Counter sanctions and well-being population of Russia: econometric analyses

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CEMI RAS, MSU

2019

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This article examines the impact of counter-sanctions on the welfare of Russia's population. We build a multiple-choice model and calculate the probability of being in a particular group of well-being based on the price (cost) of consumed counter-sanctions goods. The next step is the construction of a structural demand-supply system for estimating similar domestic good's production elasticities. By knowing elasticity estimates we determine the price response to particular import closure. According to our estimates Russia's counter-sanctions led to an increase in poverty by 2.64 %.

Keywords: counter sanctions; well-being; multiple-choice model; structural demand-supply system.

JEL classification: C15; C35; C38; I31.

1. Introduction

Due to Crimea becoming part of Russia and the conflict in East Ukraine, in 2014 most European countries and the United States imposed economic sanctions on Russia. In response, Russia imposed embargo on several imported goods. Such measures in the short and medium term are going to result in a decreasing supply of goods in the domestic market and a price increase on domestically produced goods. Long term effects depend on relevant economic sectors ability to adopt their investment and production plans to the new macroeconomic conditions, as well as on existing barriers to entry. The process of import substitution is further intensified by investment complications. These complications are due to Russia adopting a free-floating currency regime and the sanctions being linked to foreign policy conjuncture.

The aim of this paper is to determine the impact of counter-sanctions on the welfare of Russia's population in the short and medium term. The main hypothesis tested in this paper is as follows: counter-sanctions result in a price increase for domestic goods, thus increasing population's consumption expenses, which in turn results in real welfare reduction and higher social differentiation. Our analysis shows that counter-sanctions imposed by Russia and the associated price increase resulted in an increase of poverty by 2,46%, which in absolute terms implies 3,8 million new poor people.

2. Study of effects caused by sanctions

There are a few studies concerned with the effects of sanctions. Usually, these studies are concerned about qualitative aspects of loss and gains of a country. Among papers devoted to quantitative analysis of the effects of sanctions, it is worth highlighting two. Uimonen uses probit technique to assess the success of applied sanctions (Elliott, Uimonen, 1993). The dependent variable takes the value of either 1 or 0 depending on whether the sanctions where successful, whereas explanatory variables are social-economic factors. Garfield studies the effect of sanctions on mortality of children in Iraq (Daponte, Garfield, 2000). Mothers in Persian Gulf countries after the events of the 1990s were interviewed in order to determine the impact of sanction on the mortality of Iraqi children. A binary choice model was used for the analysis. The following indicators were used as independent variables influencing child mortality: gender, place of living, presence of brothers and sisters, education of the mother, age of the mother at the time of giving birth. The model also includes a dummy variable "sanctions" taking the value 1 if the time was during the sanctions (September -December 1990) and 0 if before 1990. It was demonstrated that during the sanctions the probability of child mortality drastically increased.

3. Modeling Methodology

In this paper the SORTED multiple choice model is applied. This paper is concerned with counter-sanctions product groups, which price increase significantly decreases the standard of living of the population.

The research is conducted in three stages. During the first stage a training set is formed based on material wealth. Material wealth is defined as the proportion of food expenditures in the level of income. To form the training set tools of cluster analysis are applied. After the respondents are grouped, each household is marked with its corresponding cluster number. The cluster number reflects the level of well-being.

In the next step, the multiple choice model is applied to the structured data of households. Multiple choice models are described with the following equation:

$$y_i = G(\theta_1 x_{i1} + ... + \theta_p x_{ip}) + \varepsilon_i = G(x_i^T \theta) + \varepsilon_i, i = 1,...n \quad (1)$$

Wherein

$$P\{y_i = s | x_i\} = E(y_i | x_i) = \partial G\left(x_i^T \theta\right) \quad (2)$$

In order to model the values of $P\{y_i = s | x_i\}$, such functions are chosen which can take the values $[0;1]$, and the linear form of $(x_i^T \theta)$ is the argument of that function. A logit function or standard normal probability distribution is usually used.

