THE MODELING OF THE ECOLOGICAL AND HEALTH SITUATION IN RUSSIA WITH USING INPUT-OUTPUT MODEL

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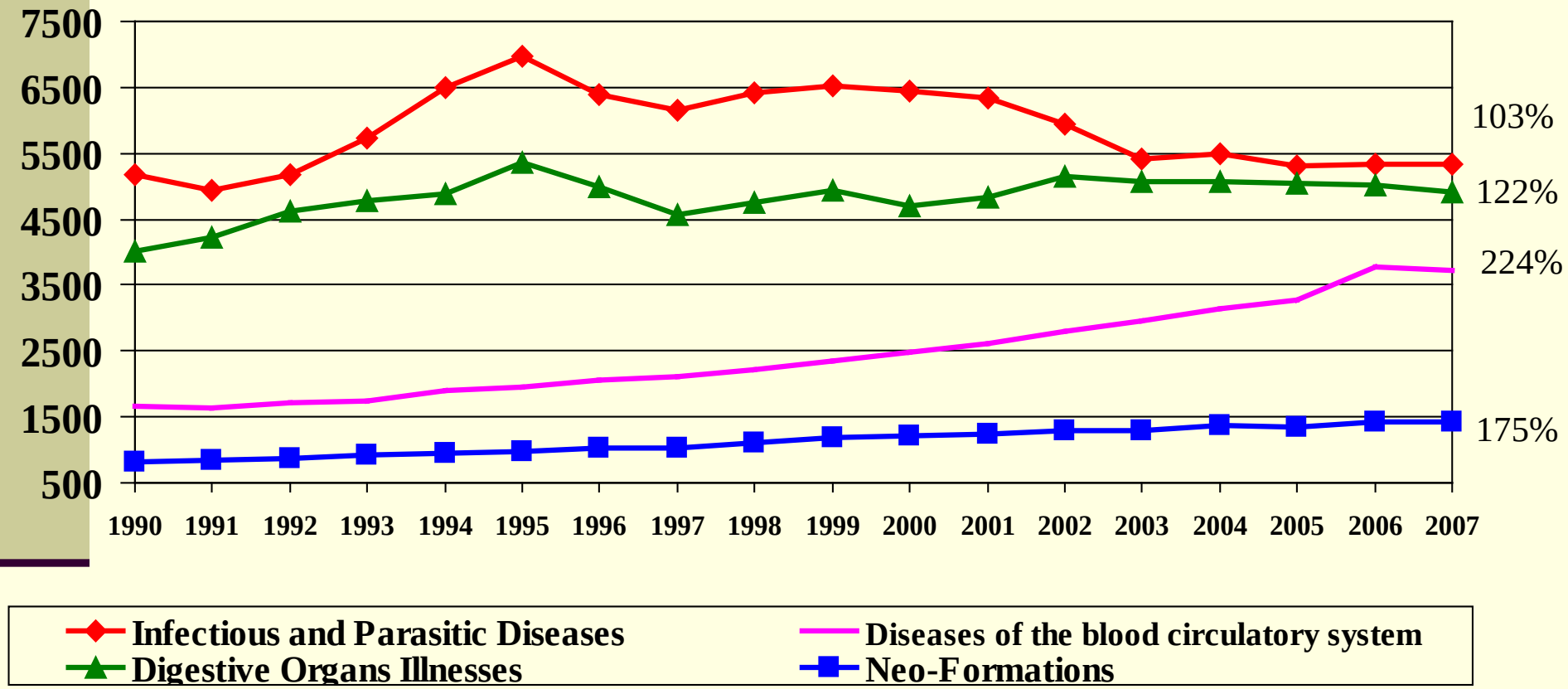
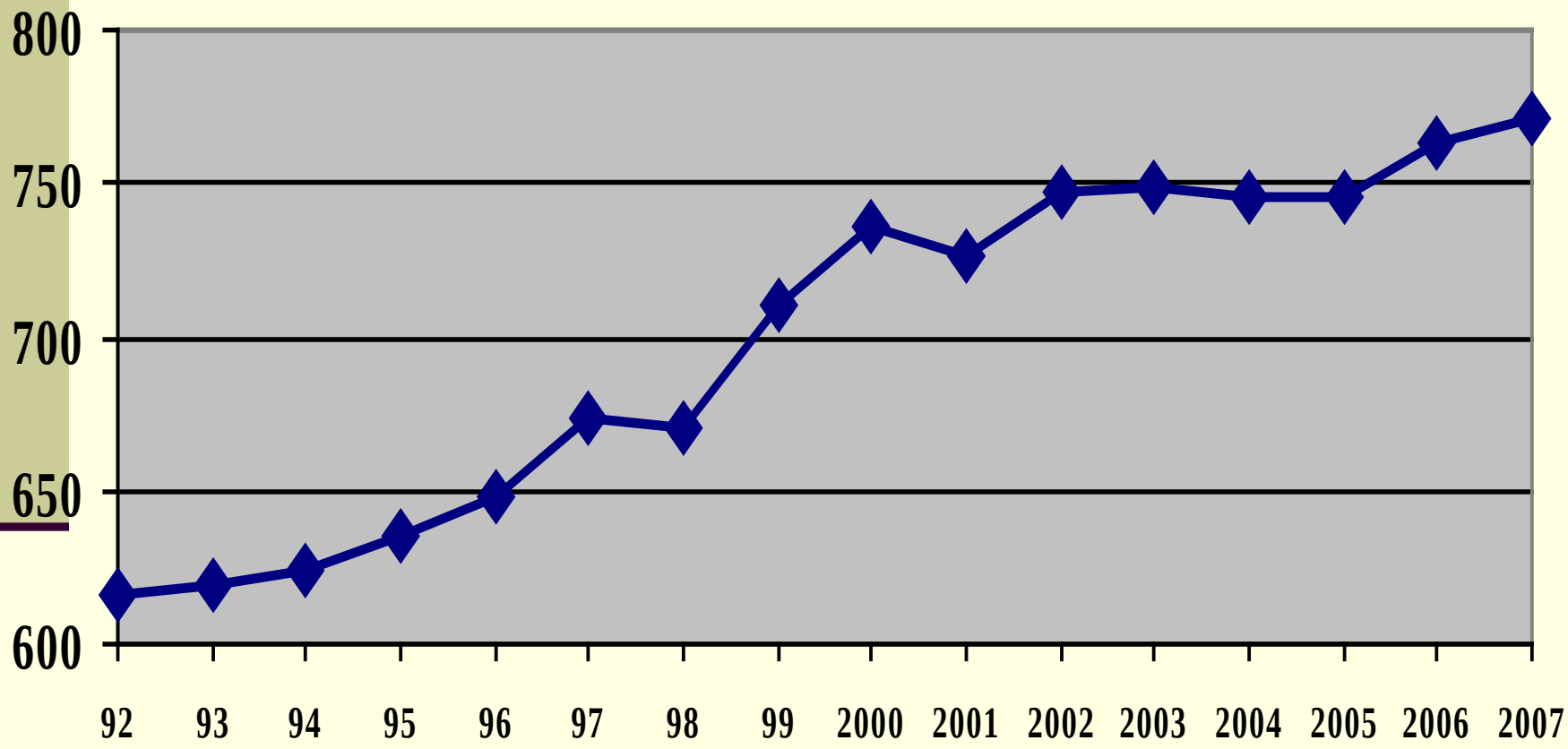
Morbidity Groups in Basic Illness (thou peoples)
(registered patients with the first diagnosed disease)



Morbidity in Russia

(registered patients with the first diagnosed disease for every thousand people)



