APPROACHING THE LOSSES
CAUSED BY IMPERFECT SHORT-TERM FINANCING
AT THE RUSSIAN FARMS

Irina V. Bezlepkina[*]
Wageningen University (the Netherlands)
Moscow Agricultural Timiryazev Academy (Russia)
Nikolai M. Svetlov[**]
Moscow Agricultural Timiryazev Academy (Russia)

This study investigates whether an insufficient short-term financing causes losses for Russian agricultural farm and what is their upper boundary. The modified Bayesian formalism provides a workaround for scarce and incomplete data in our data set. This formalism is incorporated into the objective function of an optimisation model so that this function expresses the empirical dependence of profit on cash flow and debts. The model seeks for the optimal quarterly cash flow distribution within a year. Empirical application employs the data from 60 quarterly reports of six agricultural enterprises in the Moscow Region in 1995-1998. The losses per total farm expenses vary from 2.2 to 42.6% depending on a farm and a year. In more than a half of cases they are greater than 10%. The opportunities to improve farm financial performance can be revealed from individual changes in the quarterly cash flow distribution.

1. Introduction

Transition processes in Russian agriculture and unfavourable economic environment have resulted in agricultural production decline over 40% between 1991-1998 and in a large share of unprofitable agricultural enterprises (84.4% in 1998). The financing of agricultural production is unstable and uncertain. Postponed and incomplete payments for agricultural products are widely observed. The share of debt receivable in gross cash receivables in 1998 was 35.8%. The major part of debt receivable (91.7%) was delayed for more than three months. The external financing takes a very small share in agriculture. In 1998 the ratio of credits and loans to gross output in agriculture was 0.62 times as large as in industry (as of 1996 it was 1.52 times)[1]. Limited access to credit sources, low financial discipline and money devaluation because of high inflation result in a lack of finance. That in turn leads to production decline and increases the losses. In order to make these losses less hampering, it is necessary to determine their essential factors and draw the strategies to overcome them.

The topical problem of agricultural production decline in transitional economies has drawn attention of agrarian economists in Eastern European countries. Gow & Swinnen

[*] Irina V. Bezlepkina is a PhD student enrolled in the programme which is jointly implemented at Wageningen University (the Netherlands) and Moscow Agricultural Timiryazev Academy (Russia). Address in Russia: Dept. of economic theory, Timiryazevskaya 49, 127550 Moscow, Russia. Address in the Netherlands: Agricultural Economics and Rural Policy Group, Hollandseweg, 1, 6701 KN Wageningen, the Netherlands.
E-mail: Irina_Bezlepkina@hotmail.com
[**] Dr. Nikolai M. Svetlov is an associate professor at the department of economic cybernetics at Moscow Agricultural Timiryazev Academy (Russia). Address: Dept. of economic cybernetics, Moscow Agricultural Academy n.a. K.A. Timiryazev, Listvennichnaia alleia 4, 127550 Moscow, Russia. E-mail: Svetlov@mnts.msk.su
[1] The source of the data given above is Goskomstat (1999).

(1998), Macours & Swinnen (1999) admit that one of the essential reasons for output decline is the financing problems due to reduced supply of agricultural credit, market uncertainty and high inflation. According to the survey conducted by Goskomstat in 1998, 78% of Russian agricultural enterprises reported a lack of finance as the most significant limiting factor of agrarian development was; 55% mentioned high interest rates; 48% underlined consumers' insolvency[1] (Goskomstat, 1999).

Among the major factors that were identified as reasons for low economic performance of Russian agricultural enterprises Pederson *et al.* (1998) pointed low profitability, a debt problem and a low rate of return on assets. Van Empel (1999) and Von Pischke (1999) fairly admit that inefficiency of agricultural credit system takes part the decline of agricultural production. As a consequence of rural credit system underdevelopment, agricultural farms cannot use loans to improve their financing due to risky nature of agricultural production and demanding requirements of the banks (Van Empel, 1999).

