A TIME-SERIES ANALYSIS OF THE BEEF SUPPLY RESPONSE IN RUSSIA: IMPLICATIONS FOR AGRICULTURAL SECTOR DEVELOPMENT POLICIES

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ABSTRACT[1]

This study analyses the substantial decline in livestock sector in Russia during the last twenty years. The observed decline could be explained by a range of factors, which are supported in this paper through a review of past research results as well as time series data related to the livestock sector. The study concludes with implications and recommendations for agricultural sector development policies.

Key words: Russia, beef livestock decline, prices of beef

1 INTRODUCTION

During the past twenty years, the number of livestock in Russia declined to about one third of the level achieved in 1986. This decline could be explained by a range of factors which are supported in our paper through a review of past research results as well as time series data related to the livestock sector. First, the liberalization of agricultural prices (coupled with the dismantlement or reduction of state subsidies to agriculture for fertilizer, feed, technology and credit) during the transformation period led to an increasing disparity between prices for agricultural inputs and capital and the prices for beef and other agricultural outputs. Second, prices for poultry meat as the major competing product were higher in the earlier years of the transformation period, but did not decline as much in real terms than beef prices. Third, the malfunctioning credit system, coupled with insecure property rights of agricultural companies, implied a major decline in the provision of agricultural credit. The dismantlement of state subsidies to agriculture and the above mentioned adverse price changes for agricultural producers led to increasing indebtedness of agricultural firms and rising bankruptcy cases. Hence, the Russian agricultural sector, including large-scale enterprises, has now suffered for many years from severe credit constraints that undermine investment in replacing outdated technology, such as tractors and buildings, and in establishing a modern integrated food chain system. Forth, apart from these domestic internal factors, Russia faced international competition from other countries (E.U., U.S.A., Brasil, etc.) that began to export beef to Russia. Some countries, namely those belonging to the EU, subsidized their beef exports to Russia in order to solve their own problems of domestic surplus. During the past twenty years, imported livestock provided an increasing share of the domestic supply of beef, thus likely to depress domestic beef prices further.

This paper seeks to analyze the changes in Russia's beef production during the past twenty years in light of changing domestic prices for meat and inputs as well as changes in technology and imports. In the next chapter, we formulate a Nerlovian supply response model for estimating the relationship between beef production and the price for beef, while seeking to control for some of the other above listed factors. Chapter 3 presents data sources and limitations. In Chapter 4, we discuss the results from various model specifications, and choose one alternative specification for simulation of the impact of three trade liberalization scenarios on domestic beef production. In Chapter 5 the impacts of policy liberalization scenarios are discussed. The final chapter summarizes conclusions and policy implications.

2 MODEL SPECIFICATION

Micro-economic theory suggests that the main determinant of the supply of a product is its own price, i.e. here the domestic price of beef. Economic theory further suggests that major shifters for beef production and supply are the prices of competing outputs and the prices of

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inputs. For the beef sector of Russia, the major competing product is poultry. A large share of costs of variable inputs for livestock production are determined by the costs of feed. In addition, a number of other factors, such as the amount of production factors (labor, land, and capital) employed in agriculture as a whole and in beef production in particular, as well as the underlying prices for these factors play an important role. Lastly, in an open economy, imports as well as exports will influence the domestic price of beef and hence its production. In the case of Russia, exports of beef are negligible, but as we see later, imports of beef into Russia have significantly risen over the past 20 years.

A suitable econometric model for the analysis of agricultural supply response based on time series data has been developed by Nerlove (1956). According to McKay et al. (1999), the NSR model allows explaining dynamic optimization behavior of farmers, their decisions and their reactions to moving targets. The Nerlove Supply Response (NSR) model is a partial adjustment supply response model, dynamic by nature, heterogeneous by commodity structure, and econometrically estimated by method. It is an „adjustment“ model, because, according to the assumption you see in equation (1), producers adjust output Y_t to the desired or optimum level, Y_t^*. The economic unit to which Y_t^* refers may not always be able or willing to make the transition to the desired level instantaneously; thus, if Y_t^* is a desired number of livestock, this optimal level may not be attained instantaneously because of cost and technology level. Hence, the observable level of the variable may reflect a partial adjustment of the economic unit from current to optimal levels (Dhrymes, 1981).