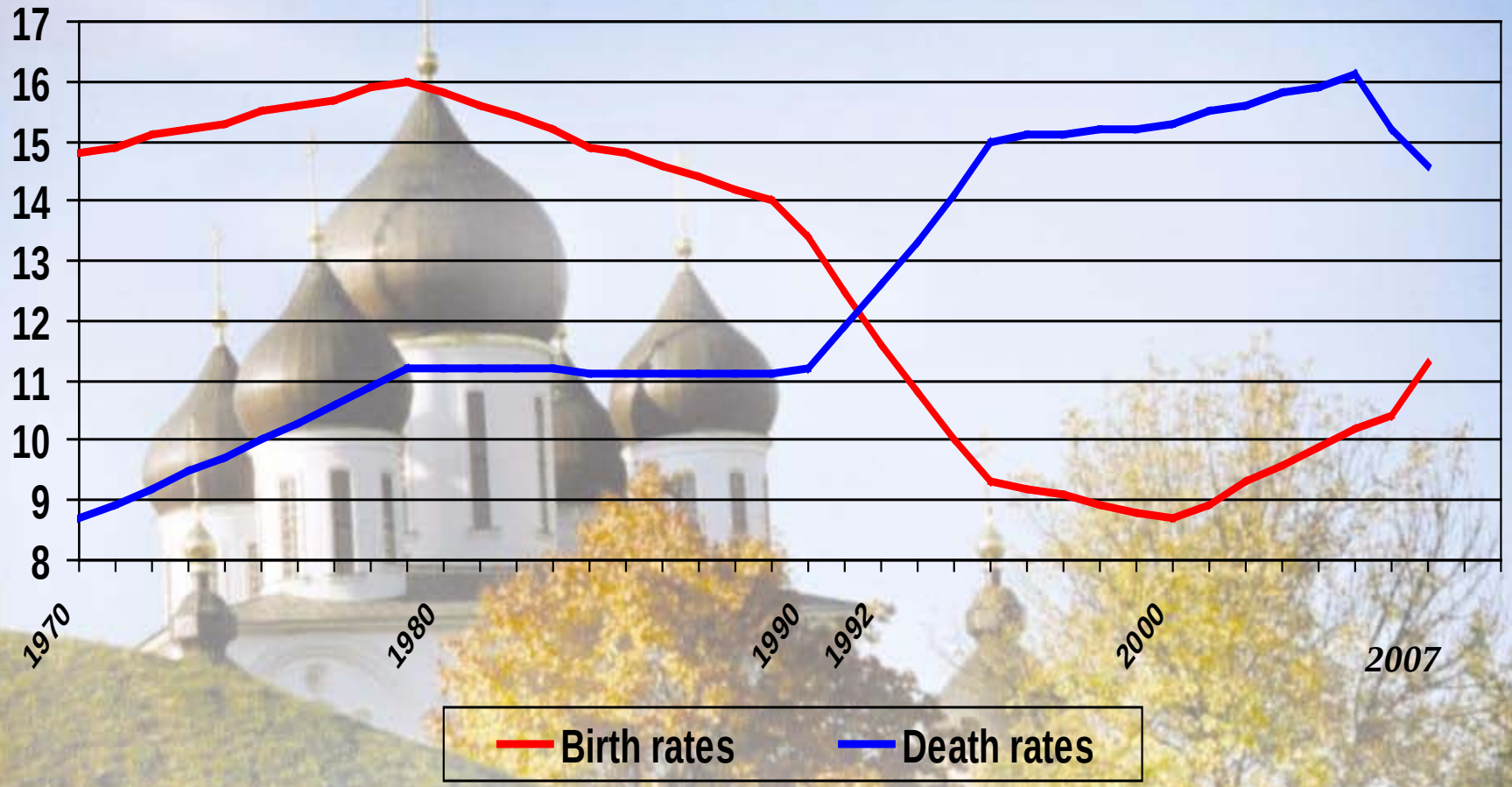
Population Reproduction
(thou peoples)

	Number of Birth	Number of Death	Increase (+) or Decrease (-) of Population
1990	1988,9	1656,0	+332,9
1995	1363,8	2203,8	-840,0
2000	1266,8	2225,3	-958,5
2003	1477,3	2365,8	-888,5
2004	1502,5	2295,4	-792,9
2005	1457,4	2303,9	-846,5
2006	1479,6	2166,7	-687,1
2007	1610,1	2080,4	-470,3

Vital Events Statistics

(per 1,000 people)

Years	Birth rates	Death rates	Rates of natural increase (+), decrease (-)
1990	13.4	11.2	+2.2
1995	9.3	15.0	-5.7
2000	8.7	15.3	-6.6
2005	10.2	16.1	-5.9
2006	10.4	15.2	-4.8
2007	11.3	14.6	-3.3
Australia (2006)	12.9	6.5	6.4
China (2006)	12.1	6.8	5.3
USA (2006)	14.2	8.1	6.1
France (2007)	13.1	8.6	4.5
Sweden (2007)	11.7	9.9	1.7



The General Coefficients of the Birth Rate and Mortality (per 1,000 people)

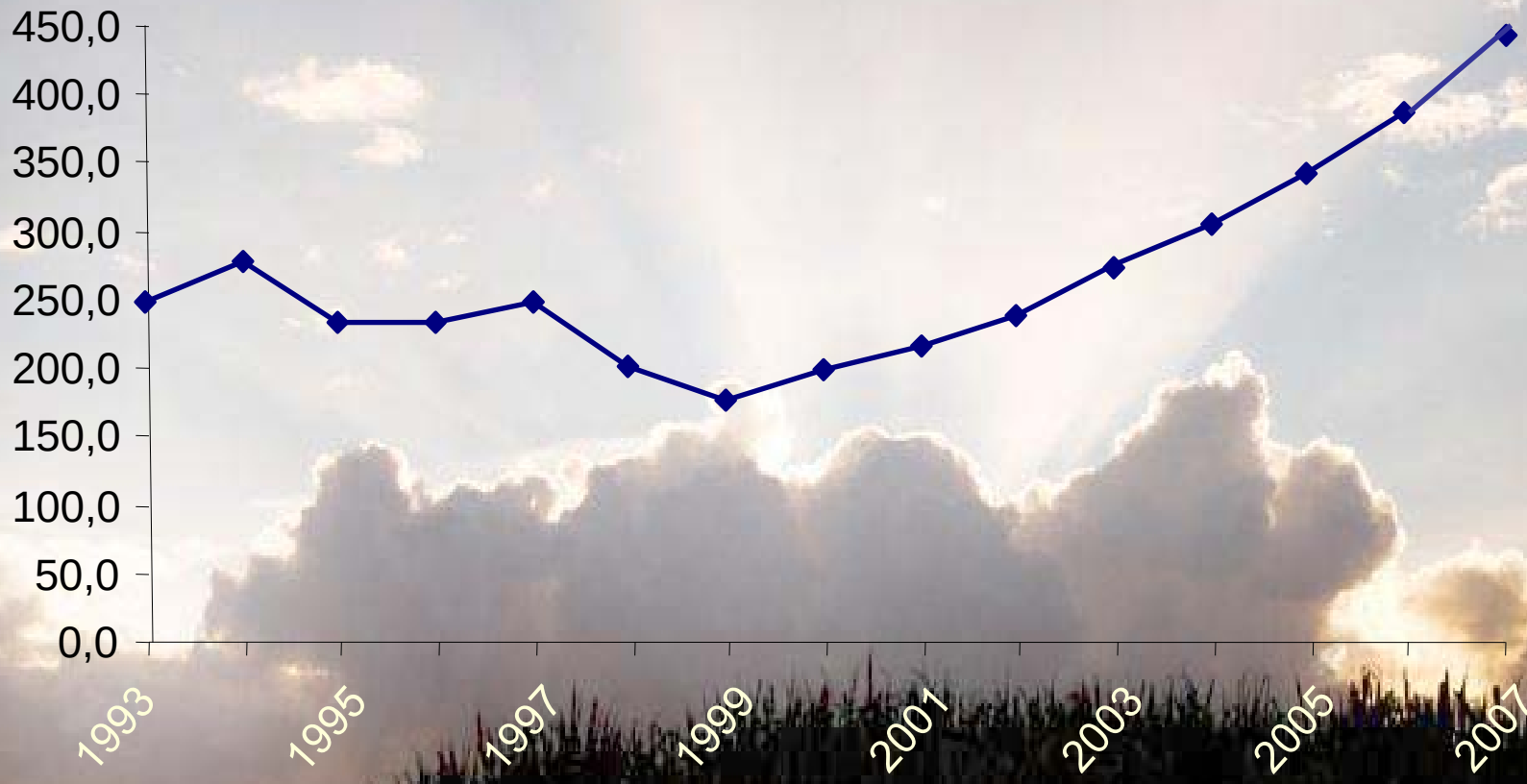
Expecting Life Length (number of years)

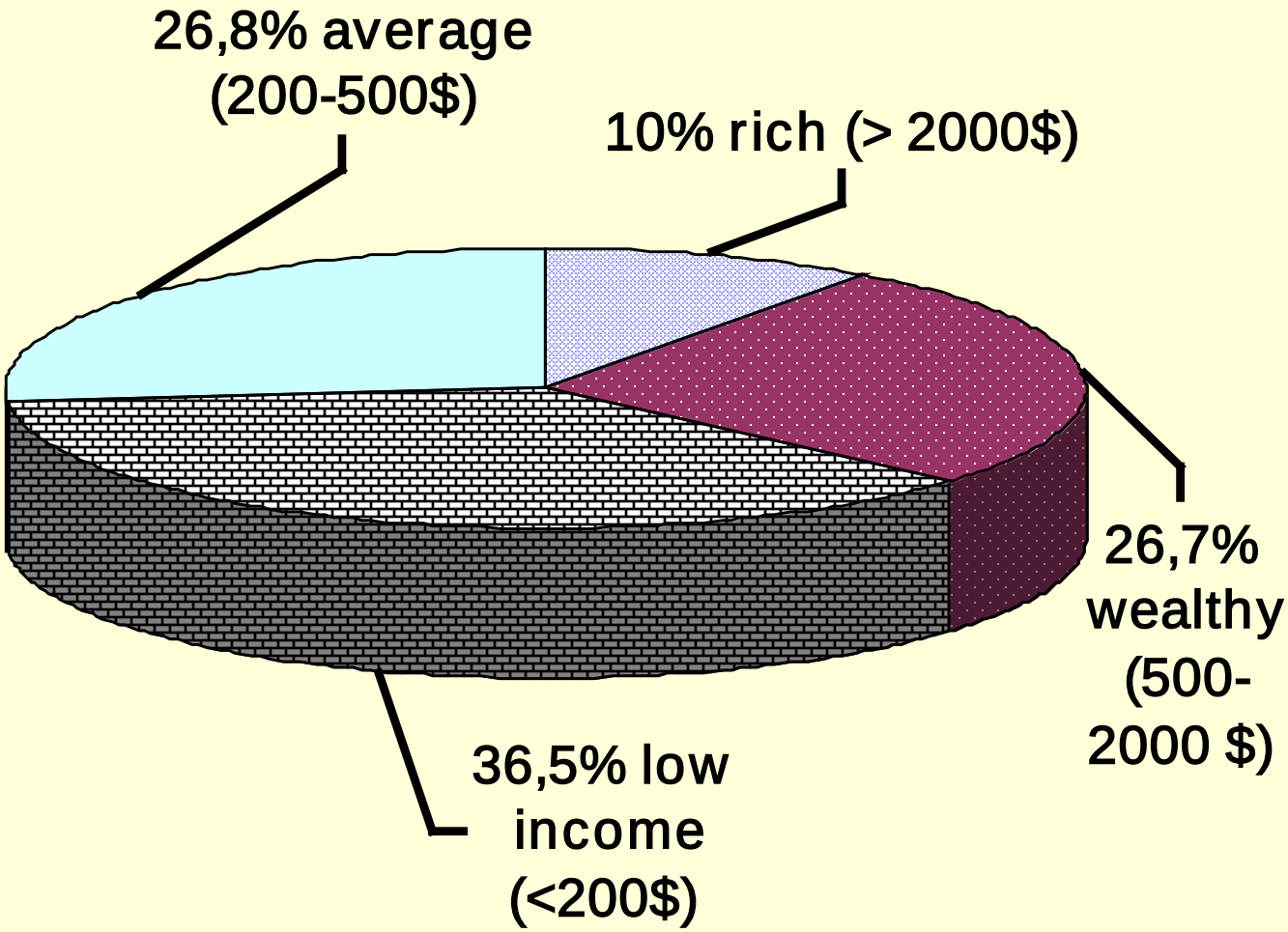
Years	Common Rate	Male	Female
1990	69.2	63.8	74.3
1995	64.6	58.3	71.7
2000	65.3	59.0	72.2
2003	64.9	58.6	71.8
2007	67.5	61.4	73.9
Bulgaria (2006)	72.7	69.2	76.3
Germany (2006)	79.9	77.2	82.4
Great Britain (2005)	79.1	77.1	81.1
USA (2005)	77.9	75.2	80.4
France (2006)	81.1	77.4	84.4
Japan (2005)	82.3	78.7	85.7

