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Using factors of external demand to construct export equations in RIM

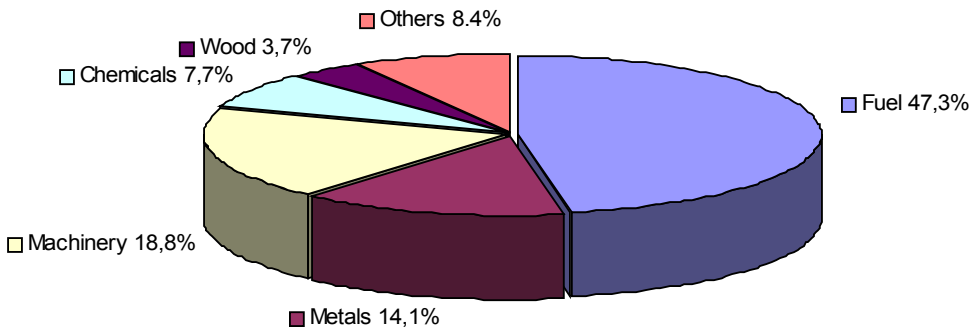
Recently one of our main approaches to modernize the Russian Interindustry Model (RIM) has been a more complicated description of interactions with the external world.

At the last INFORUM Conference in Suzdal we described our first step in this direction, which was to include into the calculations the macro indicators of the world economy and the price dynamics on the world markets. The undertaken modernization of the model has allowed us to improve the quality of the calculation results; however, the mentioned indicators were too general. For Interindustry Model and for RIM we need to use factors related to the sectoral structure.

At the second stage we tried to include into our calculations some indicators of the world trade. This opportunity appeared thanks to Mr. Nyhus, who provided us the results of the world trade development forecast till 2020 obtained with the help of the BTM.

We used the data on the development of the export block. By using the sectoral indicators of the external demand for Russian products we were hoping to obtain exports equations of a higher quality.

The Russian export is still dominated by raw materials (See pic. 1): fuel (47.3%), metals (14.1%), wood and woods products (3.7%), chemical products (7.7%) (totally 72.8% of the Russian export). These sectoral flows were the first ones where the factors of the external demand from the BTM were built in. It was difficult to use the BMT estimates in other sectors because of a different degree of aggregation for the RIM and BTM (25 and 120 sectors respectively).



BTM comprises forecasts of exports and imports for 14 countries and two country groups. We were mainly interested in the import estimates for the countries most important from the point of view of Russian exports. By summing the external demand for the Russian products in the countries which are the largest consumers of Russian-made products we obtained an aggregate which we later used for constructing separate equations.

Historically, the main foreign trade partners for Russia have been the EU countries, the former USSR countries are also important.

Out of total Russian exports in 2003, 31% is exports to the EU countries (while the USA is responsible for 5.7%, and the three largest CIS countries, Ukraine, Kazakhstan, and Belarus – 13.3%. After the EU expansion in 2004, 47% of Russian exports goes to it (as of the first half of 2004).

Table 1

Country shares in Russian exports and imports, 2003 (in percent)		
	EXPORTS	**IMPORTS**
France	2.5	4.1
Netherlands	7.1	2.3
Italy	7	4.8
Germany	7.6	14.1
Great Britain	3.6	2.4
EU (without new members)	**31**	**33**
USA	5.7	6.5
CIS (Ukraine + Kazakhstan + Belarus)	13.3	19.1

Consequently, Balance of Payments of Russia strongly depends on trade and economic relations with the European Union. This is explained by the fact that the main energy flows go from East to West. Energy trade with South-East Asia and the USA is impeded by the lack of developed infrastructure. It should be said that Russia mainly buys high-tech products in the European markets as well.

Let us look at the trade relations between Russia and Germany. Germany is the most important trade partner for Russia (see table 1). However, Russia is only ranked fifteenth in the list of the Germany's import origins (2.5%) and fourteenth in its export destimations (1.9%). This is close to what the shares of Russia's export (1.7%) and imports (0.7%) are with regard to the world trade. So the trade relations with Germany are more important for Russia.