<u>The aim of this study</u> is to evaluate the upper boundary of losses for a set of agricultural enterprises. The research hypothesis is that insufficient financing is one of the causes of losses incurred at the agricultural enterprises. The contribution of this research is that it explicitly quantifies the costs of two causes of imperfect financing: 1) restricted access to credit sources and 2) deferred payments for agricultural products. The relevance of these results is as follows. At the farm level these results indicate to what extent a farm management exploits the internal resources to compensate the losses caused by the imperfect financing. At the policy level the calculated losses express how costly the mentioned financial imperfections are and, hence, indicate the urgency of development of the policy which is aimed at creating a favourable financial environment for agrarian production.

The data limitation problem in Russia recently stressed by Moers (1999) remains in this study. 26% of the data in the set used in this study are missing. We deal with the data scarcity problem by employing the Bayesian formalism.

The current analysis of financial problems in Russian farming is different from previous research, e.g. Pederson et al. (1998), Epstein & Tillack (1999), in several ways. First, it introduces new data that have a quarterly basis, thus allowing the modelling of cash flow distribution within a year. Second, it provides an estimation of the upper boundary of losses associated with imperfect financing. Third, it permits preliminary identification of the reserves to soften the damage caused by a lack of finance.

[1] The respondents also mentioned insufficient support from the state, aggravated conditions of the fixed assets, high taxes and inefficient management.

To achieve the aim of the study the theoretical concept was developed which relates to modelling of agricultural production financing. In section 2 a mathematical programming model is presented which forms a base for the empirical evidence. Two values of profit to operating capital ratio are derived using Bayesian inference. The first of them relates to an optimal farm's cash flow while the second corresponds to an actual cash flow. The loss per unit of operating capital is determined as the difference between these two values. In section 3 we describe the modifications that have been applied to a standard Bayesian formalism. The data description is given in section 4 and results can be found in section 5. In the final section we focus on possibilities to improve the economic performance of agricultural farms, discuss the applied model and outline its further improvements.

2. Theoretical framework for accounting the losses incurred due to a lack of finance

The mathematical programming approach forms the base of this study. The theory is presented in (Kantorovich, 1960; Hazell & Norton, 1986) and many others. To derive the upper boundary of losses caused by financial imperfections, an optimisation model of farm profit is employed. The objective function of this model is maximum profit to operating capital ratio subject to the available yearly financing that remains constant over a year. The level of losses is derived by comparing two modelled values. The first value (E^*) is the optimal profit to operating capital ratio that is modelled with incorporated financial constraints. The second value (E) is derived by setting the values of the model to their actual values, so that no optimisation is involved[1]. The difference ($E^* - E$) presents the upper boundary of losses.

Two specifications of the optimisation model are developed. In both specifications described below the vector $\mathbf{x} = (x_i)$ of independent variables consists of the following 9 components: $x_1 \ldots x_4$ are profit to total costs ratios for quarters I…IV respectively; $x_5 \ldots x_8$ are debt receivable to operating capital ratios at the end of quarters I…IV respectively[2]; x_9 is a debt payable to operating capital ratio at the end of quarter IV. We use the symbol $\mathbf{x}_0 = (x_{0i})$ to denote the constant vector of the actually observed values of nine mentioned variables.

The base of both specifications is a function π of profit per operating capital on vector $\mathbf{x}$: $\pi = f(\mathbf{x})$. Given this function, E is derived from the following equation: $E / W = f(\mathbf{x}_0)$, where

[1] We do not compare actual and modelled values since it is rather difficult to capture the difference caused by an error term.

[2] The model could gain by means of monthly data about profits and debts receivable. However, Russian farms are obliged to draw up a balance sheet only quarterly. So, the data that required for such detailed model is not accessible.

W is a value of the operating capital. The derivation of E^* is different for two specifications of the model.