$$Y_t - Y_{t-1} = \beta\,(Y_t^* - Y_{t-1}) \qquad \beta \in [0,1] \tag{1}$$

In other words, the change in output between the current and previous periods is only a proportion of the difference between the optimum level and the last year's output. β is the adjustment coefficient, which lies between zero and one. The restriction placed on the parameter β in equation (1) is both intuitive, and theoretically sound. If $\beta = 1$, it implies that producers are able to fully adjust to supply and demand shocks in one period and $Y_t^* = Y_t$. If $\beta = 0$, it implies that there is no adjustment $Y_t = Y_{t-1}$. An estimate of β close to one implies almost immediate adjustment, a low β implies a very slow adjustment to changes in exogenous variables (Griliches, 1959). $\alpha\beta$ means a short-run, while α coefficient alone is response for a long-run supply elasticity of a given variable (Pindyck and Rubinfeld, 1998). The coefficient β could be easily calculated by subtracting a unity from the estimated parameters.

The NSR model, additionally to the adjustment component, includes also another assumption, the so called "price expectations component".

$$P_t^* - P_{t-1}^* = \beta\,(P_{t-1} - P_{t-1}^*) \quad \beta \in [0,1] \tag{2}$$

The price expectations component (equation 2) consists of the idea, that each year farmers revise the price they expect to prevail in the coming year in proportion to the error they made in predicting price this period (Nerlove, 1956). So that the price expected in this year is denoted by P_t^*, the price expected last year by P_{t-1}^*, the actual price last year by P_{t-1}, and the proportion of the error, by which farmers revise their expectations, by a constant β, which lies between zero and one (see equation 2). So the expected price P_t^* is represented as a weighted moving average of past prices (equation 3)

$$P_t^* = \beta P_{t-1} + (1-\beta)\,\beta P_{t-2} + \ldots \tag{3}$$

Nerlove (1956) argues, that although in theory all past prices must be included, the fact that the weights decline means that practically we can safely ignore prices in the very distant past. Thus, he achieves an equation of his second hypothesis (see equation 4), that farmers revise their expectations by a portion of the error they make in prediction to obtain estimates both of the elasticity of output to expected price and of the coefficient of expectation. Nerlove restricts himself to the simple case, in which the output, devoted to the crop is a linear function of the expected relative price of that crop alone:

$$Y_t = \alpha_o + \alpha_1 P^*_t + \varepsilon_t, \qquad (4)$$

where
Y_t – output,
P^*_t – price of output y, expected this year,
ε_t – random residual term.

We cannot observe P^*_t, declares Nerlove, and so we cannot estimate equation (4) as we would any other simple equation. We must represent P^*_t in terms of variables we can observe. Equation (4) means that we can write any expected price, P^*_t, as a linear function of output Y_t. In particular last year's expected price, P^*_{t-1}, can be represented by last year's output, Y_{t-1}. But this means that expected price this year is a function of last year's actual price and last year's actual output. Because the expectation model, as expressed in equation (2), says that expected price this year is a function of actual price last year and expected price last year. We can replace last year's expected price in equation (2) by a linear function of a last year's output. If we now substitute this new expression for expected price into the output response function, equation (2), we obtain a new relation between output this year and last year's actual price and last year's output:

$$Y_t = \pi_0 + \pi_1 P_{t-1} + \pi_2 Y_{t-1} + \beta\varepsilon_t, \qquad (5)$$

where π_0 turns out to be equal to $\alpha_o\beta$, π_1 equals $\alpha_1\beta$, and π_2 equals $1-\beta$, (implications from Nerlove, 1956).