Health risk factors:

- **1) economic**
- **2) psychological**
- **3) the general level of culture**
- **4) the level of medical care and preventive health care**
- **5) the environmental situation in the country**

Average Monthly Real Income per Capita ($ USA, prices of 2006)

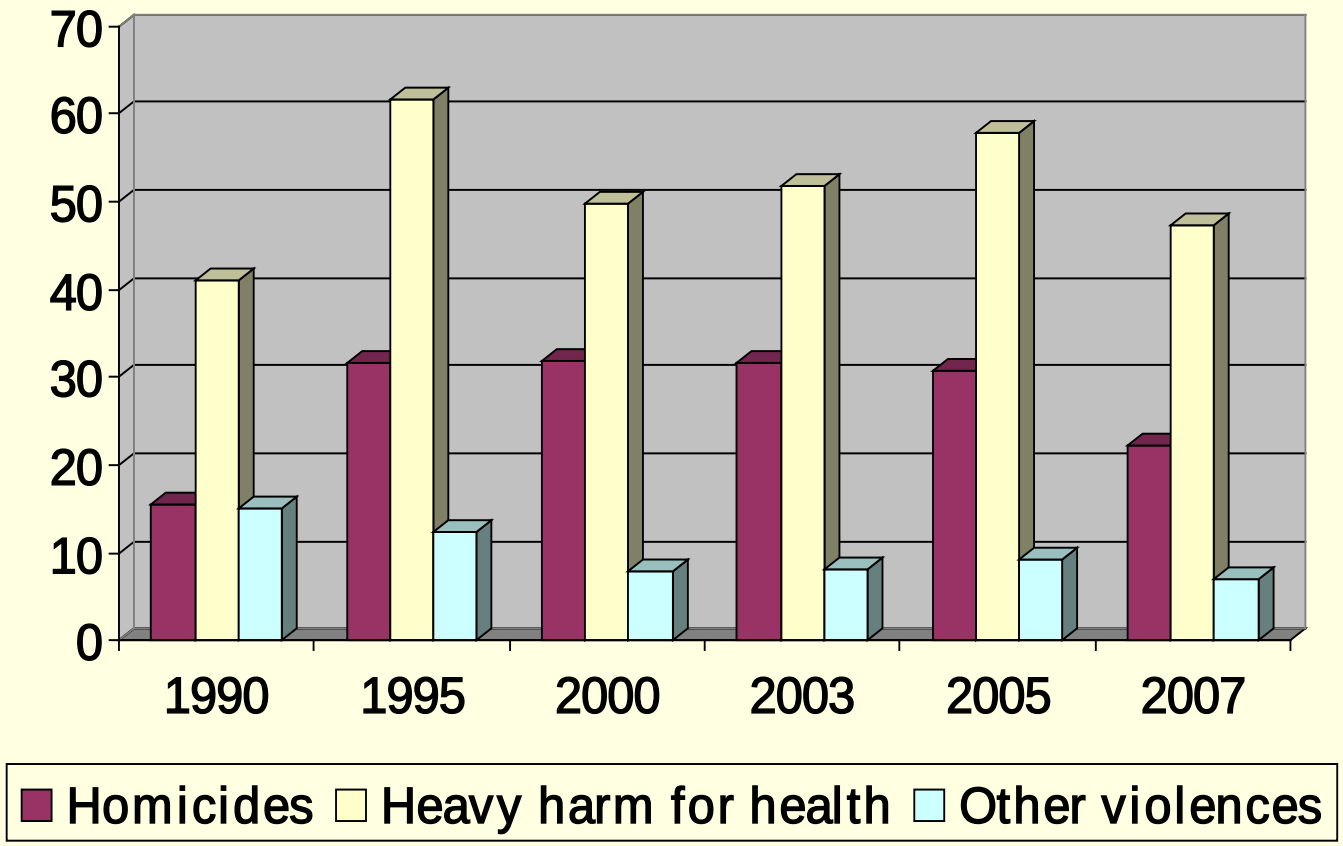




The structure of the population size having different income per person a month in 2007

Number of Crimes Registered

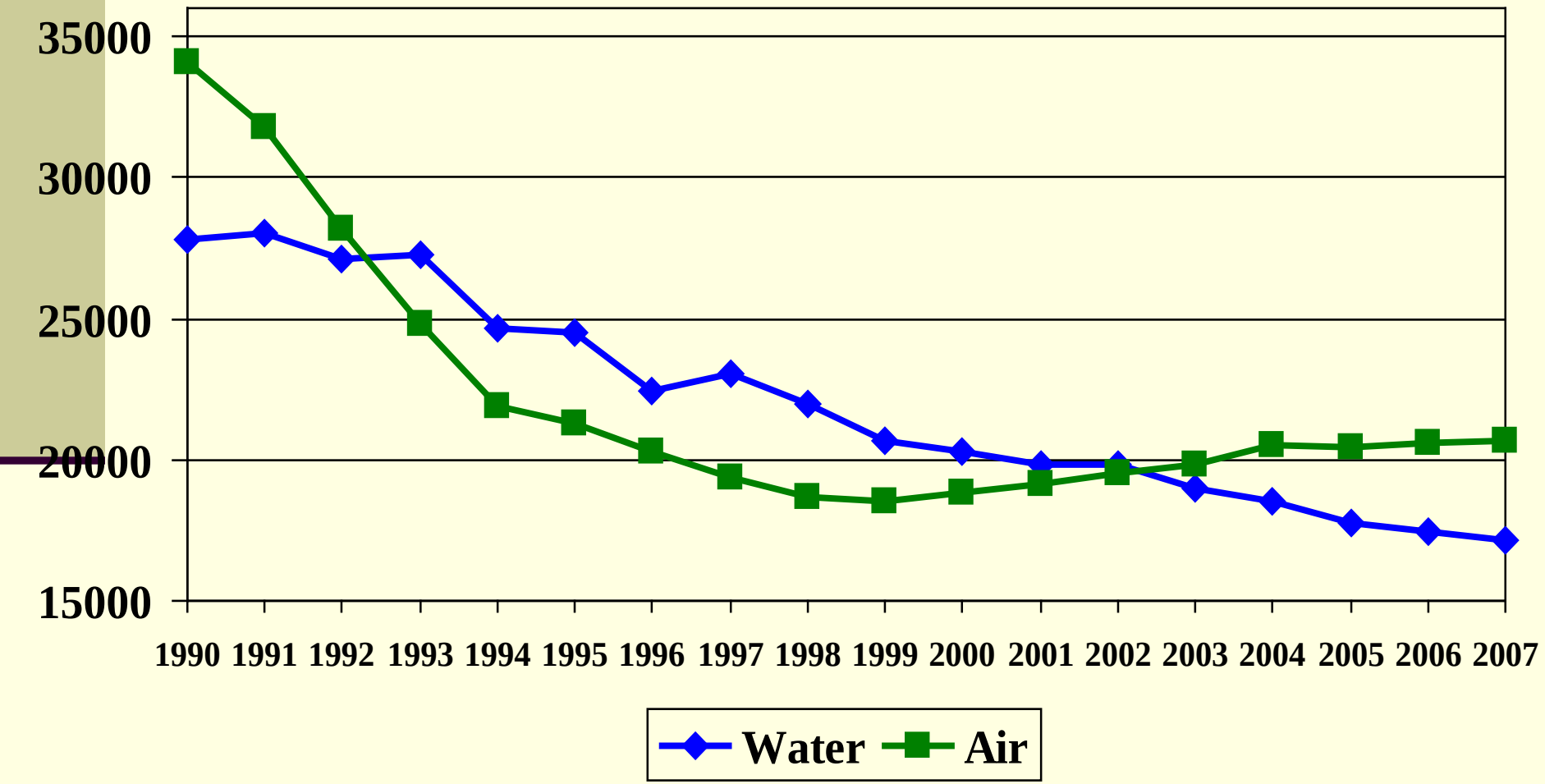
(thou cases)