However, supply of energy products from Russia is very important for Germany. Oil export to Germany totaled 35 million tons in 2003, which accounted to 27% of the total domestic consumption in that country. Out of the total oil export from Russia 22% goes to Germany.

Germany imports about 81% of the consumed natural gas, and supplies from Russia exceed 40% of the import volume.

The analysis demonstrates that import structures in other EU countries are rather close to the one described above.

In accordance with the BMT estimates, the share of energy products in the EU import volumes will decrease from 4.3% in 2000 to 3.6% in 2010. The shares of all energy products in the total import volume are supposed to decrease.

As regards physical volumes of energy product import, the highest growth rates, up to 5.5% per year, are demonstrated by the import of gas and oil products in the EU countries. These

numbers, in general, correspond with our understanding of the possible development trend in the world energy markets.

We believe that it would be advisable to include into the RIM equations for oil, gas, and oil product export an estimate of the total import of these products by the EU countries included in the BTM.

Technically speaking we added a BMT *vam* file to the DATA directory of RIM. Aggregation of varibles and transition from the bank *vam* format to the G format was done using *vamtog.add* file.

For example, an expression for the aggregate of the external demand for Russian oil in the vamtog.add file looks as follows:

do {f eum_2 = c.frm14 + c.itm14 + c.gem14 + c.spm14 + c.bem14 + c.gbm14},

where:

eum_2 – oil imports by the main EU countries;

frm14 – oil imports by France;

itm14 - oil imports by Italy;

gem14 - oil imports by Germany;

spm14 - oil imports by Spain;

bem14 - oil imports by Belgium and Luxembourg;

gbm14 - oil imports by Great Britain;

In the sector of ferrous and non-ferrous metals and in wood industry we used import volume indicators not only for the EU but also for Japan, China, and the USA.

For the sectors that are represented in BTM by a large number of products we chose those products which most of all affected the Russian exports in this sector. So, out of chemical products we chose fertilizers that account for 80% of the export volume in this sector in Russia.

Below is an example of the equation of the RIM foreign trade block where the BTM indicators are used:

$$exar9 = a_1*in\_con9 + a_2*wm\_9 + a_3*dum95 \qquad (1)$$

where:

exar9 – exports of chemical products in constant prices;

in_con9 - domestic consumption of chemical products;

wm_9 – import of fertilizers by the EU, China, and Japan;

dum95 – a dummy;

$a_{1,2,3}$ – regression coefficient.

Formula (1) shows that both external and internal factors were included in the equation. At present, the BTM variables were used to obtain exports estimates for the following sectors :

Oil production

Oil refining

Gas

Coal

Ferrous metals

Non-ferrous metals

Chemical products

Timber, wood processing, pulp and paper

In other sectors dynamics of the world economy is used as indicators of the external demand.

So, we have constructed a RIM version which allows to take into account some factors of external demand which are of a sectoral character. Recently this RIM version was employed to forecast the social and economic development of the Russian Federation in a mid-term (till 2015) and demonstrated rather good quality of estimates. Some results of the macroeconomic forecast are given in Appendix.