The Z vector was included into the Nerlove model, as the impact of other factors, such as labor, technology, price for comparative product, etc., which could be also important:

$$Y_t = \alpha_o\beta + \alpha_1\beta P_{t-1} + \alpha_2\beta Z_{t-1} + (1-\beta) Y_{t-1} + \beta\varepsilon_t, \qquad (6)$$

Thus, the structural model can be summarized as follows:

$$LP = f(Pb, Pp, Pf, AW, TE, Imp) \qquad (7)$$

Where LP = livestock population
Pb = producer price of beef
Pp = producer price of poultry
Pf = price of feed for animals
AW = Labor force involved in agriculture
TE = Technology (proxied by number of tractors)
Imp = imported amount of beef livestock
Capital stock = was omitted because of lack of data

After some substitution in equation (1) and considering the specific variables of vector Z in equation (7), we obtain the final estimation equation (8), as follows:

$$LP_t = \alpha_o\beta + \alpha_1\beta Pb_{t-1} + \alpha_2\beta Pp_{t-1} + \alpha_3\beta Pf_{t-1} + \alpha_4\beta AW_{t-1} + \alpha_5\beta TE_{t-1} + \alpha_6\beta Imp_{t-1} + (1-\beta) LP_{t-1} + \beta\varepsilon_t \quad (8)$$

The price of feed represents the costs of the major variable input for beef production, and the sign of the estimated coefficient is expected to be negative. Another variable contained in the vector Z is the number of tractors. This variable shall represent the level of technology used in beef production. Prices for technical equipment were not available for the whole twenty years period, and no data on technology specifically used in the beef production sector was available. Hence, the amount of tractors serves as our best possible proxy variable for the technology level employed in beef production, and is hypothesized to have a positive influence on the agricultural output, i.e. the number of livestock. Another variable, which is expected to have a negative influence on beef production, is the price of poultry. Poultry meat is the major competing product for beef in Russia.

A number of Russian studies argue that cheap imports depress Russian domestic beef production (Ananiev, 1998; Brazhevskaja, 2005). However, these studies do not provide econometric evidence for this argument. We seek to empirically test and measure the influence of beef imports on domestic beef production.

Finally, the Nerlovian adjustment process (i.e. the level of beef production and the speed of adjustment) will heavily depend on the available stock of labor and capital employed in the beef sector. The agricultural labor force in Russia has declined over the past twenty years, but this decline was not compensated by significant increases in capital intensity since – as Krylov (2001) suggests - the farm operations suffer from lack of financial capital. In the next section, we show that the number of tractors have declined in Russia, thus providing another indication of declining capital intensity per hectare. Unfortunately, we could not obtain any time series data for measuring the stock of capital employed in Russia, neither for the beef sector nor for the agricultural sector as a whole.

3 DATA SOURCES AND LIMITATIONS

During the transition period of Russian agriculture, major changes in agricultural output and input prices occurred. The main characteristic of this change is a growing "price disparity" for agricultural inputs in relation to outputs (Serova et al.; Brazhevskaja, 2005, and Krylov et al., 2001). Prices for agricultural inputs rose by a much greater percentage than prices for agricultural output (Liefert and Swinnen, 2002), reducing the comparative advantage of the agricultural sector compared to other sectors in the Russian economy. As a result, debts of agricultural producers were growing (Krylov, 2001) while the sluggish transformation of the parastatal agricultural credit system meant severe credit rationing and increases in interest rates for loans to the agricultural sector (compared to the socialistic period). Hence, the lack of capital is likely to induce lower investments in the replacement of technology, for example as can be seen in the decline of number of tractors during the past 20 years.

In Table 1, we show data on the number of livestock in Russia as an indicator for beef production. The number of livestock declined by two thirds, from a pre-reform level in the late 1980s of about 60 million animals, to the most recent level in 2005 of about 21 million animals. Table 1 also provides evidence of the decline in beef price in relation to the price of poultry meat. Other major factors of production influencing the agricultural sector in general, and the livestock sector, are the prices or availability of capital and the population employed in agriculture. For the former variable, we were unable to obtain time series data on provision of agricultural credit, or stock of financial capital or other fixed assets such as buildings.