Quantitative Data of Public Health in Russia

	1990	1995	2000	2006	2007
A number of medical institutions	12762	12064	10704	7500	6800
A number of beds (thousands)	2037,6	1850,5	1671,6	1559,8	1522,1
A number of beds per 10, 000 people	137,5	125,8	115,0	108,8	107,2

Volumes of Waste Water Disposals (million cubic m) and Emissions (thou tons) in Russia



Coefficients of Water Pollution

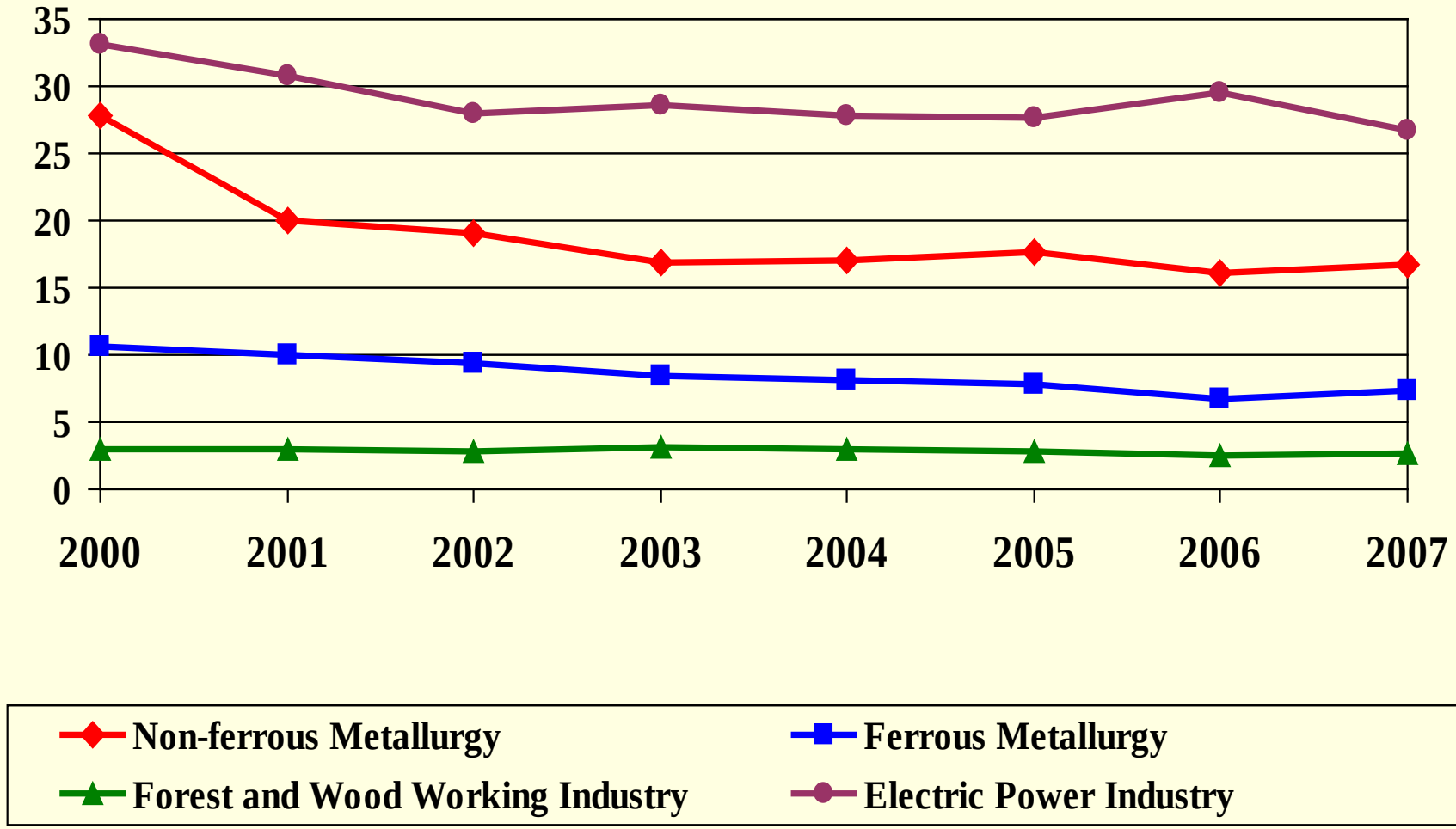
(cubic m per 1 thou Rbl, before 1998 - per 1 million Rbl)

and Air Pollution

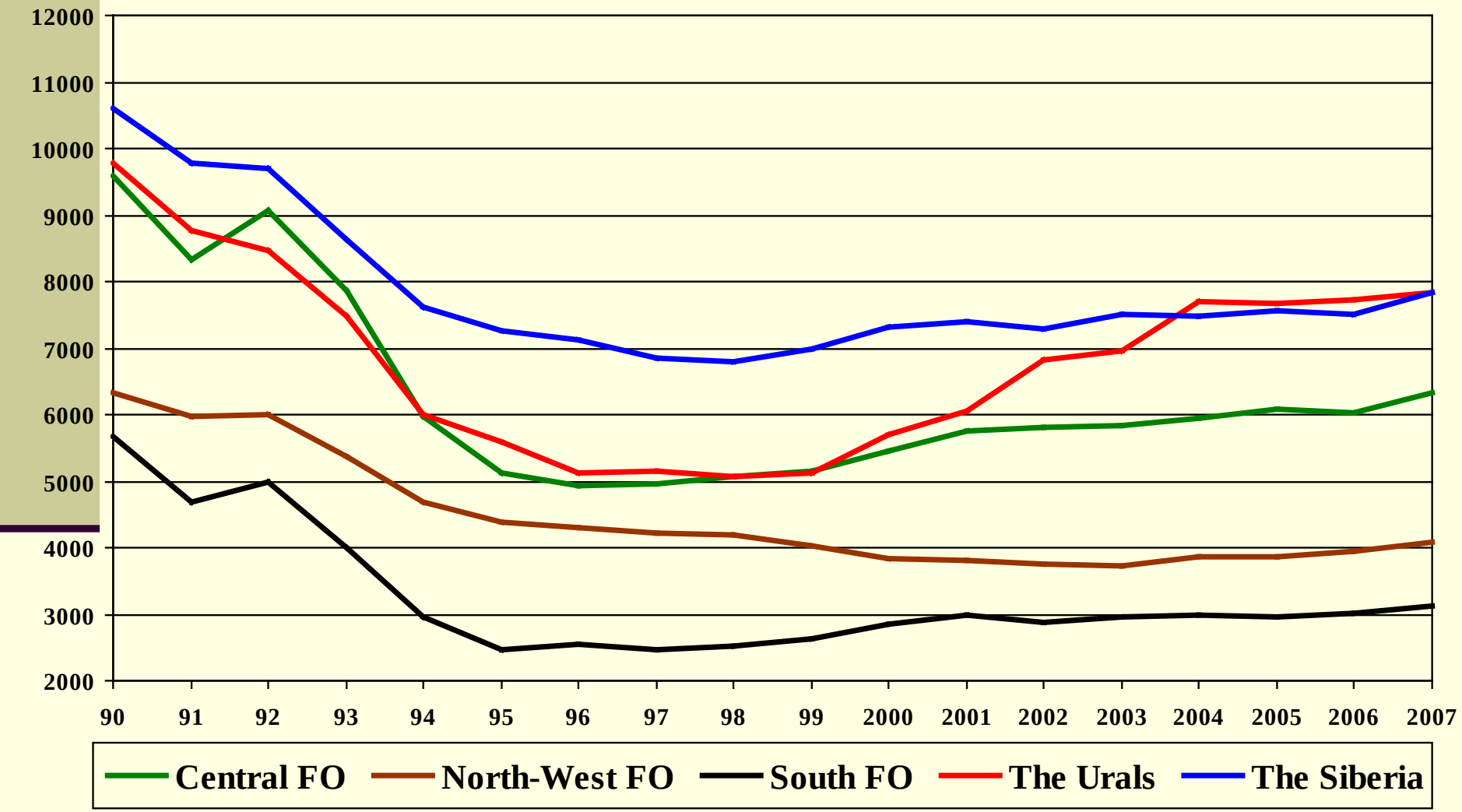
(tons per 1 million Rbl, before 1998 - per 1 billion Rbl), price of 2003.

