The impact of energy resources price increase on inflation in Russia in 2000-2010

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Abstract

Monetary instruments don't give sufficient and stable results in decreasing inflation in Russia. That's why it is proposed that one of the reasons is a significant number of monopolistic and oligopolistic markets in Russian economy. Companies on such markets have the power to increase prices and transfer the increase of their costs to consumers. Price shock on one of the markets could result in growth of prices in a whole economy.

Energy resources extraction (oil, gas, coal) are such sectors. There are a few large companies in each of these sectors, they have market power and they use it. Also oil and gas price increase in 2000s could have impact on inflation in Russia. Giving Central Bank policy of stable ruble, export sales could resulted in increase of money supply and inflation.

The Input-Output Price Model is used to test this hypothesis. In the first, productions chains were identified using technical input coefficient matrix and price correlation matrix. In the second, the response to change in price in sectors of one chain was measured depending on technical input coefficients and the degree of concentrations on the markets of resources and products. So inflation effect of one sector was estimated. Finally, the overall impact of energy resources price increase was estimated.

Key words: Energy Price, Input Output Analysis, Russia

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1. Introduction

One of the features of Russian Economy is high and stable inflation rates. They are high in comparison with OECD countries. In Russia average inflation rate for the last 10 years is 14,6% and for the last 3 years 10,4% (measured as a GDP deflator). In OECD country inflation rates rarely exceeds 3% or 4%. There are different hypothesis to explain such difference. They could be broadly divided in two groups. Monetary factors are in the first group. For example, if many supply growth rate exceeds GDP growth rate it can cause prices to increase.

All the nonmonetary factors are in the second group of factors. For example, supply price shock. If such shock is accidental it can only increase price level. But if such shocks are regular they can influence inflation expectations and so increase inflation. Examples of such "regular" shocks in Russia are annual increase of price for natural monopolies (railroads, utilities, gas, energy and etc.). In Russia with its imperfect market institutes, high degree of monopolistic sectors and affluent government regulation in key sectors nonmonetary factors could play significant role in determination of inflation rates.

Input output models are more suitable for such situation than usual econometric models which include only macroeconomic parameters. There are interdependences between different branches of economy in such tables, so it is possible to determine the direct effect of price shock in one sector on the other sectors and economy in a whole. Because such shocks could be transmitted via chain of sectors and even return to the sector where the shock had begun, there is indirect effect of price shock. It is also could be described via input output tables. All this interdependences are in the tables so it's possible to estimate indirect effect.

There are branches that could drive price changes and there are branches which transmit price shocks. Price drivers are of the first interest for the research. Disabling or lowering consequences could soften effect of price shock for a whole economy. There are several conditions for such a branch. In the first its share in national output should be significant. In the second, the branch should be exposed by external shocks, as an example it could be dependent of external commodity prices. In other words, there should be some event that could cause price shock in the branch.

An example of such price driving branch is an energy resources extracting branch. This branch plays significant role in Russian economy. Its share in GDP estimates as 25%. Oil and gas exporter receive up to 70% of all export sales, besides this share has been growing for the last 10 years. The share of oil extraction taxes and export fees in the government budget is about 30-36%. 15 more percents is a share of Gasprom, the largest Russian gas company and the only gas exporter. Share of all the oil and gas companies in stock market capitalization is about 50%.

2. Government policy

Oil and gas extraction industry can influence inflation in two ways. In the first, large portion of extracted oil and gas goes for export: 50% of oil production, 60% of petrochemicals and и 25% of gas goes for export. Revenue in foreign currency has to be exchanged for rubles. Given value of oil and gas exports of 238 bln US dollars or 16% of Russian GDP, it causes either ruble revaluation or increase in money supply. The reason is that Central Bank increases amount

of rubles in economy by buying US dollars. Otherwise ruble exchange rate would increase in dramatic manner. Partly this problem is solved by flexible system of export fees. Part of them goes to the Reserve Fund and the Fund of National Welfare. Given increasing commodity prices and stable or decreasing extraction, selling export revenue makes money supply growth rates exceed GDP growth rate. And this imbalance could cause the inflation.