Specification I aims at defining the best quarterly distribution of money flow and allows for taking credit and making deposit when needed. The function $\pi = f(\mathbf{x})$ is maximised in $x_1 \ldots x_4$, whereas the variables $x_5 \ldots x_9$ are fixed at their actual levels. The mathematical expression of this maximisation model is as follows:

$$E^*/W = \max_{x_1 \ldots x_4} \quad f(x_1 \ldots x_4, x_{05} \ldots x_{09})$$

subject to (1)

$$\sum_{i=1}^{4} \frac{x_i c_i}{(1+\delta)^{i-1}} \le \sum_{i=1}^{4} \frac{x_{0i} c_i}{(1+\delta)^{i-1}}$$

where δ is a quarterly discount rate[1] and c_i are farm expenses for the quarter i. The constraint ensures that the total available yearly financing does not get higher than its actual discounted value so that there is no overestimation in the modelled values of cash flow. In other words, the constant amount of financing is allowed to be optimally distributed among the quarters.

Specification II in addition to the previous one optimises the quarterly distribution of debt receivable. The variables $x_1 \ldots x_8$ are involved in optimisation. As in specification I, the model is constrained keeping the sum of the discounted financial resources constant:

$$E^*/W = \max_{x_1 \ldots x_8} f(x_1 \ldots x_8, x_{09})$$

subject to (2)

$$\sum_{i=1}^{4} \frac{x_i c_i}{(1+\delta)^{i-1}} - \sum_{i=5}^{8} \frac{\omega(x_i - x_{0i})}{(1+\delta)^{i-5}} \le \sum_{i=1}^{4} \frac{x_{0i} c_i}{(1+\delta)^{i-1}}$$

Here ω is amount of operating capital at the end of the year.

In both specifications the increased profit is brought by the same amount of operating capital due to increased production which becomes possible under the optimal cash flow.

The level of losses defined as represents the approximate reserve of cash flow improvement under the assumption that input and output allocations are in optimal (regarding to available knowledge) accordance with the cash flow that induces E^*. If we omit this assumption then ($E^* - E$) approximates the **upper boundary** of the reserves to improve the cash flow distribution.

If ($E^* - E$) is defined by means of different model specifications then the meaning of this value is also different. Given specification I, we define the losses caused by the imperfec-

[1] As soon as our aim is an approximate estimation of losses, in both specifications the interest rates on credit and deposit are assumed to be equal for simplicity.

tions in the banking system which hamper farm's cash flow improvement by the instrumentality of credits and deposits. As for specification II, the losses caused by the behaviour of farm's debtors are also accounted. Hence, the losses defined with specification II are expected to be higher than those defined with specification I. The difference between these two values of losses can be attached to the externalities received from debtors.

3. An empirical profit on cash flow dependence: a modified Bayesian approach

The empirical specification of the objective function $f(\mathbf{x})$ of the optimisation problems (1) and (2) involves the data set in which there are many missing data. To employ this data set the Bayesian formalism is engaged. The empirical function $\pi = f(\mathbf{x})$ incorporates the modified Bayesian inference.

Most of the Bayesian inference problems can be expressed as the evaluation of the expectation of a function of interest under the posterior. The classical Bayesian formalism is useful to derive the distribution of the variable considering the *known* factors influencing it (Judge *et al.*, 1988). The sufficient and robust rule for such derivation can be drawn even on the base of a data set in which a significant share of data is missed.

To employ the Bayesian inference, input data require special preparations to extract all necessary information from it. The dependent (objective) variable and independent (factor) variables need to be converted into the discrete form. Insofar as the traditional Bayesian formalism operates with discrete data, the small (within one quantile[1]) alternation of a factor variable will yield no change of the dependent variable. Hence, the optimisation methods based on differential calculus will not work. Svetlov (2000) suggests the modified version of the Bayesian formalism that allows applying the traditional numerical methods of optimisation. In the modified Bayesian formalism the value of a variable is considered as reliably belonging to a particular quantile only in case when it matches with a quantile mean. Otherwise the variable's value is attached to both adjacent quantiles with a certain probability. The modification ensures that the values of $\partial\pi / \partial x_n$ for $n = 1\ldots9$ are, as a rule, non-zero, so we can engage the Newton's method of solving for optimum[1].