	1990	1997	2000	2003	2007
Coefficients of sewage formation per unit of Gross Product	0.78	1.49	1.13	0.90	0.63
Coefficients of waste water disposals per unit of GDP	1.63	2.23	1.81	1.43	0.98
Coefficients of air-pollutant formation per unit of Gross Product	3.51	4.48	4.23	3.27	2.70
Coefficients of emissions per unit of GDP	1.78	1.70	1.68	1.50	1.18

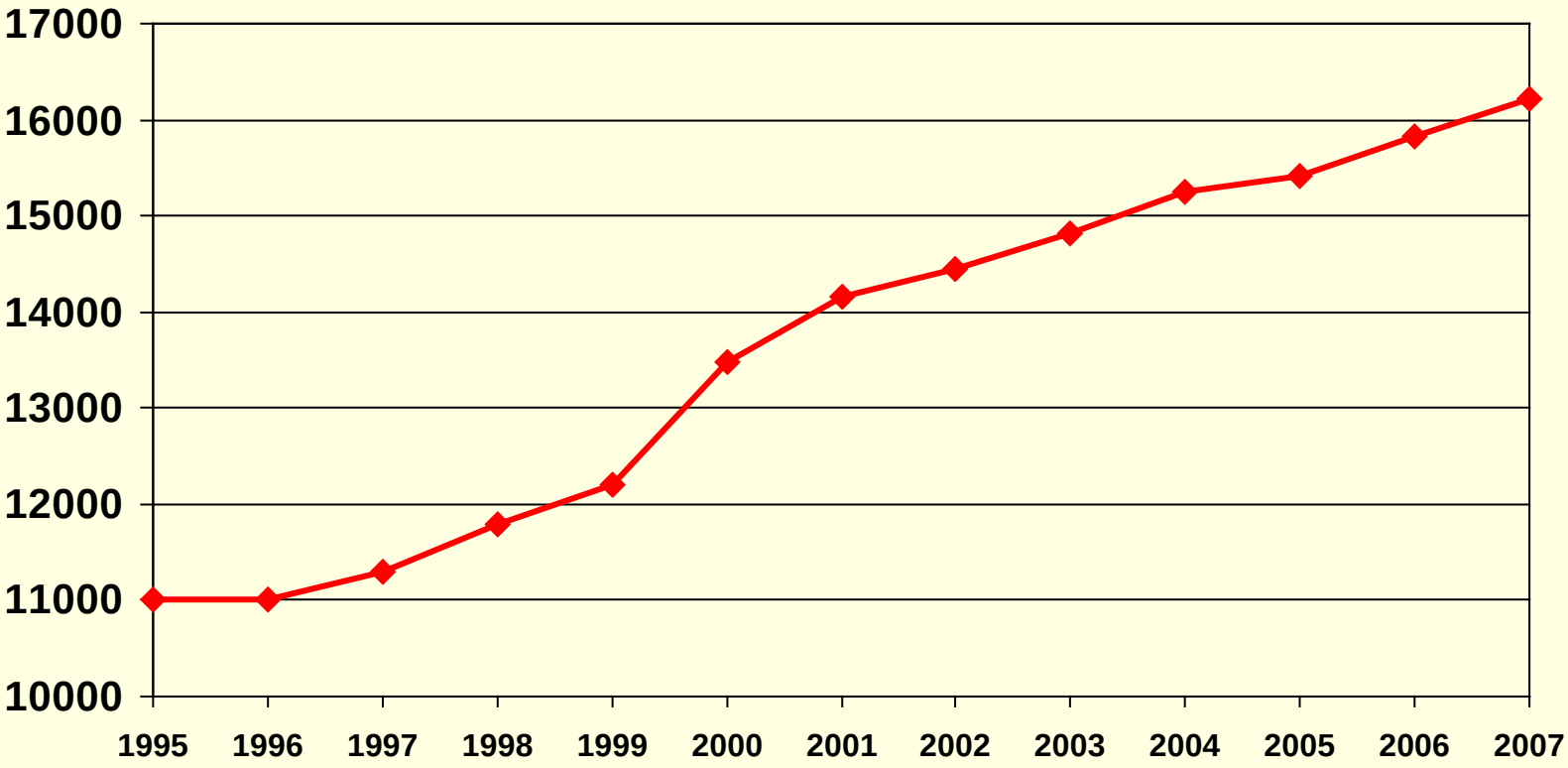
Coefficients of Air-pollutant Formation per Unit of Product (tons per 1 million Rbl, price of 2003)



Volumes of Emissions in Federal Okrugs (FO), thou tons



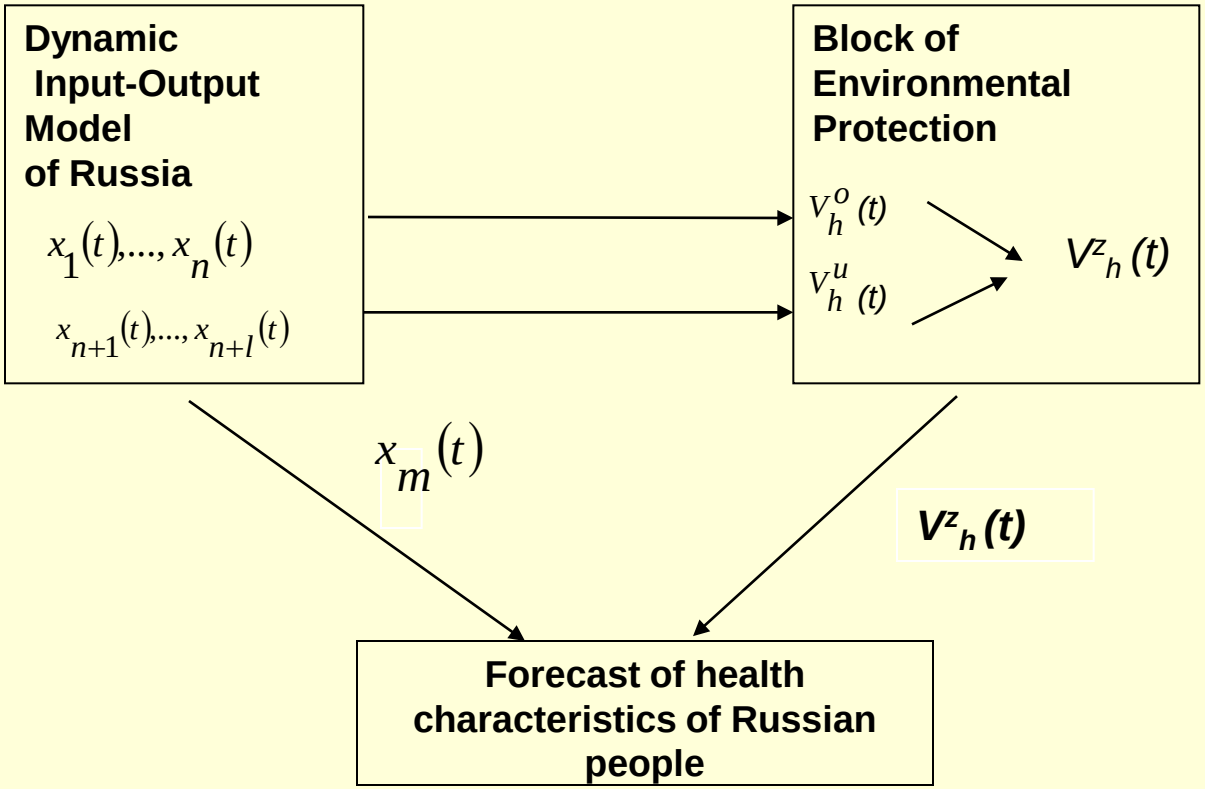
Motor Transport Emission of Polluting Substances into Atmosphere (thousand tons)



Prevalence of Chronic Pathology Forms among Children on an Average in Russia and in the Ecologically Unfavorable Territories (cases per 1,000 children)

Diseases	Russia	Ecologically unfavorable territories
Chronic diseases of nose and accessory sinuses of nose	21	31
Chronic tonsillitis	116	239
Chronic otitis	7	9
Allergic diseases	35	180
Food allergy among children of early age	70	400
Bronchial asthma	10	24
Respiratory allergosis	48	122
Recurrent bronchitis	6	94
Vascular dystonia	12	144
Gastritis, gastroduodenitis	60	180
Nephropathy	33	187
Nervous system affection:		
encephalopathy, cerebral spastic infantile paralysis	30	50
IQ < 70%	30	138
congenital malformation	11	140

Model Apparatus of Forecast Calculations



$x(t) = (x_1(t), ..., x_n(t), x_{n+1}(t), ..., x_{n+l}(t))$

$x_i(t), i = 1, ..., n$ gross output of industry *i* in year *t*

$x_{n+h}(t)$ h=1,…,l current environmental protection cost for natural resource h

$$V_h^o(t) = \sum_{i=1}^{n} w_{ih}(t) x_i(t) + D_h(t)$$

w_{ih} – coefficient of pollutant *h* formation (volume of polluted natural resource *h,* referred to manufacturing of a unit of production of industry *i*)

$D_h(t)$ - output of pollutant *h* (volume of pollution or destruction of a natural resource) in household.

$$x_{n+h}(t) = \sum_{i=1}^{n} g_{ih}(t) V_{ih}^u(t)$$

$$V_h^u(t) = \sum_{i=1}^{n} V_{ih}^u(t)$$

$g_{ih}(t)$ – current cost to recover unit of natural resource *h* (to destroy or to trap unit of pollutant *h*) in industry *i*

$V_h^u(t)$ – volume of a recovered natural resource (destroyed or trapped pollutant) of type *h*

$$V_h^z(t) = V_h^o(t) - V_h^u(t)$$

- volume of pollutant *h* (a polluted natural resource) that gets into the natural environment without purification (or by volume of destroyed but not reproduced natural resource)

Two scenarios of the forecast were based on the following basic assumptions:

1. The dynamics of macroeconomic and sectoral indices in 2008 corresponded to the reporting data of the Federal Statistical Service of the Russian Federation.