Besides this, there is the second way the oil and gas extraction industry influence the price level. It's investigated in this article. It's the mechanism of oil price shock transmission via the interbranch connections. Given imperfect competition in these industries, companies have market power to transfer increase of their costs to their customers.

In contrast with the most OECD countries, Russia exports energy resources, but external price shocks do have impact on the domestic market. Petroleum companies have the choice either sell their products on domestic market or export them. So they must have the equal profitability on all of their markets. If export prices exceed domestic prices, the companies have reasons to increase their export and to decrease sales on the domestic market. As an example is situation on Russian gasoline market in April 2011 in some regions. Price caps in domestic market and increasing world prices resulted if 67% increase of petrochemicals exports in April and lack of gasoline in some Russian regions. Price caps were introduced after the government interference in price regulation of the market. Prime minister ordered them to lower prices after complaint of some customers.

There is no such connection on the gas market, because prices are controlled by government. Given the largest gas extraction company Gasprom is a natural monopoly, prices for the domestic market are changed every quarter or annually by the decision of government. And given low level of domestic prices in comparison to external prices, increase in tariff always exceeds inflation rates.

One more factor which increases the role of energy resource is energy intensity of Russian economy. Manufacturing, energy production and utilities in Russia need 2 to 3 times more energy than in OECD countries. This results in larger sensitivity to price changes of energy resources, because energy costs takes larger part in overall consumption.

3. Literature Overview

The most authors investigate energy price shock in countries which import energy resources. The common approach is different econometric models. Besides inflation impact, influence on GDP growth rate is researched.

Ito (2008) researches impact of oil exports and oil price increase on different macroeconomic parameters via VEC model for the period of 1997-2007. It is estimated than 1% oil price increase results in 0,36% more inflation and in 0,25% more GDP growth rate.

Suslov (2002) researches interaction of power industry and the economy. In particular he investigates role of electric energy prices during the time of structural changes of the 90-th. He estimates that 100% power energy prices increase results in 14% producer's price increase and

that price transmission to other branches could last up to 4 months. In his book dynamic input output model is used.

Tunali, Aydogus (2007) research impact of energy price increase on industrial price and general price level for 4 European countries and Turkey with open static Leontief model. The countries they consider are importing energy resources. They estimate that 100% increase in energy resource prices results in not more than 5% increase in industrial prices and 4% increase in Consumer prices, so inflation impact of energy resource prices increase is limited.

4. Model and empirical results

Two methods are used to investigate interbranch connections of oil and gas extraction branch with other industries: correlation analysis and static input output tables. If prices in two branches move in the same directions it can be tested via correlation analysis. Input output tables are used to verify these connections, to compute direct and indirect effect on inflation of energy resource price increase. These estimates are compared with actual price indices. Finally effect of large energy intensity of Russian economy on prices is estimated and forecast future energy price increase on inflation is made.

Price data have tendency to increase which means that data series is nonstationary. Using such time series would result in finding correlations which are result of common trend but not common interbranch connections. Monthly price increase rates are free of trends so they can be used for purpose of our research. Producer price indexes were used as a data for correlations analysis. Also Russian Natural Gas border price in Germany is used as a source of external price for gas. Domestic gas price indexes were taken from the Russian federation federal state statistics service. The period is from 2000 to 2010. This period is characterized by stable institutional structure, in contrast with 1990-2000 which is characterized by structural changes from Soviet economy. First of all, domestic natural gas prices for 2000-2010 years had increased 7 times while foreign prices only 2,6 times. Outrunning growth of domestic gas prices is explained by low base effect. Even in 2010 domestic prices are 2 are about 50% of gas prices on the border of Germany. Correlation coefficient for these two time series is (-0,15). Under Student criteria all values lower than 0,25 mean absence of correlations with 1% probability of type I error. It means that there is no correlation between monthly growth rates of domestic gas prices and natural gas border prices in Germany.