Appendix 1

Main scenario parameters of the Russian ecomomy development till 2015

	2000	2001	2002	2003	2004	2005	2006	2007	2010	2015
Oil prices Urals, usd. / b.										
1 variant (Moderate)	26.9	23	23.7	27.2	26	20	20	20	18.5	18.5
2 variant (Favorable)					28	24	24	24	25	27.5
3 variant (Accelerated development)					30	26	26	26	27	29
Gas prices, usd / thd. m^3										
1 variant	85.7	101	85.7	106	108	96.9	89.8	86.7	103	112
2 variant					116	109.3	111	109	109	123
3 variant					120	114	115	113	113	127
Foreign debt,										
The Schedule	10.9	14	14.07	17.5	16.3	18.9	17.6	14.9	9	7
Oil export, tonns										
1 variant	144.5	162.2	188.4	224	220	231	233	235	248	261
2 variant					242	247	253	260	294	323
3 variant					240	242	244	246	250	255
Gas export, bln. m^3										
1 variant	194.1	181.2	185.5	189	193	195	198	231	220	232
2 variant					195	200	207	248	229	231
3 variant					194	198	202	205	212	222
Rates of World economy growth, in %										
1 variant	4.8	2.4	3	3.8	3.2	2.8	2.8	2.8	2.5	2.5
2 variant					4.6	4.4	3.9	3.8	3.5	3.5
3 variant					4.6	4.4	3.9	3.8	3.5	3.5
Exchange rate, rub/Usd										
1 variant	28.1	29.2	31.3	30.7	29.2	30.6	32	32.9	34	34.6
2 variant					28.8	30.1	30.8	31.3	33.3	33.7
3 variant					28.8	30.1	30.8	31.3	33.3	33.7
Foreign investment, bln. Usd										
1 variant	4.4	4	4	6.8	7.8	7.9	8.5	9.2	10	12
2 variant					8.2	9	11	14	14	16
3 variant					10	14	16	18	22	24

Source (www.economy.gov.ru)

Appendix 2

Dynamics of basic elements of a final demand Russian Federation in constant prices and rate of inflation 2000 –2015 г.г.

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010 by 2003 in %	2011	2012	2013	2014	2015	2015 by 2010 in %	2015 by 2003 in %
GDP (In percentage by the previous period)	Variant 1	110	105	104.3	107.3	106	105.5	104.8	103.6	102.7	102.6	102.5	**131**	102.3	102	102.8	103.1	103.3	**114.2**	**149.5**
	Variant 2					106	105.8	105.2	104.5	104.7	103.6	103.9	**139.1**	102.6	102.8	103	103.1	103.4	**115.8**	**161**
	Variant 3					107	108.8	107.6	106.4	107.2	105.6	106.8	**161.1**	105.1	103.7	104.2	102.7	102.6	**119.8**	**192.9**
Private Consumption (In percentage by the previous period)	Variant 1	106.4	101.8	102.8	104.5	105	102.9	103	102.3	101.8	101.5	101.1	**118.8**	101.8	101.2	102.5	102.3	103.1	**111.3**	**132.3**
