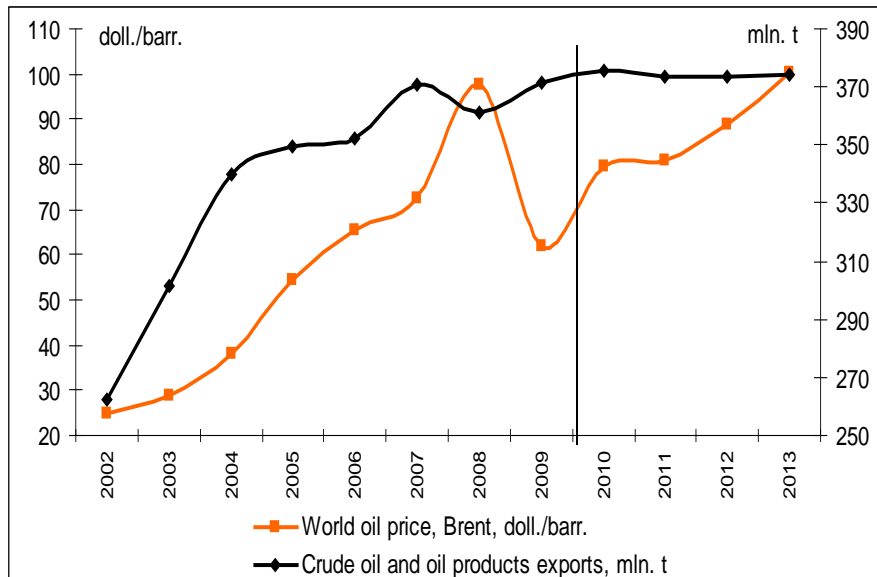brent – world oil price, brent, doll./barr.
ruex_oil, ruex_pet – exports of oil and oil products, mln. t
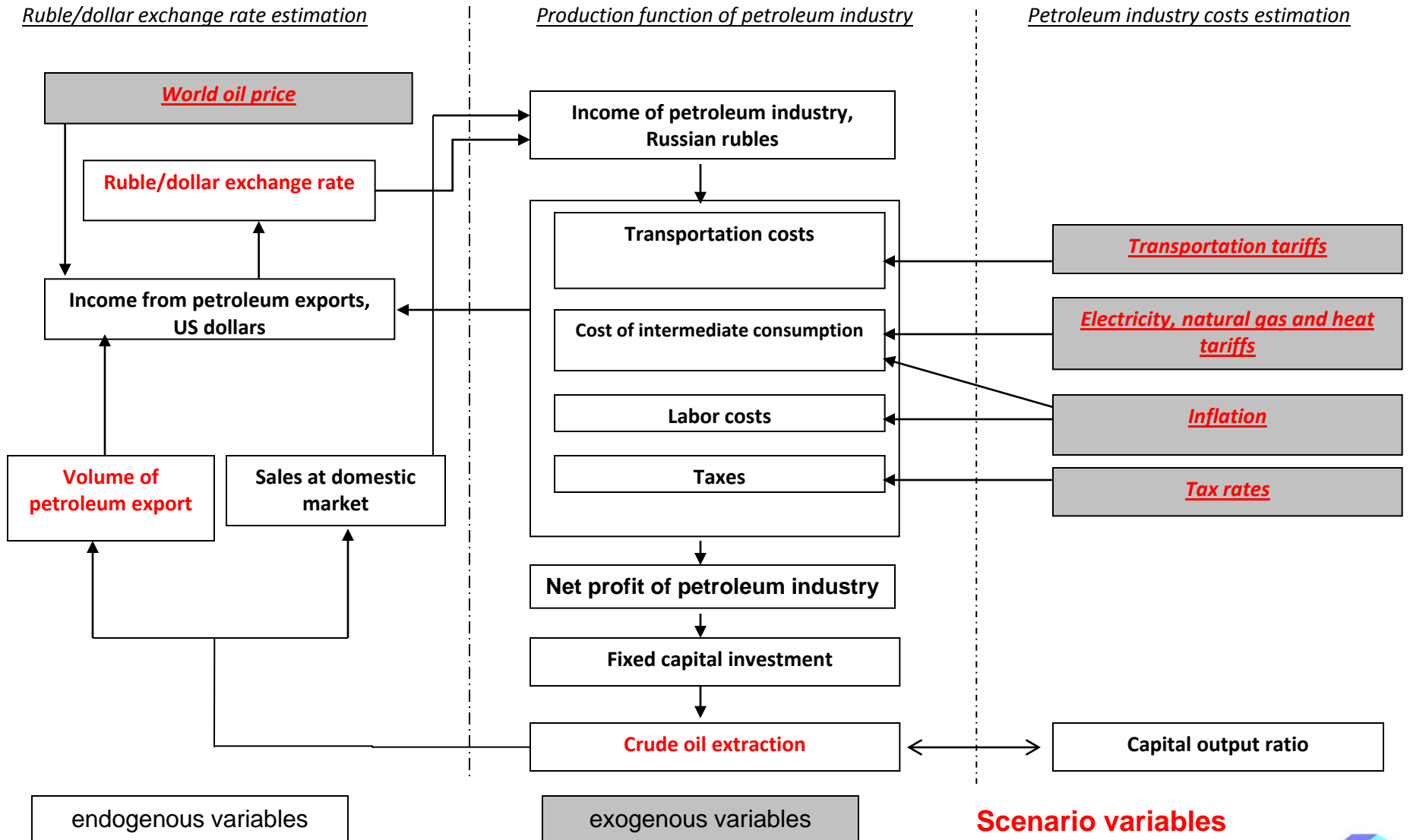us_gdp, ru_gdp – US and Russian GDP at a constant 2000 US dollars