Explanation of this fact is that gas prices on the foreign markets are determined on the market or they are dependent of oil prices with 6 to 9 months lag. In contrast, domestic gas prices in Russia are regulated by government and are increased once a quarter or months. Such annual gas price increase is one of the reasons high inflations rate in the beginning of the year. So Europe gas prices are more flexible than domestics so there is no correlation between them.

Also correlation analysis didn’t identify any connections with other branches. This also could be explained by annual gas price increases and by distribution of price increase effect between several months.

Price correlation analysis for oil industry showed several results. Oil prices are correlated with chemical and petrochemical industry products prices (correlation coefficient of 0,40), and metallurgical products prices (0,40). Connections with other branches are insignificant.

Oil prices can influence the most branches of Russian economy via oil refining industry. Transportation cost plays significant role in Russian economy with its large distances. Automobile transportation is more profitable than railroad on a distance of several hundred kilometers. And the main fuel for automobile transportations is a gasoline and diesel which are oil refining products.

The most common gasoline in Russia is with octane number of 92. Its price is correlated with crude oil and gas prices (correlation coefficient of 0,42) and Coke and oil refining products (0,70). So there is no strong price correlation with other branches. Probably, such correlation comes with lag of several moths and is distributed between several months. Estimating such correlation would be a difficult task.

Also correlation between petrol prices and world crude oil prices was tested. Oil companies are to get the same profitability on domestic and foreign market. If sales on domestic market are less profitable oil companies are to increase export of petroleum and lower sales on domestic market. Deficit on the local market cause prices to increase so profitability of local and foreign market becomes equal. It gives theoretical ground to testing correlation between petroleum price and crude oil price. But such correlation analysis shows no statistical connection between petroleum prices in Russia and crude oil prices on the world market.

Input output model helps to identify and estimate price connections when correlation analysis isn't applicable.

Direct costs matrix A allows identifying such connections. To find the branches which are dependent of the oil and gas extraction branch we look at the second row of the input output table. The most dependent branches are «electrical energy» (0,10 – direct costs coefficient), «oil and gas extraction» (0,23), «oil shale and и peat» (0,09), «chemical and petrochemical products» (0,07), «construction materials» (0,05), «transportation and communication» (0,04) и «utilities» (0,03).

Given input output tables, indirect effect of price shock could be estimated. Calculations were made under certain assumptions

Let «driver branch» is a branch where price increase has occurred and «transmission branches» are the branches which are affected by the price increase in the driver branch. Price increase in transmission branch is led by increased cost of material consumption of driver branch products. This increase is proportional to the share of this cost in revenue of transmission branch. It means that share of wage, profit and interest expenses doesn't change. The technology is kept the same, so the structure of costs doesn't change.

There are no supply or demand effects. So increase in price doesn't make companies change the amount of their production. The only way for them is to increase price for their customers to compensate increased costs.

All the prices changes simultaneously. It means that in some period of times all the transmission branches change their prices to compensate increased cost of resource provided by driver branch. At the same time price are changed according to the inflation expectations. In the next period prices are corrected because all the prices had changed in the previous period and company have to compensate their increased costs and etc. As companies costs are less than their revenues the process of price correction is fading after some iterations changes become insignificant. The weak point of model is that it doesn't answer the question about the value of such unit period – day, month or year. Also model don't consider that time of reaction in different branches varies

All the price changes are flexible, so no price regulations affect them. Also it means that prices decrease in the same way as they increase.

2000 and 2003 input output tables are used in calculations. This is the latest available. More important is that 2003 input output table is based on structure of economy of 90-th. So the structural changes in economy during the post Soviet period are not completely taken into account. The list of branches consists of 22 branches. 13 of them refer to industry and 9 to services.

Let A is a matrix of technological coefficients. Column a^i represent share of other branches in production of the branch i. Row a_i represent consumption of products of i-th branch in all other branches. To compute direct effect of price change in the branch I we need to multiply row of price changes Λ by the matrix A. So we get price changes in every industry as a response on price change in the branch i. To compute impact of increase in prices in oil and gas extracting industry we use row $\Lambda = (0,\Lambda_2, 0,...,0)$,with 0 elements except of the second element which represent actual price change. Oil and gas price changes for period 2000-2010 are got from the site of Russian federation federal state statistics service.