Table 1: Time series data concerning Russia's livestock sector

	Price of feed (Euro per kilo)	Price of beef (Euro per kilo)	Price of poultry (Euro per kilo)	Number of people working in agriculture (in million)	Technology: Number of Tractors (in million)	Livestock imports: Number of animals (in million)	Livestock population Number of animals (in million)
1986	0.91	7.61	4.83	10.31	1.43	2.52	59.60
1987	1.23	6.71	4.28	10.00	1.39	1.92	60.50
1988	2.27	7.83	4.43	10.31	1.39	1.50	59.80
1989	2.85	8.62	5.11	9.64	1.35	1.77	59.30
1990	1.82	6.30	3.66	9.20	1.34	2.77	57.04
1991	1.02	2.27	1.95	8.72	1.33	3.21	54.68
1992	0.08	0.09	0.12	8.41	1.29	3.64	52.23
1993	0.13	0.46	0.57	8.17	1.24	3.89	48.91
1994	0.09	0.50	0.77	7.60	1.15	3.66	43.30
1995	0.10	0.41	0.67	6.70	1.05	4.55	39.70
1996	0.14	0.51	0.87	6.20	0.97	3.89	35.10
1997	0.11	0.61	1.08	5.70	0.89	5.35	31.52
1998	0.07	0.45	0.80	5.30	0.86	3.96	28.48
1999	0.08	0.45	0.63	5.10	0.79	4.10	28.03
2000	0.10	0.55	0.79	4.70	0.75	2.12	27.29
2001	0.13	0.76	1.03	4.20	0.70	3.31	27.11
2002	0.10	0.88	0.87	3.80	0.65	3.71	26.52
2003	0.08	0.64	0.82	3.30	0.59	3.82	24.94
2004	0.10	0.74	1.02	2.90	0.53	3.68	22.99
2005	0.08	0.94	1.16	2.90	0.51	2.79	21.40

Note: Domestic prices for poultry, beef and feed are expressed in Euro, using the official exchange rate between Ruble and Euro.
Source of data: Prices are from the OECD for the years 1986-1990, and for all years later are based on the information from the State Statistical Committee of the Russian Federation. Data for agricultural workers and livestock population was taken from the State Statistical Committee of Russian Federation. Number of tractors and data for beef import was taken from the FAO database.

The number of tractors in Russian agricultural sector in 2005 was three times smaller than in 1986 (see Table 1). While this data does not give any information about changes in quality of technology, the numbers nevertheless suggest a decline in the mechanization level (and capital intensity per hectare) of Russian agriculture. In 2005, on average 102 hectares were serviced per tractor in Russia. The corresponding figure for the U.S.A. is 28 hectare, and for Germany it is 8 hectare (Krylov, 2001). Krylov also cites that over 30 percent of crops harvest is being lost in Russia every year because of insufficient quantity and quality of agricultural machinery. The severe decline in the mechanization of Russian agriculture during the transformation period is caused – according to Krylov (2001) - by a low profitability and increasing indebtedness of agricultural enterprises.

The import data, considered in the model, is from the FAO database. According to the Association of Russian Polultry Market Operators (Surikov, 2004), the illegal import of meat in Russia is an important problem. For example, in 2004 it was estimated to be over 25-35 percent of all meat consumption.

For example, in 2004, imported beef occupied over 25-35 percent of all meat consumption, including 15-20 percent of a so called "black", and 10-15 percent of a so called "gray" illegal import of meat.

A "black" import, according to Davleev (2004), is contraband of a cheap and low quality meat, which is brought into the country, bypassing customs services and frontier guards. Such meat is quickly sold through the illegal channels by very low prices, which partially satisfies countries' domestic demand and lowers the average domestic price of meat. "Gray" import (Ibid.) is a main reason for a livestock decrease in Russia. Meat, coming from Europe into the CIS countries, changes its' "citizenship" by receiving new documents and being marked as meat produced in Ukraine, Byelorussia, or Kaliningrad's' free economic zone (Medovikov, 2004). This meat is partly processed in a "new home country", for example, taken out of bones, divided into smaller pieces, sprinkled with salt and pepper, etc. Such a new product does not fall under the regulations of quotas and tariffs, when being sent to Russia, since it is a product from the CIS countries (Surikov, 2004). In Russia "gray meat" is over 10 percent cheaper than the average quality Russian meat (Davleev, 2004). As a result increased imports lead to a decrease in the price of beef. Thus, the import variable in our model is hypothesized to have a negative effect on domestic production of livestock in Russia.