2. The dynamics of macroeconomic and sectoral indices in 2009 were estimated with the help of reporting information of the Federal Statistical Service of the Russian Federation for four months of 2009. It was assumed that annual dynamics would not differ greatly from growth rates in the first quarter of 2009.

3. Both scenarios of the forecast proceed from the assumption that after 2009 there will be no explosive industrial recovery.

The first scenario of the forecast was constructed on the basis on the following assumptions:

A. In 2010 the economy would start to emerge gradually from the crisis. In these conditions, demand for Russian exported good would grow, which would stimulate economic growth in Russia.

B. Measures taken to stabilize the Russian financial system would give noticeable results in 2010 that would result in increased crediting of business and population, which, in its turn, would lead to a gradual increase of economic growth rates.

Dynamics of Branch Outputs of Russian Economy in 2008-2012 according to the First Scenario (%, 2008 year = 100%)

	2009	2010	2011	2012
GDP	93,3	95,2	100,3	108,7
Extractive industry	91,2	92,9	95,7	98,8
Manufacturing industry	80,6	82,2	85,3	91,0
including Machine-building industry	85,2	88,1	101,4	120,1
Power engineering	94,2	90,1	91,5	94,9
Agriculture	101,5	104,2	103,8	105,9
Construction	83,1	82,1	88,2	99,9
Transport	84,7	87,3	88,1	91,5
Trade	99,9	102,9	111,9	126,9
Other branches of material production	98,6	85,5	87,9	93,6
Non-material service	91,2	89,2	94,6	103,6

The second scenario of the forecast was constructed on the basis on the following assumptions:

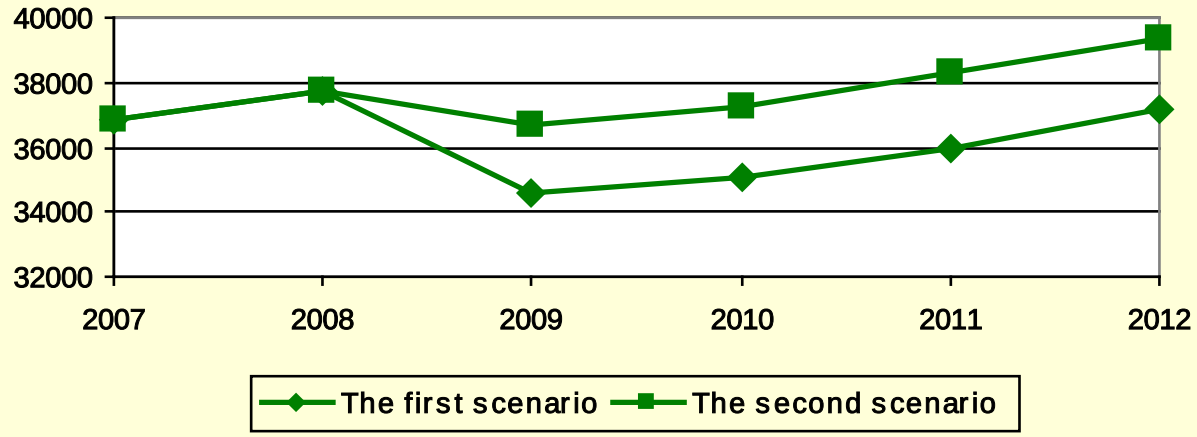
A. Measures taken to stabilize world economy would be starting to bring positive results by the end of 2009 already. And the slump of production in 2009 would not be so great as first variant.

B. Beginning with 2010, there would be economic recovery in the USA, European Union and Japan; there would be greater economic growth in China and other key countries of the world economy. This would lead to an increase of demand for traditionally exported Russian goods and would stimulate a noticeable production recovery in Russia by 2010 already. World economic growth would also encourage the stabilization of the Russian banking system, which would get an opportunity to attract financial resources from abroad.

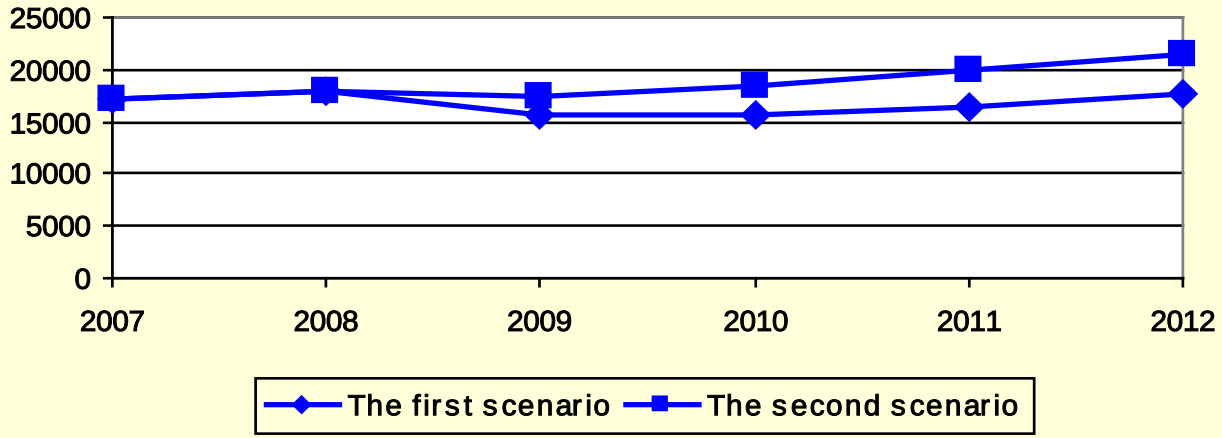
Dynamics of Branch Outputs of Russian Economy in 2008-2012 according to the Second Scenario (%, 2008 year = 100%)

	2009	2010	2011	2012
GDP	95,3	99,4	107,5	116,6
Extractive industry	95,6	97,0	99,2	102,0
Manufacturing industry	92,4	93,8	99,6	105,5
including Machine-building industry	85,7	93,6	112,7	134,0
Power engineering	96,0	97,2	99,2	99,7
Agriculture	101,5	102,6	106,8	110,8
Construction	82,7	85,6	96,2	108,7
Transport	87,5	88,1	91,5	95,1
Trade	94,6	102,4	116,7	135,4
Other branches of material production	88,4	89,9	95,2	101,0
Non-material service	101,5	109,0	120,5	132,8

Amount of Emission Polluting the Atmosphere (thousand tons) according to Results of Forecasting Estimates



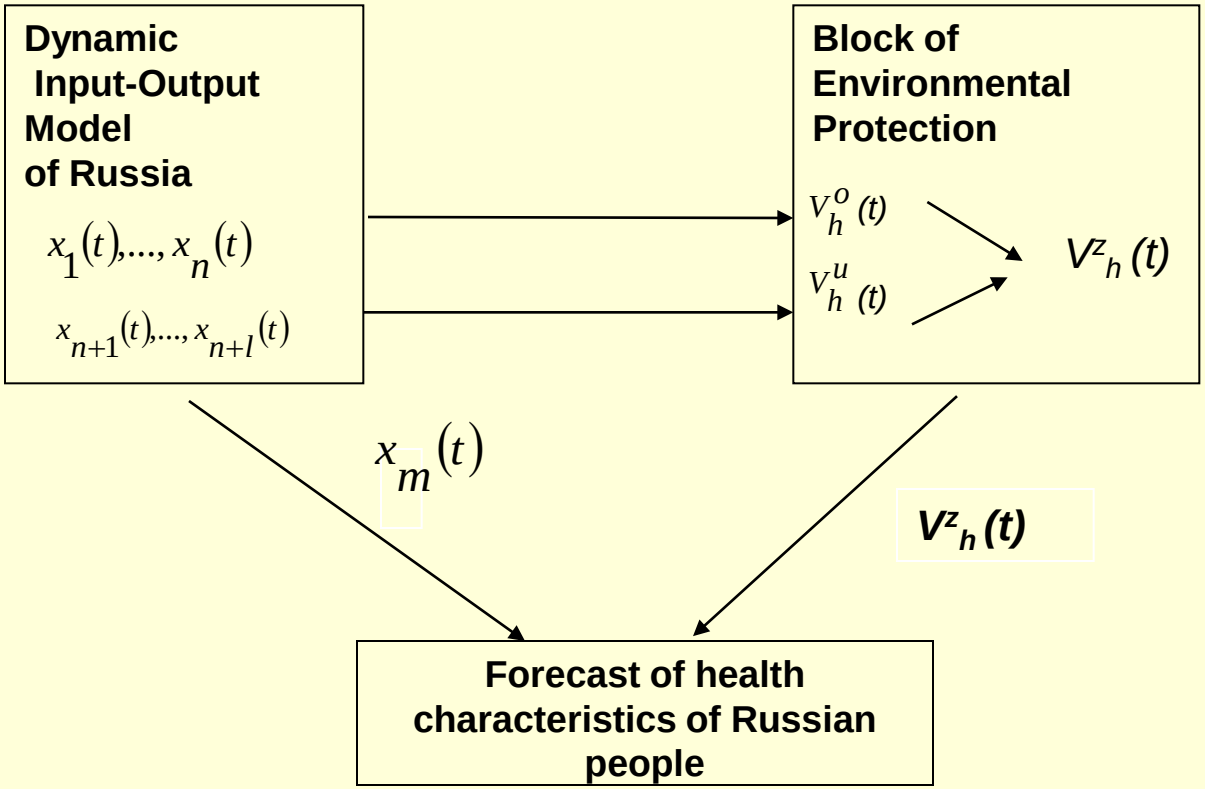
Amount of Waste Water Discharge (mln. cubic meters) according to Results of Forecasting Estimates



Prognostic Coefficients of Water Pollution (cubic m per 1 thou Rbl) and Air Pollution (tons per 1 million Rbl), price of 2003.