Since multiple choice models are not linear, the coefficients do not have an obvious interpretation. Thus, marginal effects for each variable are found. This effect is defined as a partial derivative with respect to the probability that $y_i = s$, according to the continuous independent variable x_{ik}:

$$\frac{\partial P\{y_i = s | x_i\}}{\partial x_{ik}} = \frac{\partial G\left(x_i^T \theta\right)}{\partial x_{ik}} \quad (3)$$

If the logit function is used to model the values of $P\{y_i = s | x_i\}$, then in the logit model $P\{y_i = s | x_i\} = \Lambda\left(x_i^T \theta\right)$, Δx_{ik} of the k-th explanatory variable results in a change in probability by approximately $100 \times \theta_k \Delta_{ik} \%$. Thus, the change in the costs (in rubles) for a certain group of goods increases / decreases the probability of being in a given group by $100 \times \theta_k \Delta_{ik} \%$. The corresponding marginal effects make it possible to identify the most sensitive goods from the point of view of their influence on the welfare of the population.

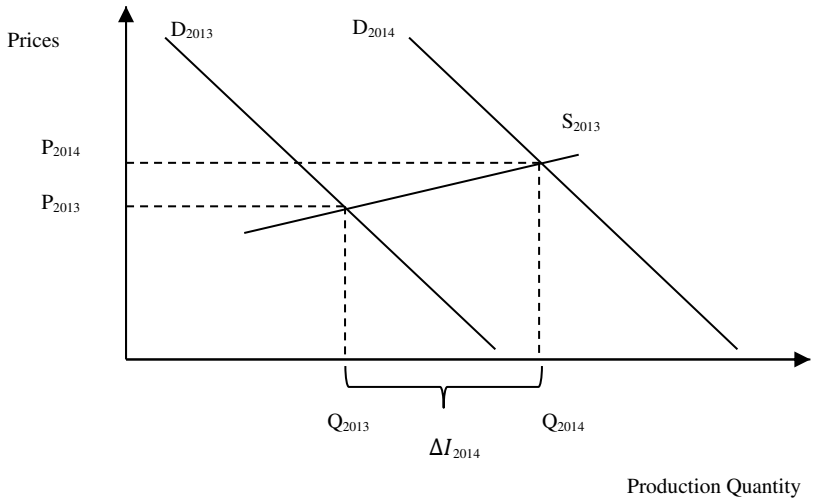
As a result of the cluster analysis the sample of households is divided in k groups by their level of well-being. The group number is the corresponding response of the ordered multiple choice model. The probability to be in a particular cluster is the function $F(X, \varepsilon)$, that is

$$P(y_i = s) = F(X, \varepsilon), \quad (4)$$

Where $s = 1...k$ is the number of the cluster to which the household belongs.

X – the set of factors which determine the provability of increasing or decreasing living standards (in our case the probability to get into a cluster). Based on the multiple choice model estimates the probability of being assigned to one or the other well-being group is based on the set of consumption goods.

On the final third step the counter-sanction effect of the price growth on sensible goods (list determined on previous step) is evaluated. This paper utilizes the identification method provided on picture 1. The decline in import ΔI caused by counter-sanctions in 2014 resulted in a shift in demand for similar domestically produced goods. In response domestic manufactures increase production output and prices. Thus, the new equilibrium is in Q_{2014} and P_{2014}. In the long run the supply of goods is going to increase, partially due to new players coming to the market, and relative prices are going to return to their previous values. However, as mentioned earlier this paper in only concerned with short and medium term effects of counter-sanctions.



Pic.1. Shift in demand for domestic goods

In order to evaluate the counter-sanction's price growth it is required to identify the supply elasticity parameter on the corresponding good's group price. The identification is done based on a two step evaluation of the system of simultaneous demand and supply equations.

$$\begin{cases} Q_d = \alpha_1 + \alpha_2 P + \alpha_3 Revenue + \varepsilon \\ Q_s = \beta_1 + \beta_2 P + \beta_3 Cost + \varepsilon \\ Q_{eq} = Q_d = Q_s \end{cases} \quad (5)$$

Determining the effect the of counter-sanctions in terms of imports is complicated by the fact that the counter-sanctions measures happened at the same time as the drop in oil prices and real weakening of the rubble, which as well had a negative impact on imports. In order to cope with the currency exchange

effects this paper separates currency exchange effects in every product group based on the following equation.

$$I_t = \alpha_0 + \alpha_1 trend + \alpha_2 rer_t + \varepsilon_t \quad (6)$$

Where I_t - import of counter-sanction goods, rer_t - real effective exchange rate, $trend$ – trend, $\alpha_0, \alpha_1, \alpha_2$ - parameters of the equation, ε_t - residuals. Using the actual data for 2014 for the real exchange rate rer_t and comparing the forecast value for the import with the actual one, we obtain part of the change in the indicator that is not related to the exchange rate dynamics - the counter-sanction effect.