One can see from Table 1, starting with 1992, the farm gate poultry prices were always higher than prices of beef, while retail prices for beef in Russia are higher than for poultry. This is hypothesized to have a negative effect on the livestock sector development.

It was not possible to gather all the necessary data from the only one statistical databank. This raises the issue of comparability of data from different sources. However, this issue is not further addressed in this paper. In spite of our intensive search using several databases, it was not possible to obtain a complete time series for all variables shown in Table 1. The observations are missing for agricultural workers for the year 1989, 1993, 1994, and for 2005. Likewise, the number of tractors is missing in the period 1989 to 2001 and again for 2005. One of the methods to calculate the missing values, offered by Pindyck and Rubinfeld (1998), is to replace the missing observations with proxy observations. These are obtained by regressing the known values of the independent variable on time and then replacing the missing observations with the fitted value of the regression. For reasons of brevity, the results are not shown here but can be provided to the interested reader upon request. Table 1 shows the estimated values for those years for which data was missing.

4 PRESENTATION AND DISCUSSION OF RESULTS FROM ALTERNATIVE MODEL SPECIFICATIONS

In order to evaluate the results of the regression analysis, various criteria have been followed in the study. The criteria can be divided into two groups, namely economic criteria, based on economic theory, and econometric criteria, based on econometric theory.

The *economic criteria* refer to the sign of the coefficients. If one does not conform to those defined by the economic theory, then the results of the regression analysis are rejected. If the sign of the coefficient does not answer economic expectations, other functional forms could be tested (Boccanfuso, Dekaluwe and Savard, 2003).

The *econometric criteria* evaluate the statistical reliability of the coefficients using some statistical tests. As far as our regression analysis involves small sample size, a convenient way to check the extent of reliability of the individual coefficient based on the standard error is the so-called t-statistic. The t-statistic greater than the t-value at 1 percent level of significance will be considered "highly significant" and at 5 percent level - "significant". The coefficient of determination (adj. R^2) measures the goodness-of-fit of the regression line of the data. In our model the adj. R^2 value of 0.995 means that 99.5 percent of the change in the values of NL can be predicted based on changes in the value of explanatory variables. Another important criteria to test is the investigation of whether the assumptions (i.e. no multicollinearity, no autocorrelation, etc.) are fulfilled. A high degree of multicollinearity is harmful in the sense that the estimates of the regression coefficients are highly imprecise and can be biased due to the large variances (Pindyck and Rubenfeld, 1998).

We examined two functional forms in the study: linear and log-log functions. The linear function led to the estimation of theoretically inconsistent signs of regression coefficients as well as multicollinearity problems. The log-log regression produced statistically more reliable results (see Table 2 and Figure 1). In regression 3 (Table 2) all variables are significant at minimum 5 percent level, except import coefficient, which is significant at 10 percent level, although it is still more significant, than in the linear function.

Pf_log (price of feed) and AW_log (agricultural workers) variables were omitted out of the regression 3, because they were not statistically significant and had a high degree of collinearity. The omission of the AW_log coefficient from the regression 3 reduced the VIF coefficient of the TE variable from 684.0 to 45.0. As a result, the significance of the TE coefficient increased from 20 to 5 percent level.

The VIF coefficients of the Pb_log and Pp_log variables anyhow remain high: 112.0 and 79.4 respectively. Estimated Durbin *h* coefficient declares about the presented series correlation in the model.

Braulke (1982) relates to this problem, saying that collinearity arises because of the simultaneous appearance of the variables Pt-1 and At-1 in the NSR model; should it be present, he concludes, there is little one can do about it.