		2008	2009	2010	2011	2012
Coefficients of waste water disposals per unit of GDP	1st	0.95	0.92	0.88	0.85	0.83
	2d	0.95	0.89	0.87	0.84	0.83
Coefficients of emissions per unit of GDP	1st	1.12	1.02	0.98	0.93	0.89
	2d	1.12	0.99	0.93	0.86	0.80

Model Apparatus of Forecast Calculations



Equation of Sickness Rate in 2007

(the number of registered cases per 1,000 people)

No	Variable	Measurement unit	Coefficient	Stand. deviation	Validity level (%)
1	Constant		1052,4	97,9	99,9
2	Average per capita atmospheric emissions	Kg /person	0,153	0,07	96.8
3	Average air temperature in July	C	-14,68	4,95	99,6
4	Unemployment rate	%	-4,41	1,89	97,8
R^2 = 28,5%, reliability level 99,9%. Normality of residual distribution 99,9%					

Equation of Respiratory Organs Sickness Rate in 2007

(number of registered cases per 1,000 people)

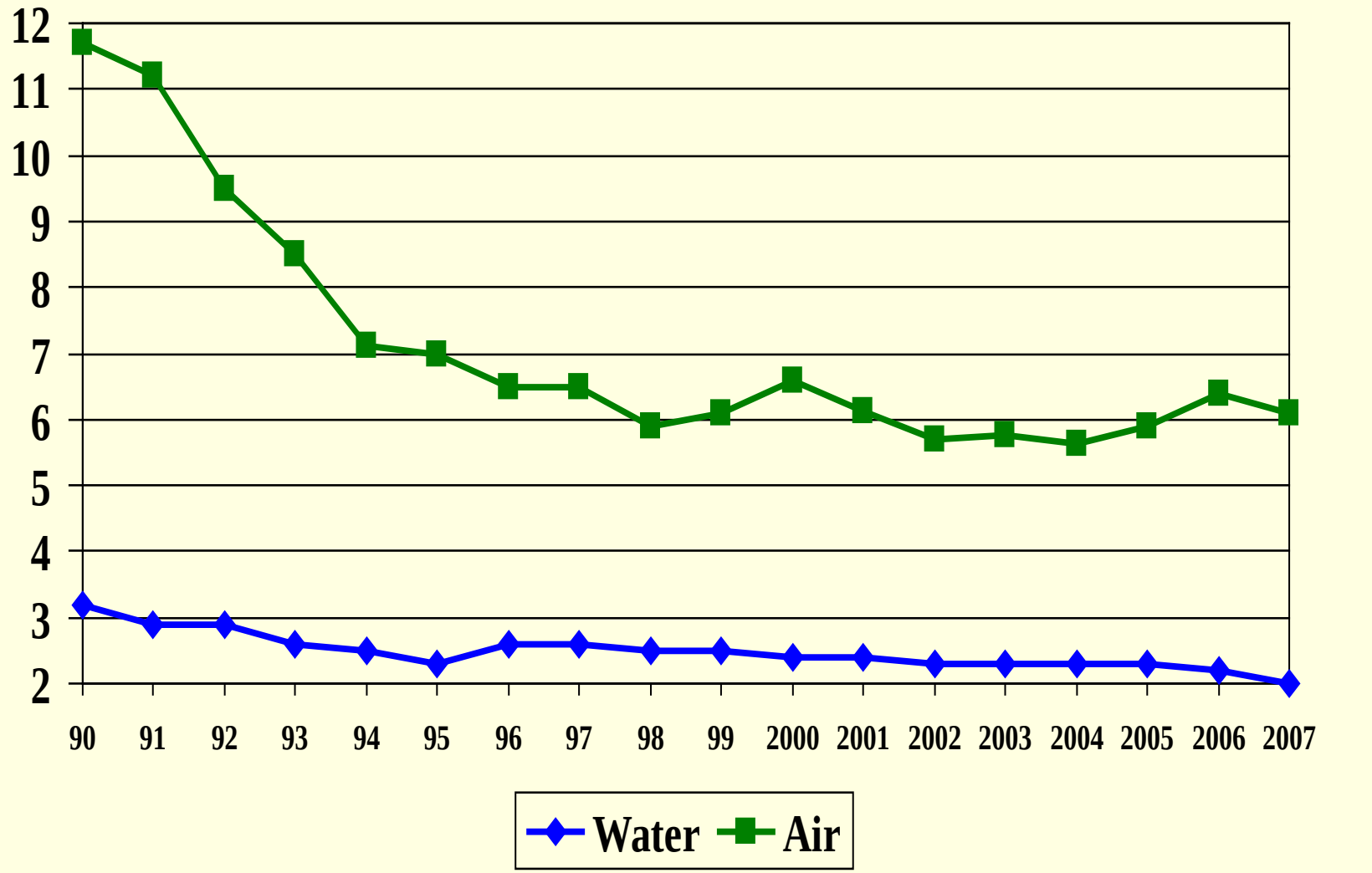
No	Variable	Measurement unit	Coefficient	Stand. deviation	Validity level (%)
1	Constant		92,6	51,3	92,5
2	Average per capita emission of greenhouse gases	Kg / person	0,097	0,052	93,2
3	Average number of hospital beds by year end	beds per 1000 people	8,568	2,367	99,9
4	Share of urban population	%	1,53	0,541	99,4
5	Unemployment rate	%	-1,77	0,95	93,4
R^2 = 46.9%, reliability level 99,9%. Normality of residual distribution 99,9%					

Dynamics of Average per Capita Atmospheric Emission and the Number of “Freshly” Sick in 2008-2012

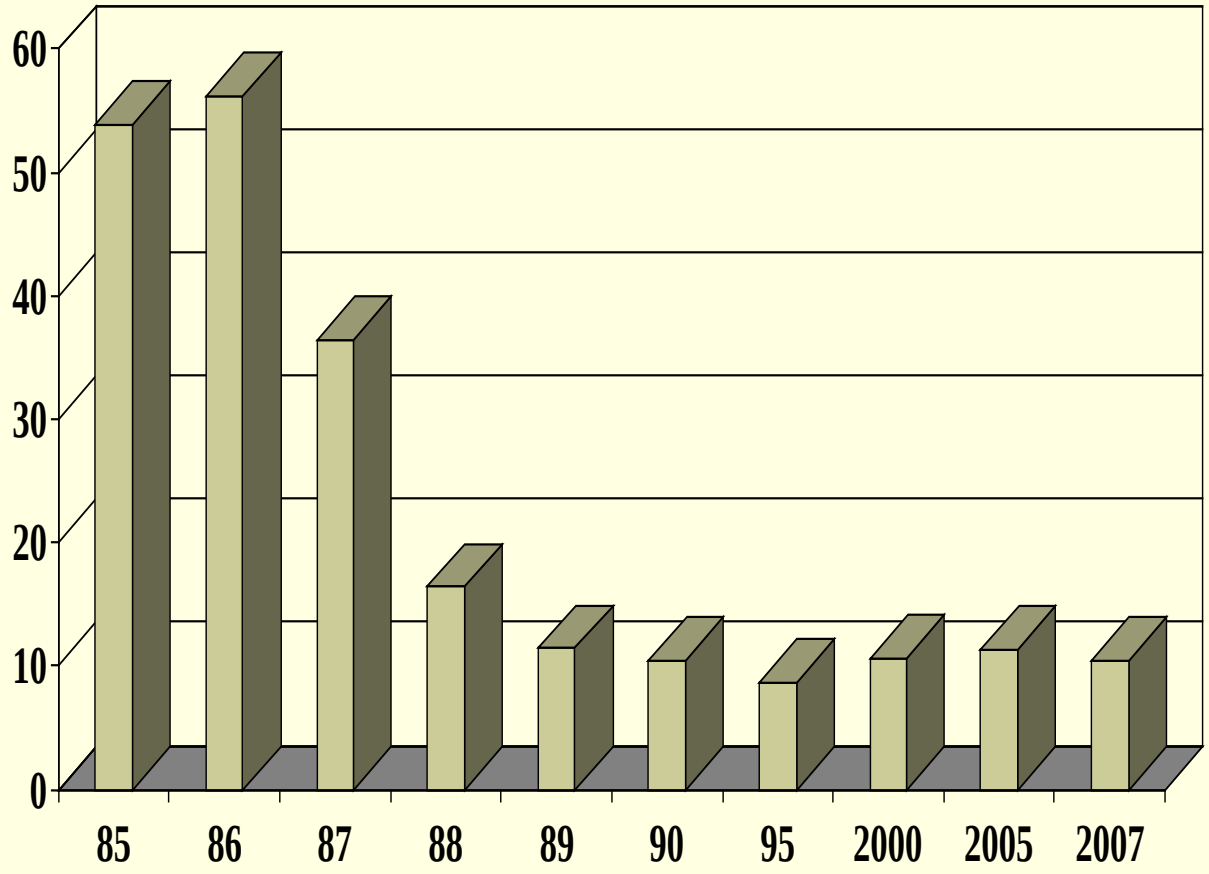
	2008	2009	2010	2011	2012
The first scenario					
The increase of average per capita atmospheric emission (kg per person in comparison with previous year)	**+6,5**	**-22,5**	**+3,6**	**+6,0**	**+8,6**
The growth in the numbers of “freshly” sick by ecological reason (thousand people in comparison with previous year)					
in average	**141,0**	**-488,0**	**78,1**	**130,1**	**186,5**
low limit	**33,5**	**-116,0**	**18,6**	**30,9**	**44,3**
high limit	**248,5**	**-860,1**	**137,6**	**229,4**	**328,7**
The second scenario					
The increase of average per capita atmospheric emission (kg per person in comparison with previous year)	**+6,5**	**-7,3**	**+4**	**+7,4**	**+7,2**
The growth in the numbers of “freshly” sick by ecological reason (thousand people in comparison with previous year)					
in average	**141,0**	**-158,3**	**86,8**	**160,5**	**156,2**
low limit	**33,5**	**-37,6**	**20,6**	**38,1**	**37,1**
high limit	**248,5**	**-279,0**	**152,9**	**282,9**	**275,2**

Thanks for your attention !