The rate of convergence of the function of interest depends critically on the choice of the probability distribution function (Geweke, 1989). In this study the decision on the probability distribution function is justified regarding to the actual data: for the variables with both negative and positive values the normal distribution is preferred and for the non-negative

[1] Quantile is a compact subset of values realising with a given probability (in our study either 1/3 or 1/4).

variables the gamma distribution is chosen. These distribution functions were found to be in accordance with the available data. The particular distribution function for each variable is presented in Appendix (Table A-3). Theoretically the number of quantiles should be chosen so to ensure that the share of the entropy removed by a factor variable in the overall entropy of the objective variable is the greatest. Empirically the number of quantiles is conditioned by the number of non-missing values. For each independent variable the conditional probabilities of every quantile with respect to the number of quantile of a dependent variable are calculated. We make use of the method described in Svetlov (1995) that allows deriving probabilities from the scarce data. These conditional probabilities form the knowledge base, which is used to derive a posterior distribution of the dependent variable.

The formalism requires the correlation between factor variables to be low. Dependencies between quarterly profits and debts receivable induced by the farm size effect are avoided by using the relative measures. The same approach does not work in case of quarterly debts payable: the correlation between them remains high. Hence, we cannot introduce the debts payable for more than one quarter in the model. The disadvantage of our approach resulting from this restriction is that the model does not allow for the influence of debt payable distribution within a year on profit.

The mathematical expression for the model's objective function that incorporates the modified Bayesian inference is as follows:

$$f(\mathbf{x}) = \sum_{i=1}^{4} p_i({}^{9}\mathbf{x})\pi_i \tag{3}$$

where

$$p_i({}^{n}\mathbf{x}) = \begin{cases} p_i({}^{n-1}\mathbf{x}) \quad if\ n > 0\ and\ x_n \text{ is missing;} \\ \dfrac{p(B_{n,k(n)} / A_i)\, p_i({}^{n-1}\mathbf{x})}{\sum_{h=1}^{4} p(B_{n,k(n)} / A_h)\, p_h({}^{n-1}\mathbf{x})} \cdot (1 - z_n + k(n)) + \dfrac{p(B_{n,k(n)+1} / A_i)\, p_i({}^{n-1}\mathbf{x})}{\sum_{h=1}^{4} p(B_{n,k(n)+1} / A_h)\, p_h({}^{n-1}\mathbf{x})} \cdot (z_n - k(n)) \\ \quad if\ n > 0\ and\ x_n \in]m_{n,1}; m_{n,q}[; \\ \dfrac{p(B_{n,k(n)} / A_i)\, p_i({}^{n-1}\mathbf{x})}{\sum_{h=1}^{4} p(B_{n,k(n)} / A_h)\, p_h({}^{n-1}\mathbf{x})} \quad if\ n > 0\ and\ x_n \notin]m_{n,1}; m_{n,q}[; \\ 0.25 \quad if\ n = 0; \end{cases} \tag{4}$$

$$z_n = k(n) + \frac{x_n - m_{n,k}}{m_{n,k+1} - m_{n,k}}. \tag{5}$$

[1] The Newton’s method is implemented in Microsoft Excel software as a standard solver procedure.

Here ${}^{n}\mathbf{x}$ is a vector consisting of the first n elements of $\mathbf{x}$, $p_i({}^{n}\mathbf{x})$ is a probability that the profit per operating capital belongs to a quantile i considering the values of the first n independent variables, π_i is a mean value of the profit per operating capital in the i-th quantile, $m_{n,k}$ is a mean value of the k-th quantile of x_n, $m_{n,q}$ is a mean value of the last quantile of x_n, $k(n)$ is either the greatest number of the n-th variable's quantile for which $x_n \geq m_{n,k(n)}$ or 1 if such quantile does not exist, A_i denotes the event that the profit per operating capital belongs to the quantile i, $p(B_{n,k(n)}/A_i)$ is an average probability of the event $B_{n,k(n)}$ that the value of the n-th variable belongs to the quantile $k(n)$ in case of the event A_i, z_n is a real number representing x_n in a form required by the modified Bayesian formalism. From (4) it follows that if the values x_n do not belong to the range $]m_{n,1}; m_{n,q}[$ then there is no difference between the standard and modified Bayesian procedures.