Regression 3 was chosen for ex-ante simulations because of the highest adjusted R^2, degrees of freedom and high variables' significance. The estimation results of the regression 3 are presented on the Figure 1.

Table 2. Regression results (linear-log estimates)

	Regression 1	**Regression 2**	**Regression 3**	**Regression 4**
Constant	2.029	1.539**	1.633***	0.816***
	(1.740)	(2.765)	(3.130)	(3.039)
Pf_log	-0.016	-0.140	Om	Om
	(-0.685)	(-0.610)		
Pb_log	0.144**	0.137**	0.125**	0.108*
	(2.407)	(2.441)	(2.439)	(2.135)

Pp_log	-0.141**	-0.137**	-0.134**	-0.118*
	(-2.229)	(-2.258)	(-2.266)	(-1.993)
AW_log	-0.170	Om	Om	0.224**
	(-0.483)			(2.516)
TE_log	0.615	0.365**	0.370**	Om
	(1.145)	(2.699)	(2.810)	
Imp_log	-0.081*	-0.070*	-0.067*	-0.055
	(-1.999)	(-2.140)	(-2.116)	(-1.618)
LAG_log	0.543**	0.587*	0.566*	0.670*
	(3.020)	(3.932)	(3.995)	(5.608)
Adj. R-square	**0.994**	**0.994**	**0.995**	**0.994**
DW test	**1.920**	**1.871**	**1.761**	**1.763**
DW *h* test	**0.281**	**0.372**	**0.663**	**0.601**
Degrees of Freedom	**11**	**12**	**13**	**13**

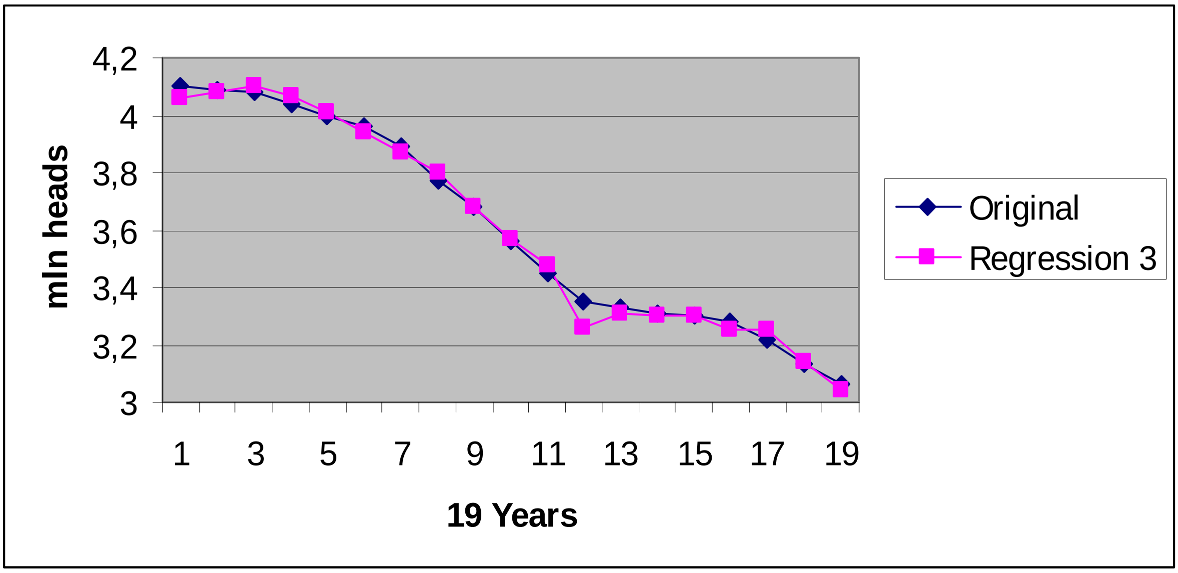
Om - omitted variable.
Notes:
t-value is given in parentheses. All explanatory variables are expressed in natural log form.
**** - significant at the 1 percent level of error probability*
*** - significant at the 5 percent level of error probability*
** - significant at the 20 percent level of error probability*