World oil price and volume of petroleum export

Rubble/dollar exchange rate

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3. Net profit of petroleum industry and ruble/dollar exchange rate matching

Ruble/dollar exchange rate estimation

Production function of petroleum industry

Petroleum industry costs estimation

endogenous variables

exogenous variables

Scenario variables

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Comparison of scenarios worked out by Russian Ministry of Economic development and Institute of Economic Forecasting in June, 2010

## World oil price, $ per barrel

$/barr.

- 61.9 (2009)
- 78.1 / 76 (2010)
- 78.5 / 76 (2011)
- 84.7 / 78 (2012)
- 93.2 / 79 (2013)

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Ministry of Economic Development
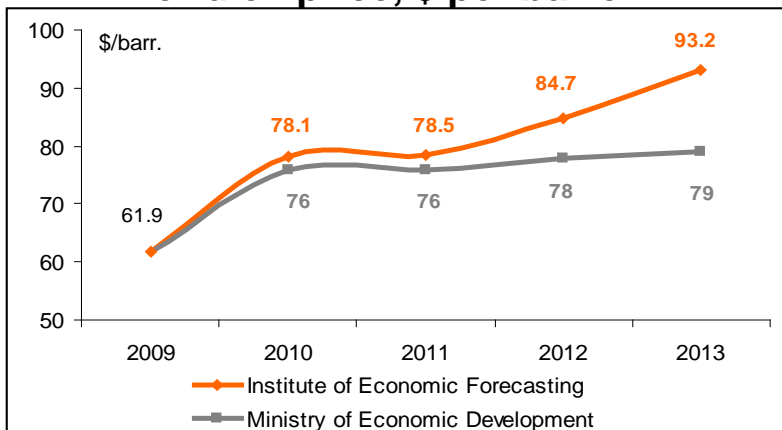
Value of petroleum export, $billion

$billion

- 168.1 (2009)
- 206.4 / 208.6 (2010)
- 207.4 / 206.9 (2011)
- 225.1 / 212.4 (2012)
- 247.0 / 215.1 (2013)

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Ministry of Economic Development

Rubble/dollar exchange rate

rubles per 1 US dollar

- 31.7 (2009)
- 27.6 / 29.1 (2010)
- 27.7 / 28.1 (2011)
- 27.2 / 27.6 (2012)
- 26.3 / 28 (2013)