According to (4) the probabilities p_i are calculated with which the value of variable π can be attached to quantile i considering the available information on values of the vector $\mathbf{x}$. This computation implements the modified Bayesian inference. *A priory* these probabilities are 0.25 by construction of quantiles. If there is no available information on $\mathbf{x}$ at all then $p_i(\mathbf{x})$ remains equal 0.25.

4. Data and their transformation

The data on production and financial activities over six agricultural enterprises located in the Moscow Region are used in this study. The agricultural enterprises in our data set are the former kolkhozes and sovkhozes with 1000-3000 hectares of arable land and 200-650 employees. Most of the farms combine the crop and livestock production activities (Table A.1 in Appendix). Four enterprises produce vegetables; three of them are strictly specialised in this product. This set is not a typical representation of the farming sector in the Moscow Region, so the conclusions are valid only for the given set of enterprises.

The approach requires the quarterly data. We used 60 quarterly balance sheets of six enterprises[1] for the period 1995-1998 to compose the data set. For some farms the data covers a shorter period. In this data set an observation represents a farm in a specific year. Each observation consists of the data of one to four quarterly reports. If less than four quarterly reports are available for some farm and year then there are missing values in the corresponding

[1] The agricultural farms provide quarterly balance sheets to the regional departments of agriculture. However, there is no facility making these sheets accessible because they are intended for internal use of the departments. Therefore one faces severe difficulties when ordering and receiving data from the quarterly balance sheets.

observation. The resulting unbalanced panel consists of 22 observations. For 13 observations of them we do not have complete records. To give a reader a clear picture how the unbalanced panel was formed and what data are missing we refer to Table A.2 in Appendix.

The data conversion to the form required for the Bayesian formalism is performed according to (5). The results can be reviewed in Tables A.3 and A.4 of Appendix. The number of quantiles is 3 or 4 depending on the number of non-missing values. Data transformation was based on either normal or gamma distribution regarding to their better conformance with the data. In Table A.4 the real number z_n usually has a fractional part. This denotes that with the probability represented by the fractional part of z_n the value x_n can be attached to the quantile which number is an integer part of z_n. With the probability (1 – fractional part of z_n) this value can be attached to the quantile which number is an integer part of $z_n + 1$. For example, $z = 2.84$ (farm №1, year 1995 in Table A.4) implies that value $x_3 = 0.2624$ can be attached to quantile 2 with probability 0.16 and to quantile 3 with probability 0.84.

Both model specifications are executed in Microsoft Excel. The software processes one observation at a time. The optimisation model operates with the transformed data that are presented in Table A.4. Two scenarios for each model specification are obtained applying different discount rates. These two scenarios allow us to compare the level of losses under the assumption that the discount rate is 25% (typical for efficiently working economy, scenario 1) and 100% (the case of the economy with financial imperfections, scenario 2). The real situation in Russian economy in 1996-1998 when the interest rates were around 100% corresponds to scenario 2.

5. Results

Though the calculations are performed at the farm level, the conclusions are drawn over the whole sample in order to be robust. The structure of the model does not take into account the farm specific characteristics other than the cash flow properties. Therefore we cannot make a conclusion at the level of individual farm about the reserves to reduce the losses. The optimisation model was run with the data from the years 1997 and 1998 for which 10 observations were available. Among them 1 observation was omitted because it did not provide the minimal amount of data, which is absolutely necessary to run the optimisation model. The graph with actual profit per operating capital and that modelled under actual conditions is presented in Appendix (Chart 1). The difference between these values is attached to the influence of the factors that are not reflected in the model.