	Variant 2					105	102.8	103.2	103.1	103.5	102.7	102.4	**125.1**	102.3	101.9	102.8	102.3	103.1	**113.1**	**141.6**
	Variant 3					106	106.6	108	106.9	107.9	106.6	106.5	**159.2**	104.9	103.2	103.3	101.6	102.9	**116.9**	**186.1**
Investment (In percentage by the previous period)	Variant 1	112.5	105	103.4	112.6	112	110.3	107.4	105.1	102.8	103.1	103.4	**152.5**	102.8	102.7	103.6	103.7	104.3	**118.2**	**180.3**
	Variant 2					113	112.4	108.5	106.1	106	104.6	105.1	**169.5**	102.8	103.3	103.7	103.8	104	**118.9**	**201.7**
	Variant 3					112	118.2	111.4	108.8	109.9	108.1	109.9	**209.5**	107.7	105.8	106.6	104.3	106.4	**134.7**	**282.2**
Government Consumption (In percentage by the previous period)	Variant 1	124.4	96.6	107.1	102	108	104.8	106.8	104.9	104.7	106.5	104.4	**147**	101.5	103.2	102.5	103.3	103.5	**114.8**	**168.8**
	Variant 2					108	105.6	107.3	105.5	106.6	107.2	105.6	**155.4**	101.7	103.7	102.6	103	103.2	**115.1**	**178.9**
	Variant 3					105	105.2	104.5	103.5	103.7	102.5	104.1	**132.4**	100.4	100.4	102.7	101.6	100.9	**106.1**	**140.5**
Export(In percentage by the previous period)	Variant 1	105.9	103.8	106.1	109.8	107	103.5	102.6	103.8	102.1	102.3	102	**125.5**	101.9	101.6	101.4	101.8	102.9	**109.9**	**138**
	Variant 2					107	104.8	103.6	103	103.2	103.5	103	**131.4**	102.3	101.6	101.6	102	103	**111**	**145.9**
	Variant 3					107	104.1	103.2	102.5	102.7	103	102.3	**127.2**	101.4	101.2	101.1	101.9	102.8	**108.7**	**138.3**
Import(In percentage by the previous period)	Variant 1	114.1	109.4	109.2	116.1	115	105.8	107.4	107.1	106.3	105.4	105.4	**165.6**	104.6	103.8	104.1	104.3	104.7	**123.4**	**204.3**
	Variant 2					116	107.2	109.3	108.5	108.8	107.1	107.4	**184.5**	105.3	105	104.8	104.9	105.3	**128.1**	**236.2**
	Variant 3					116	110.8	111.7	111	111.3	109.1	109.7	**211.4**	107.4	105.8	106.1	105.1	103.7	**131.3**	**277.4**
CPI (Gain of the prices in percentage)	Variant 1	20.2	18.6	15.1	12	10.6	8.5	8.8	8.3	7.1	5.2	5.7		3.6	2.7	2.2	2.0	1.9		
	Variant 2					10.6	8.3	8.7	8.4	7.4	5.6	6.2		4.1	3.2	2.7	2.6	2.8		
	Variant 3					10.5	8.2	8.4	8.3	7.1	5.6	6.0		4.5	4.0	3.9	4.3	4.9		