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Ministry of Economic Development
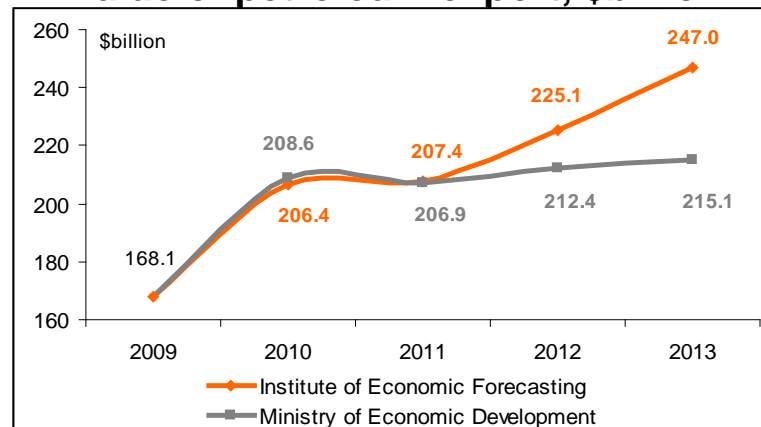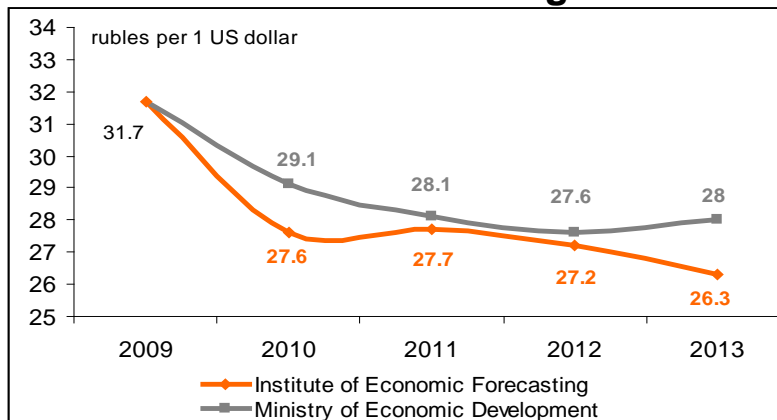
Exogenous variables equal for two scenarios	2010	2011	2012	2013
World GDP growth	4.0	3.9	4.0	3.7
CPI inflation, year-to-date	7.0	7.0	6.5	6.0

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The Bad:

• the solution of scenario problem shown above is a simplification of real economic interactions and a lot of them were left out of account;

• scenario consistency requires additional assumptions, which have essential influence on results.

The Good:

• we hope the implementation of proposed approach helps to clarify the procedure of scenario development and increases the consistency of exogenous variables.

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Total primary energy consumption

$$LOG (All) = 12.37 - 0.78*LOG (time) - 0.059*LOG (OGC[-2])$$

t-stat   (153.9)   (-35.3)   (-6.3)   adj. R-squared 0.99

Renewable energy consumption

$$LOG (Rest) = 0.78*LOG (ALL) + 0.1*LOG (OGC[-8])$$

t-stat   (649.7)   (7.11)   adj. R-squared 0.88

Petroleum consumption

$$OIL = 0.45*ALL – 384.9*(POIL[-2]/(OGC[-2])$$

t-stat   (32.9)   (-3.73)   adj. R-squared 0.98

Natural gas consumption

$$GAS = -0.73*COAL + 0.44*ALL -504.5*(PGAS/OGC)$$

t-stat   (-16.7)   (-38.7)   (-5.8)   adj. R-squared 0.95

Coal consumption

$$COAL = 7775.1 -1371.9*LOG (time) - 365.3*(PCOAL/OGC)$$

t-stat   (40.2)   (-35.8)   (-1.9)   adj. R-squared 0.97

All – total primary energy consumption (BTU per GDP)
OIL, GAS, COAL, REST – petroleum, natural gas, coal and renewables consumption (BTU per GDP)
OGC – average energy price (US dollar per BTU)
POIL, PGAS, PCOAL – prices for crude oil, natural gas and coal (US dollar per BTU)

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Crude oil demand (demand for crude oil imports) is defined as a difference between oil importers consumption and production

Crude oil production in oil importing countries

$Prod\_c = 8805+0.699*Prod\_c[-1]+0.088*brent(-1)*usd\_rateind$
t-stat   (5.7)   (12.9)   (3.27)   adj. R-squared 0.96

Demand for imports in oil importing countries
$Im\_c = Con\_c - Prod\_c = Ex\_p$

World oil price
Brent $= -102.3+0.066*$**Ex_p**-0.87 **usd_rateind**
t-stat   (-4.8)   (10.1)   (4.66)   adj. R-squared 0.86

Natural gas price
$P\_Gas = 0.95+0.06*Brent$
t-stat   (23.6)   (10.2)   adj. R-squared 0.96

Coal price
$P\_Coal = 13.1+0.95*Brent$
t-stat   (3.7)   (9.9)   adj. R-squared 0.77

Index of nominal effective US dollar exchange rate

$usd\_rateind = 805.6-220.9*((GDP\_world-GDP\_usa)/GDP\_usa)) – 553.8*(OilCon\_usa/(OilCon\_world-OilCon\_usa))$
t-stat   (14.9)   (14.1)   (-8.0)   adj. R-squared 0.92

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