4. Data Sources

This paper utilizes the data of the 23rd wave of the Russian Monitoring of the Economic Situation and Health RLMS-HSE survey[1]. The survey was conducted from October 2014 to February 2015. It is a series of annual nationwide representative surveys based on a probabilistic stratified multistage territorial sample, developed with the participation of the world's leading experts in the field. The size of the representative sample was 217 households, taking into account the removal of all missing values.

In order to classify the sample into groups based on well-being, the share of expenditures on food in the household's income is calculated. The variable for income is sf14 (What was the monetary income of your entire family in the last 30 days? Include all monetary incomes including wage, pension, scholarships, other monetary income including ones in foreign currency.)

The data se1.1c - se1.57c in the RLMS survey (food expenditures for the past 7 days) multiplied by 4 were used for the value of food expenditures. The share of food expenditure in income is then just the ratio of food expenditure in the income.

Official Russian Federal State Statistics Service data was used in evaluating the demand-supply model. Federal Customs Service data was used in the predictive import model.

5. Empirical Results

For the k-average method clusterization of the surveyed population of respondents by welfare, the variable share of expenditures on products was used. Table. 1 describes each cluster.**Table 1.** Cluster properties

Cluster Number	Average ratio of food expenditures to income, %
1	15.30
2	36.21
3	67.87
Average in 3 clusters	27,83

[1] RLMS-HSE:Website http://www.cpc.unc.edu/projects/rlms and http://www.hse.ru/rlms

Even though in recent years the standards of living of Russian people were improving, the main expenditures remain food ones. The proportion of food expenditures to total expenditures does not exceed 15% in developed countries, whereas in Russia that indicator equals 27%.

Cluster 3 with expenses on food compared to overall expenses exceeding 67% can be described as the least prosperous in terms of standards of living. Cluster 1 on the other hand has small proportion of food expenses (15,3%) which describes this groups as the wealthiest. Cluster 2 describes households with a middle standard of living.

Expenditures on counter-sanction goods are used as variables for the multiple choice model (Table 2):

Table 2. Variables in the multiple choice model

Variable name	Variable definition
meat	How many rubles did your family spend on meat in the past 7 days?
milk	How many rubles did your family spend on milk, excluding powdered milk, in the past 7 days?
cheese	How many rubles did your family spend on cheese in the past 7 days?
fruit	How many rubles did your family spend on fruits (watermelon, melon, canned fruits and berries, fresh berries, other fresh fruits, dried fruits and berries) in the past 7 days?[2]
vegetable	How many rubles did your family spend on vegetables (potato, canned vegetables, cabbage, cucumber, tomatoes, beets, carrot, garlic, zucchini, pumpkin and others) in the past 7 days?[3]
fish	How many rubles did your family spend on fish, fresh frozen, salted dried, fish semi-finished products in the past 7 days?
sausage	How many rubles did your family spend on sausages, smoked products in the past 7 days?

As mentioned previously, coefficients of the multiple choice model do have an explicit economic interpretation. Thus, for the rest of the analysis, this paper uses marginal effect coefficients which can be interpreted as a change in the probability of falling into a particular cluster, depending on the change in the corresponding factor - the independent variable of the multiple choice model (Table 3), Below estimations of the cluster of interest ("poverty") are provided.

Table 3. Marginal effects of the multiple choice model for cluster 3

[2] Sum of se1.15c – se 1.9 based on data of the 23rd wave of RLMS
[3] Sum of se1.6c – se 1.4 based on data of the 23rd wave of RLMS

	dy/dx*100%	Std. Err.	z	P>|z|
Vegatables	0.0075	.00004	1.76	0.078
Fruits	- 0.0181	.00007	-2.49	0.013
Meat (beef)	0.0135	.00004	3.25	0.001
Sausages	0.0017	.00008	0.23	0.820
Milk	0.0117	.00006	1.99	0.047
Cheese	- 0.0230	.00013	-1.80	0.071
Fish	8.86e-04	.00005	0.18	0.856

The following five product groups have significant marginal welfare effects: vegetables, fruits, meat, milk, cheese. A positive sign indicates a direct relationship between the cost of a given product and the probability of being in the group of the lowest living standard.

Product groups "fruit" and "cheese" have a negative sign. This unexpected result can be a consequence of the following hypotheses. The first is that the "poverty" group includes households with high consumer preferences for cheese or fruit - they will continue to consume these goods even in case a significant increase in prices. Another hypothesis is that, even with a slight increase in prices, there is a refusal to consume cheese or fruit in favor of other cheaper food products, which does not lead to an increase in the share of food expenditure in the expenditure structure.