Table 1. The losses caused by a lack of short-term finance
% of total yearly farm's expanses

Farm number, year	Specification I		Specification II	
	efficient economy (scenario 1)	imperfect economy (scenario 2)	efficient economy (scenario 1)	imperfect economy (scenario 2)
№1, 1997	9.6	9.6	29.1	29.1
№2, 1997	27.1	27.1	33.3	33.3
№3, 1997	1.8	9.8	2.2	14.9
№4, 1997	5.9	3.8	6.0	4.3
№5, 1997	19.2	21.5	19.2	21.5
№6, 1997	2.8	2.8	4.0	5.6
№3, 1998	0.4	0.8	0.4	2.2
№5, 1998	33.8	40.2	39.2	42.6
№6, 1998	5.5	5.5	10.2	9.9

Table 1 presents the calculated losses (per unit of farm's expenses) caused by a lack of short-term finance.

Model specification II compared to specification I allows wider possibilities in optimisation of cash flows, i.e. optimisation of debt receivable, therefore the losses derived from specification I cannot be higher. The results conform to this expectation. In 3 cases of 9 both specifications yield the same magnitude of losses. In other cases the losses derived from specification II are higher. The difference per total farm's expenses amounts to 19.5%. These additional losses approximate the negative externalities received by the farms from their debtors.

Under the actual economic conditions the typical level of losses caused by the banking system (defined by means of specification I) is several percent amounting to 20% and higher for 3 observations of 9. Thus, the imperfect banking system forms a considerable source of farms' losses. Another source of losses, namely the behaviour of debtors with respect to their liabilities, is less hampering but still worth attention. It varies within the range 0…6.2% of total expenses (except for the farm 1 in year 1997). Contrarily, the discount rate that reflects the opportunity cost of capital does not discernibly affect the level of possible losses. Derived losses are not always higher for the scenario of imperfect economy because to some extent the farms have been adapted to the conditions of high interest rates.

Table 2. Net cash flow distribution
Thousand roubles

Farm number, year	Number of a quarter	Under actual conditions	After optimisation			
			Specification I		Specification II	
			efficient economy (scenario 1)	imperfect economy (scenario 2)	efficient economy (scenario 1)	imperfect economy (scenario 2)
№1, 1997	I	-1443	-1009	-1009	**-1009**	**-1009**
	II	-1142	-1220	-1220	-49	-49
	III	**-2130**	**-2934**	**-2934**	-2	-2
	IV	2277	1999	300	1136	1136
№2, 1997	I	**-162**	**-302**	**-302**	**-302**	**-302**
	II	555	265	265	265	265
	III	n.a.*	n.a.	n.a.	n.a.	n.a.
	IV	n.a.	n.a.	n.a.	n.a.	n.a.
№3, 1997	I	31	31	-291	-1072	**-1072**
	II	**-1144**	**-1144**	**-1261**	**-1206**	-430
	III	-394	-394	-282	-561	-234
	IV	1877	1877	1777	1761	271
№4, 1997	I	**83**	373	274	**-442**	373
	II	48	**-100**	**-100**	-306	**-100**
	III	422	210	323	-79	567
	IV	580	627	587	54	750
№5, 1997	I	**-231**	258	**-564**	**-454**	-892
	II	-62	76	98	328	-895
	III	511	**-209**	-209	-209	**-2255**
	IV	538	567	834	834	1108
№6, 1997	I	-1226	-892	-892	-892	-892
	II	-685	-895	-895	-888	-895
	III	**-1970**	**-2255**	**-2255**	**-2137**	**-2255**
	IV	-544	-796	-796	-672	1108
№3, 1998	I	248	403	-187	296	734
	II	-97	-713	137	-164	-881
	III	144	-850	-850	75	-417
	IV	-47	215	118	-81	0
№5, 1998	I	68	**-242**	**-359**	**-242**	**-364**
	II	512	-165	-25	-165	-25
	III	**-537**	161	122	161	113
	IV	-8	55	55	55	55
№6, 1998	I	-398	-454	-454	-454	208
	II	**-610**	**-991**	**-991**	**-812**	-76
	III	-329	-513	-513	-486	**-90**
	IV	1800	1978	1978	1827	1410