Surce: Calculations on model RIM

The calculation of the regression coefficients in some equetions of the export block of the model RIM

```
title Export 2 Oil
lim 1992 1997
f z=(rateusd2*(1-exps2))*reform92
f in_con2=out2-ex2+im2
r exar2=!out2,eum_2,oilpr,oilpr[1],dum93
:                          Export 2 Oil
 SEE   =    452.22 RSQ   = 0.9980 RHO =  -0.68 Obser  =    6 from 1992.000
 SEE+1 =    327.84 RBSQ  = 0.9902 DW  =   3.36 DoFree =    1 to   1997.000
 MAPE  =      0.33
  Variable name         Reg-Coef  Mexval  Elas   NorRes     Mean   Beta
 0 exar2              - - - - - - - - - - - - - - - - -  91386.20 - - -
 1 out2                 0.27513  1002.2   0.59 1415.43 197300.93
 2 eum_2                0.00022   108.2   0.09 1389.06 38725852.00  0.113
 3 oilpr              912.48990   365.8   0.16  206.92     15.98  0.658
 4 oilpr[1]          1086.65176   435.7   0.15    1.33     12.72  0.974
 5 dum93              2224.45129    15.5   0.00    1.00      0.17  0.081

ipch exar1 2 a 3 30 18 20 13

title Export 3.
lim 1991 1997
f z=(rateusd2*(1-exps3))*reform92
f in_con3=out3-ex3+im3
r exar3=in_con3,eum_3,dum93
:                          Export 3. Oil refining
 SEE   =   1165.42 RSQ   = 0.9618 RHO =  -0.23 Obser  =    7 from 1991.000
 SEE+1 =   1044.21 RBSQ  = 0.9236 DW  =   2.47 DoFree =    3 to   1997.000
 MAPE  =      3.53
  Variable name         Reg-Coef  Mexval  Elas   NorRes     Mean   Beta
 0 exar3              - - - - - - - - - - - - - - - - -  26863.56 - - -
```

```
 1 intercept          14816.54195    37.5   0.55   26.17      1.00
 2 in_con3              -0.12693    291.0  -1.66    6.42 350256.80 -1.838
 3 eum_3                 0.00228    142.8   2.14    4.38 25300853.14  1.141
 4 dum93              -7414.56938    109.2  -0.04    1.00      0.14 -0.435
```

```
title Export 4. Gas
lim 1993 1997
f z=(rateusd2*(1-exps4))*reform92
f in_con4=out4-ex4+im4
r exar4=!out4,eum_4,dum93
:                          Export 4. Gas
 SEE   =    2108.59 RSQ   = 0.9183 RHO =  -0.27 Obser  =    5 from 1993.000
 SEE+1 =    2028.21 RBSQ  = 0.8366 DW  =   2.55 DoFree =    2 to   1997.000
 MAPE  =       1.82
  Variable name         Reg-Coef  Mexval  Elas   NorRes     Mean   Beta
 0 exar4              - - - - - - - - - - - - - - - - -  82829.89 - - -
 1 out4                  0.35782   363.7   0.85   12.69 197067.25
 2 eum_4                 0.00129    43.2   0.18    7.50 11867005.60  0.315
 3 dum93              -14796.66065   173.9  -0.04    1.00      0.20 -0.802
```

```
title Export 7 Ferrous metals
lim 1992 1997
f z=(rateusd2*(1-exps7))*reform92
f in_con7=out7-ex7+im7
r exar7=!wm_7,in_con7
:                          Export Ferrous metals
 SEE   =    3471.42 RSQ   = 0.9553 RHO =   0.54 Obser  =    6 from 1992.000
 SEE+1 =    3110.92 RBSQ  = 0.9441 DW  =   0.93 DoFree =    4 to   1997.000
 MAPE  =       9.99
  Variable name         Reg-Coef  Mexval  Elas   NorRes     Mean   Beta
 0 exar7              - - - - - - - - - - - - - - - - -  39216.73 - - -
 1 wm_7                  0.00106   636.6   2.13   16.90 79010044.00
```

```
 2 in_con7              -0.30976   311.1  -1.13    1.00 142682.66 -0.695
```

```
title Export 8. Non-ferrous metals
lim 1992 1997
f z=(rateusd2*(1-exps8))*reform92
#con 1000 12.2 = a2
f in_con8=out8-ex8+im8
f deltaout8=out8-out8[1]
r exar8=!in_con8,wm_8
:                          Export 8.  Non-ferrous metals
 SEE   =    3640.65 RSQ   = 0.9643 RHO =  -0.07 Obser  =    6 from 1992.000
 SEE+1 =    3612.86 RBSQ  = 0.9554 DW  =   2.14 DoFree =    4 to   1997.000
 MAPE  =       9.29
  Variable name          Reg-Coef  Mexval  Elas   NorRes     Mean   Beta
 0 exar8              - - - - - - - - - - - - - - - - -  50173.39 - - -
 1 in_con8              -0.41932   350.8  -0.77   92.29  91696.44
 2 wm_8                  0.00129   860.7   1.76    1.00 68370246.67  0.333
```

```
title Export 9. Chemical products
lim 1991 1997
f z=(rateusd2*(1-exps9))*reform92
f in_con9=out9-ex9+im9
f deltaout17=out17-out17[1]
r exar9=!in_con9,wm_9,dum95
:                          Export 9. Chemical products
 SEE   =    3453.69 RSQ   = 0.8779 RHO =  -0.06 Obser  =    7 from 1991.000
 SEE+1 =    3422.21 RBSQ  = 0.8168 DW  =   2.13 DoFree =    4 to   1997.000
 MAPE  =      23.84
  Variable name          Reg-Coef  Mexval  Elas   NorRes     Mean   Beta
 0 exar9              - - - - - - - - - - - - - - - - -  22031.12 - - -
 1 in_con9              -0.02999   103.1  -0.41   31.53 300328.45
```

2	wm_9	0.00012	390.3	1.38	1.18	244567837.71	0.329
3	dum95	4334.31290	8.5	0.03	1.00	0.14	0.153