Since regression 3 in the NSR model produced the most reliable results than other functional forms, it was chosen for the elasticity analysis. In regression 3 β coefficient is equal to 0.434 and therefore represents not very high, but still substantial supply adjustment to changes in exogenous variables. Increase in beef price for 10 percent in short run will lead to livestock population increase of 1.25 percent. At the same time the competing good (poultry) price increase by 10 percent will result in beef livestock decrease by 1.34 percent. The poultry price coefficient in absolute terms is higher, than a price of beef coefficient. In other words, if prices of beef and poultry would increase proportionally, the increase in prices would be followed by the decrease in livestock population. Such short-run elasticities of beef and poultry prices could be explained by the fact, that farm-gate price of poultry in Russia during the past 20 years have been higher, than price of beef (see Table 1). Since farm-gate poultry prices are higher in Russia, than beef prices, but the costs at the same time for poultry breading are lower, farmers in Russia preferred to switch from beef into poultry production.

The technical equipment variable has the highest elasticity coefficient among the other participating variables. A ten percent increase in the number of technical units will lead to 3.7 percent increase in livestock population.

A ten percent increase in beef import will reduce livestock for 0.67 percent.

Figure 1. Ex-post simulation results of the NSR model, logarithmic regression 3



Source: Author's own presentation.

5 SIMULATION OF TRADE POLICY SCENARIOS

There are four simulations in the study: the ex-post simulation is done in order to prove that in our case the NSR model is working successfully and the predicted results are not far from reality. The results for regression 3 are shown on the Figure 1. Fitted and actual values are very close to each other.

The next three simulations are related to the final period of time and consider respectively three cases: the case of global trade liberalization, the case of EU trade liberalization and a separate effect of the EU export subsidy elimination.

5.1 Simulation scenarios

OECD economic report No. 802 (2001) estimates international prices for all three trade liberalization cases, considered in our simulations (see Table 3).

Table 3. Price estimates for simulation scenarios

	European Union		**World**
	Export subsidy elimination	All distorting policies elimination	All distorting policies elimination
Livestock prices (increase in %)	-	-	22.30
Agricultural prices (increase in %)	0.9	4.4	-

Source: Diao, Somwaru, and Roe in the USDA report No. 802.

Serova et al (undated source) show that world market price has a direct relationship with a domestic price in Russia. This means that increase in a world market price (other factors stay constant) will lead to a proportional increase in a Russian domestic price. They mention that this is particular true for beef production in Russia, because this good is highly imported. However, we lack exact data on price transmission elasticities, and use here a simplified and admittedly imprecise functional relationship between the world market and the domestic price for beef in Russia.

For our simulation of trade scenarios, we choose the domestic price of beef as our baseline price. For the three scenarios, this current price is multiplied by 0.9, 3.0 and 22.3 percent, respectively, in order to achieve a domestic producer price for ex-ante simulation period. In this case we assume that the base import price in Russia for the prediction period will be the same one as before the prediction period.

Elasticity estimation

OECD report gives a percentage of price increase during trade liberalization only for a price of beef. Since it was complicated to find studies with computed producer price of poultry elasticity against a beef price and beef import elasticity against a beef price in Russia, this elasticity was estimated in the current study. The results of elasticity estimation showed that an increase in the beef price by 1 percent will lead to the increase in the poultry price by 0.717 percent. And an increase in the beef price by 1 percent will lead to a decrease in beef imports by 0.175 percent. The computation of elasticities could be provided to an interested reader.

5.2 Simulations Results

According to the OECD report, if the EU export subsidies will be eliminated, the world market beef prices will rise up by 0.9 percent. Following the assumption that Russian domestic prices for beef will rise up proportionally to the world market prices, after this policy measure implementation, Russian domestic price of beef will also rise by 0.9 percent. At the same time poultry price in Russia will rise by 0.65 percent and a beef import will decrease by 0.16 percent. In the case of EU all distorting policies elimination price of beef will rise up by 4.4 percent, price of poultry – by 3.16 and import will decrease by 0.77 percent. In the case of full global policy liberalization price of beef is expected to rise up by 22.3 percent, price of poultry – by 15.99 percent and import will decrease by 3.9 percent.