To compute indirect effect matrix of complete technological coefficients A' was used. Such table is available on the site of the Russian federation federal state statistics service. Also it can be computed from the original matrix of technological coefficients A as $A'=(E-A)^{-1}-E$

Also row of price changes $\Lambda =(0,\Lambda_2, 0,\ldots,0)$ was multiplied with the matrix A'.

Price changes for oil and gas were taken from the table Average Producer Prices for Selected Energy Resources. Index of oil and gas branch prices was composed with share of oil price change of 80% and gas price change of 20%. These shares are equal to values of gross output of these industries in 2003.

The result of computations is a row of price changes in every branch. We need some coefficient to get weighted average and receive producers' price index. Branch's share in gross output was used as such coefficient.

All estimates were made using 2003 input output tables as the last available. 100% price increase cause 3,9% direct price increase and 8,6% indirect price increase. Energy resource price increase resulted in 17,6% producers' price increase out of 371% for the period 2000-2010.

Using 2000 year table resulted in lower price impact which means that influence of energy resource branch has grown.

Matrix of direct costs A was modified to estimate effect of large energy intensity of Russian economy. One of the programs of Federal government has a goal to lower energy intensity of Russian economy by 40% till 2020. This would lower dependence of oil and lower inflationary impact of energy resource price increase on economy. For computations it is assumed that all branches need 30% less of products of oil and gas extraction industry. This would lower direct effect by 30% and indirect effect by 36%. If energy intensity would be lower by 2000 it would decrease inflation rates by 12% for 10 years.

Also model allows forecasting impact of future oil and gas price increase on price level. Present Urals oil price exceeds 120 US dollars per barrel. Predicting future oil price is a hard task with large measure of uncertainty. In our estimates we assume 20% more increase in the next years.

Assuming natural gas price is more certain because there is external goal. Domestic sales should be as profitable as sales in Europe. Given natural gas prices in Russia is about 50% of European prices, we assume 100% natural gas price increase. Government was planning to increase natural gas prices, so they would be equal to European prices (less transportation costs) till 2011. But crisis of 2008 made government postpone this plan. So natural gas price increase for up to 100% is possible in the next 5 years. It will add 4,5% to price increase in the next 5 years or about 0,9% to annual inflation. It's more than 10% of target inflations rates of 7% for the 2011. This is one more obstacle in decreasing inflation rates.

Conclusion

Energy resource extraction branch plays significant role in Russian economy. It also has impact on inflation rates. 100% price increase results in 8,6% increase in producers' price index. It was defined that oil and gas branch could be in the beginning of chain price increase in several branches.

All estimates should be treated with caution because they were made under strict and not always realistic assumptions. It means that all estimates and are needed to be verified with more detailed models. Key directions for expanding basic model are implementing supply and demand effects, imperfect competition in different branches and defining the limits in which price changes are described by basic input output model. Also should be researched question about the duration of price increase and its impact on other industries.

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Table 1: Effects of energy resource price increase by year, %

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Oil price increase	66,5	-29,2	32,7	37,3	-5,7	44,4	-14,1	61,8	-70,7	152,2	46,3
Natural gas price increase	26,1	22,5	39,9	22,6	21,2	19,1	10,9	19,4	25,2	21,9	14,2
Energy resourse price increase	58,4	-18,9	34,1	34,4	-0,3	39,3	-9,1	53,3	-51,5	126,1	39,9
Direct efect on PPI	2,28	-0,74	1,33	1,33	0,00	1,53	-0,35	2,08	-2,04	4,96	1,57
Indirect effect on PPI	4,98	-1,63	2,92	2,92	0,00	3,35	-0,77	4,55	-4,46	10,82	4,46
Indirect effect with 30% lower energy intensity	3,18	-1,04	1,86	1,86	0,00	2,14	-0,49	2,91	-2,85	6,91	2,19
PPI	31,9	8,3	17,7	12,5	28,8	13,4	10,4	25,1	-7,0	13,9	16,7