To test the first hypothesis, we will conduct a cluster analysis using the k-means method within a group with a low standard of living, in order to identify the group of "cheese lovers (fruits)", then, similarly to the previous one, we construct a model of ordered multiple choice for the formed subgroups of the "poverty" group. As a dependent variable we use an (unobservable) binary variable that takes the value 1 if the individual likes cheese (fruit) and zero if her preferences are moderate. As independent variables, the share of expenses for cheese and fruits is used in the structure of all expenditures for goods and services. Table. 4 shows the marginal effects of the model.

Table 4. Marginal effects of the multiple choice model for cluster 3 for “cheese lovers”

	dy/dx*100%	Std. Err.	z	P>|z|
Fruits	– 0.0702	0.00025	– 2.77	0.006

The positive sign of the coefficient for the variable cheese confirms the hypothesis formulated earlier: even though the cheese price increases, individuals of the subgroup "cheese lovers" do not reduce consumption of the product, increasing its share in the structure of consumption expenditure, thus increasing the probability of belonging to the "poverty" group. In the case of the "fruit lovers" group, however, this hypothesis does not find confirmation. The "fruit lovers" group is excluded from further analysis.

The next part describes the model for markets of goods. As a result of the estimation, five equations are obtained for supply. Supply elasticities of the analyzed goods are presented in Table 5.

Table 5. Elasticity of goods to price change

Name of product	Elasticity coefficient
Meat	0,45
Milk	0,21
Cheese	0,13
Vegetables	0,07

The estimates for counter-sanction effects of declining imports are not related to devaluation as shown in Table 6.

Table 6. Conter-sanction effects on Import

	Expected import dynamics in 2014 taking accountiong exchange rate changes	Actual import dynamics	Import decrrase due to Contersanction d
(1)	(2)	(3)	(4) = abs((3) – (2))
Cheese	–21.56	–27.01	5.45
Meat	– 9.84	–19.01	9.17
Milk and milk products	– 3.84	–11.82	7.98
Vegatables	30.55	21.86	8.69

Finally, we acquired all necessary information in order to estimate the counter-sanction effect of increasing the probability to be assigned to the “poverty” cluster. Results are presented in table 7.

Table 7. The effect of counter-sanctions on well-being

	Elasticity coefficients	Price change of domestic goods, %, YoY	Poverty Growth	Coefficients of marginal effects
(1)	(2)	(3) = табл.6 (4)/(2)	(4) = (3)*(5)	(5)
Cheese	0.13	41.8	0.96	0.0230
Meat	0.45	20.4	0,28	0.0135
Milk and milk products	0.21	38	0.45	0.0117
Vegetables	0.07	125.9	0.95	0.0075

The total increase in probability of falling into low income group as the result of counter-sanctions measures and the corresponding domestic price increase is 2,64% (Table 7, Column 4). This is equivalent to the emergence of 3,8 million new poor people. According to Russia’s Statistical Agency the

grows of people with income below the poverty line constituted 3 million people (In 2015 13,3% of the population were people with incomes equal or below poverty line. In 2014 that number was at 11,2%)[4]

6. Conclusion

This paper obtained a clusterasation of the population by grouping by the share of consumption expenditure to total income. Boundaries for poverty were defined. Marginal effects and sensitive groups goods were identified. Estimates of the elasticities of production of counter-sank commodities are obtained. The counter-sanctions effects of import reduction, not related to the devaluation of the ruble, are singled out. The estimates of the growth of domestic prices for commodity groups, including counter-sanction goods, are obtained.

Clusters for the population based on proportion of consumption expenses in overall income were received. The boundaries of poverty are determined. Marginal effects were determined and sensitive groups of goods were identified. Elasticities of countersanction goods production were estimated. This paper highlighted the counter-sanctions effects on the decline of import, not including effects from devaluation. Estimates for increased prices on product groups, including counter-sanction product goods were received.

As a result of the study, it appears that counter-sanction measures led to an increase in poverty in the country by 3.8 million people.

In the conditions of preserving the counter-sanction regime, adjustment to a new equilibrium - a larger volume of production, will promote the growth of wages and profits in "closed" sectors of the economy. The spread of these impulses in the economy will lead to a positive effect on the welfare of the country's population, including the low-income group. However, these positive effects will occur only in the medium and long term. An assessment of the cumulative effect of counter-sanctions on the welfare of the country requires further research.

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