The run of the NSR Model under the "EU export subsidy elimination" scenario shows a decrease in livestock population (see Table 4). An increase in beef price induces producers to increase livestock production, but the corresponding increase in poultry price in a multi-market context has a greater negative effect than the direct own-price effect. In the second scenario, "EU all distorting policies elimination", the world market price for beef is expected to increase by 4.4 percent. Livestock population in Russia does not change in this case. This happens because the smallest beef price coefficient is compensated by the highest elasticity of beef price. This means that the higher will be increase in prices, the lower will be the gap between them. In the third scenario "Global full policy liberalization", the price of beef is predicted to rise up by 22.3 percent, which leads to an increase in livestock population (see Table 4).

Thus, we come to the conclusion that under the present circumstances the change in livestock population will be very small with respect to price changes caused by the three trade policy scenarios. In other words, the observed decline in Russia's livestock sector is largely due to domestic structural problems.

Table 4. Results of simulation scenarios

Simulation Scenarios	Beef Price Increase (%)	Beef Livestock Population, (mln heads)

Year 2005 in ex-post simulation	**-**	**20.53**
EU export subsidy elimination	0.90	20.51
EU full policy liberalization	3.00	20.53
Global full policy liberalization	22.30	20.66

6 CONCLUSIONS

The study results show that Russia's livestock sector has been in decline because of three major driving factors. First, cheap (and partially illegal) imports from the EU and other countries have depressed farm-gate prices for beef. However, our simulation results regarding the three scenarios suggest that beef production would not rise by much after liberalization, mainly because of the more competitive poultry sector. Second, the beef sector in Russia was highly subsidized under the socialistic rule, and price changes during the transition period led to a growing price disparity between agricultural and industrial goods in general and agricultural inputs and outputs in particular. Third, because of changes in demand and in production, poultry meat became more competitive compared to beef, and was to a large extent responsible for the decline in livestock production. Agricultural producers have shifted out of beef production into the production of poultry. Based on the simulation results, we do not expect significant increases in beef production in Russia during the coming years even under full liberalization of beef production in world markets. Our analysis shows that the transition to a market-based agricultural sector implies the decline of previously heavily subsidized sectors, such as beef, and the rise of other sectors, such as poultry.

The National Priority Project entitled „Agricultural Sector Development" seeks to halt the decline in the livestock sector by providing subsidized credit for investment in cattle barns and increase in volume of state-supported leasing of agricultural equipment and pedigree cattle to livestock producers. According to the study results, such political measure could be efficient only in cases, when prices of beef are not depressed by the competitive products. Such cases, for example, could be newly emerging agricultural operators, the so called agroholdings, covering all stages of the food chain from input supply to processing and wholesaling (Hockmann et al, 2005), as inside such structures no farm-gate prices exist.

Such measures, on the other side, could not be sustainable in conventional agriculture, where subsidized inputs in technology will be depressed by the inefficient for a livestock sector farm-gate price structure. Apart from product-specific policies and programs which entail the risk of setting up production structures that prove to be inefficient in the long-run, the state may consider investing in public goods that do not necessarily benefit specific agricultural products but rather provide impetus for private investment and production increases in the agricultural sector and rural development overall. Such investments would include the improvement and expansion of rural infrastructure (roads, communication), property rights, and market information systems. Such measures are likely to induce a sustained agricultural supply response while leaving the choice of which agricultural enterprise (be it poultry, beef, or certain crops) is most efficient to the private sector.

Our results should be interpreted with caution, however. We pointed out to the limitations in data. Second, our assumption about the price transmission elasticities as well as the domestic cross-price elasticities, and other factors, should be further explored by future studies. The use of multi-market models for the meat sector in Russia would be one of the promising research tasks to validate and possibly extend the results shown in this paper.

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