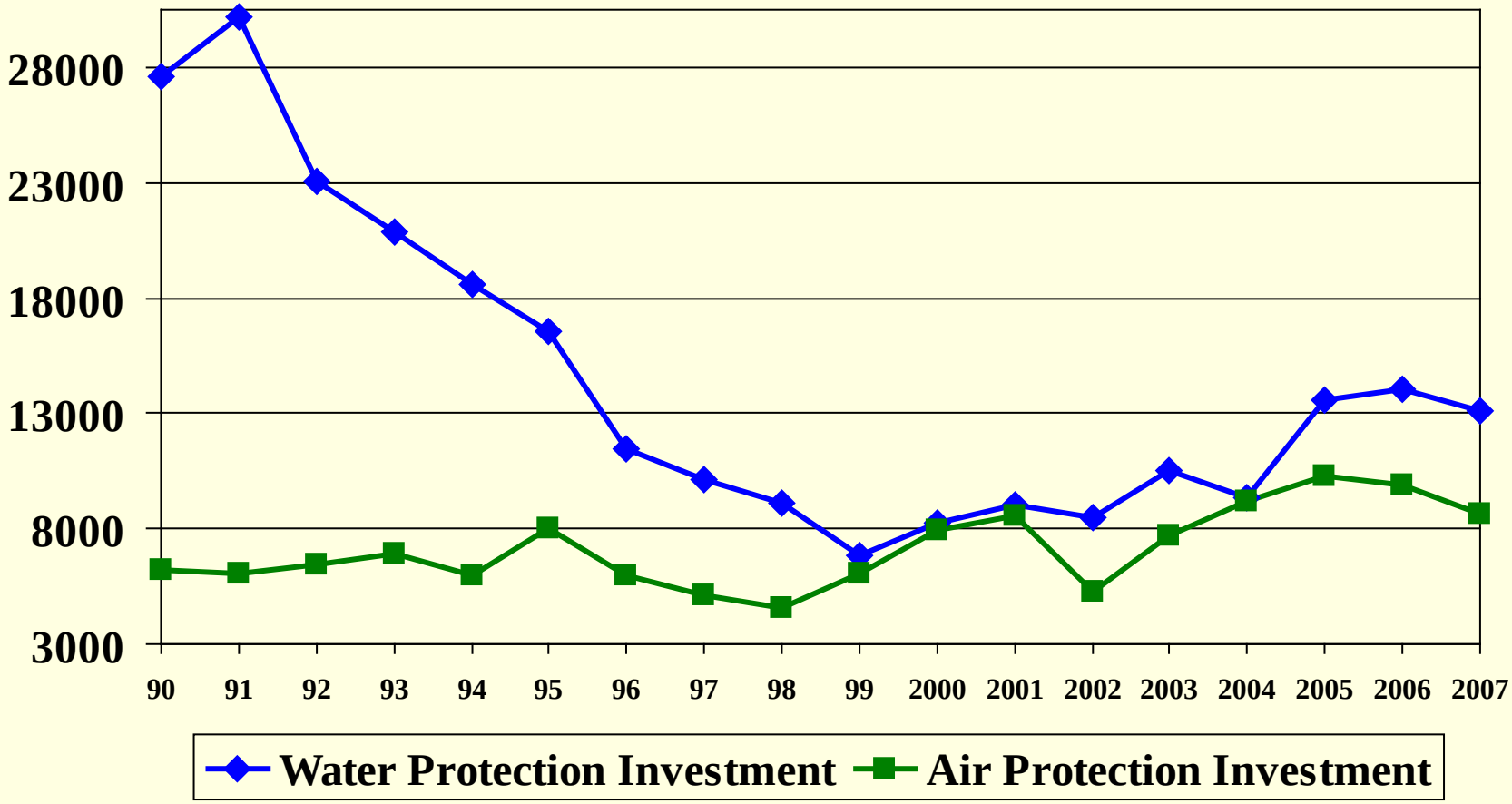
Volumes of Sewage Purification (billion cubic m) and Pollution Trapping (10^7 tons)



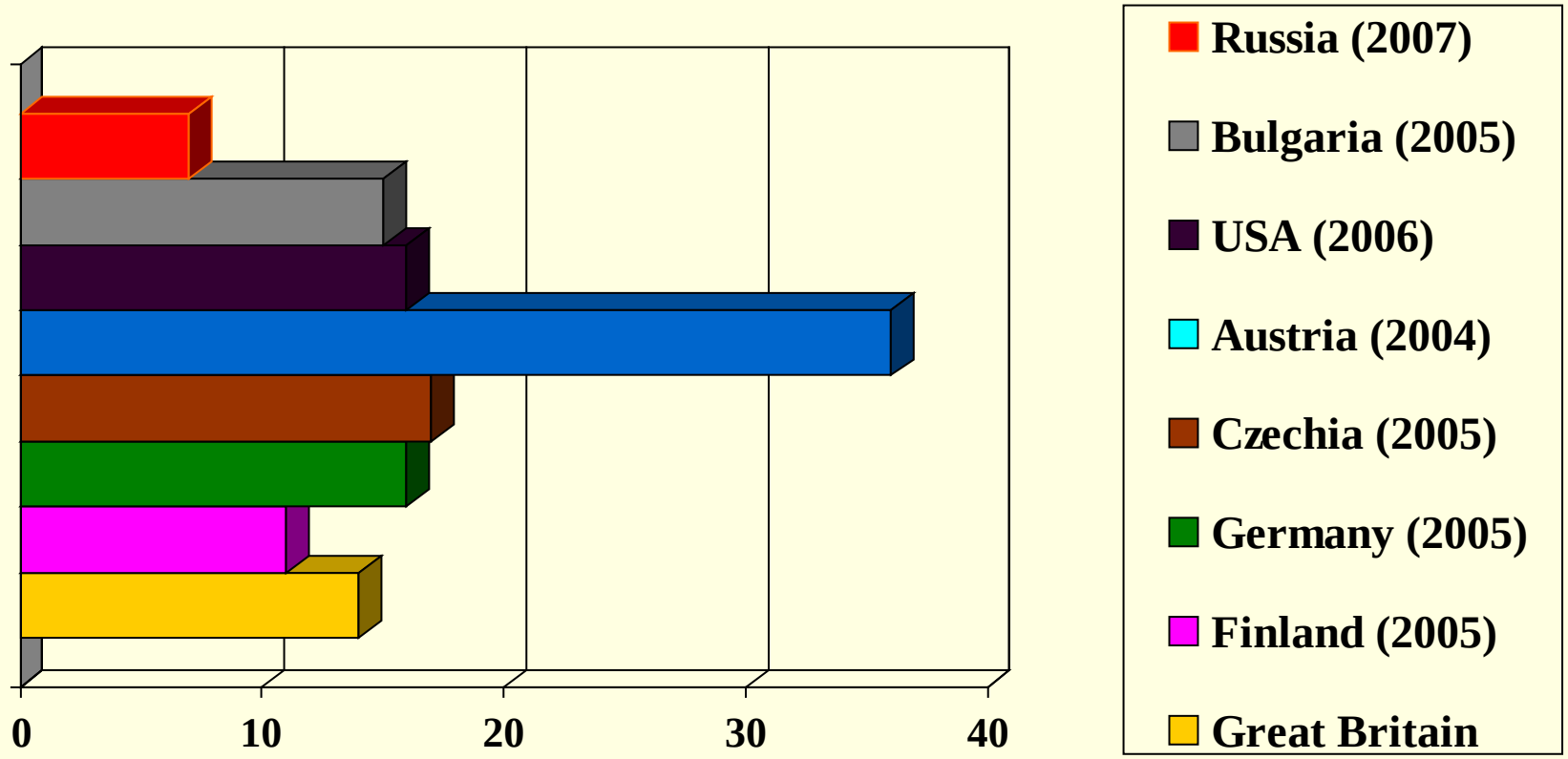
The Proportion of Sewage Treatment Providing Their Standard Quality (%)



Ecological Investment (million Rbl, before 1998 - billion Rbl, price of 2000)



Environmental Protection Cost ($ per 1000 $ of GDP, 2004-2007)



Putting into Operation of Environvental Fixed Assets

	1990	1992	1997	2003	2005	2007
Putting into service the production facilities for sewage treatment (thou cubic m per day)	2000	751	1004	522	1300	1500
Putting into service the production facilities for pollution trapping (thou cubic m hour)	16400	5642	3101	4378	4200	4100