* n.a. = not available from the quarterly reports

In Table 2 the quarterly net cash flows under actual and modelled conditions are presented. The outflows of the quarters-recipients are in bold. The quarter-recipient is a quarter that has the largest outflow. It tends to attract the money from other periods and requires the credit. There is no significant difference at the discount factor 25% or 100% in the shifts of cash flow in model specification I. For specification II the cash flow allocation is different for two scenarios: in some cases receivables shift to adjacent quarters. Under Russian conditions, farms are constrained in their capabilities to control receivables because the debtors usually have no money on their accounts. The possible interpretation of this scenario is that farms may use the service of some non-profit intermediate that concentrates the debts and supplies the money to the farms instead.

We present the quarterly values of debt receivable for actual situation and for two scenarios of the second specification in Appendix, Table A.5. The dissimilarity between two scenarios in quarterly values of debt receivable for the specification II amounts to 37%. For some observations the modelled and actual quarterly values of debt receivable differ a lot underlying that the debt allocation within a year is a subject to be optimised. Greater differences are observed for the scenario 2 when the discount rate is higher.

Efficiency of the operating capital that is defined as balance profit to operating capital ratio is always positive after optimisation (Table 3). On average it is improved by 10% according to the model specification I and by 15% according to the results of specification II.

Table 3. Efficiency of the operating capital before and after optimisation
Roubles of balance profit per rouble of operating capital

Farm number, year	Before optimisation	After optimisation			
		Specification I		Specification II	
		efficient economy (scenario 1)	imperfect economy (scenario 2)	efficient economy (scenario 1)	imperfect economy (scenario 2)
№1, 1997	-0.059	0.049	0.049	0.268	0.268
№2, 1997	-0.032	0.087	0.087	0.115	0.115
№3, 1997	0.206	0.226	0.313	0.230	0.369
№4, 1997	0.151	0.212	0.191	0.214	0.196
№5, 1997	0.091	0.242	0.260	0.242	0.260
№6, 1997	0.102	0.141	0.141	0.158	0.181
№3, 1998	0.297	0.303	0.308	0.303	0.327
№5, 1998	-0.160	0.106	0.157	0.149	0.177
№6, 1998	0.111	0.176	0.176	0.233	0.230

Currently we have very limited results to give a comprehensive explanation to the observed differences between scenarios. It is possible that many enterprises have adjusted their activities so that their expected profits are higher under high discount rates, which reflect prevailing short-term preferences. For instance, in our case the enterprises whose debt payable is greater have, as a rule, higher results under the economic imperfections. In case of successful agrarian policy such enterprises can suffer. So they could potentially form an opposition to this policy thus playing a negative role in the reformation process. However, this question needs deeper study to make certain conclusions.

6. Conclusion and Discussion

This paper has presented a framework for explicit evaluation of the upper boundary of losses that agricultural enterprises face due to imperfect short-term financing. The possibility to solve the problem of preliminary evaluation of losses given scarce data by means of the Bayesian approach is demonstrated. This study provides the evidence of the possible existence of significant losses accumulated due to imperfect short-term financing by the farms in the Moscow Region. The level of losses derived for two scenarios (with different discount rates) and for two specifications of optimisation model (allowing for different optimisation possibilities) shows that it amounts to 42.6% of farm’s expenses. So the initial research hypothesis that insufficient financing is one of the considerable causes of losses accumulated at the agricultural enterprises in Russia is not rejected. As it was shown, the impact of banking system on farms' losses is higher than that of farms' debtors.

The study has shown that the influence of opportunity cost of capital on optimal cash flow is low. This result is in line with our recent investigation presented in Bezlepkina & Svetlov (1997). There were no large differences in the shifts of cash flow in model specification I between the scenarios with the discount factor 25% and 100%. The influence of discount rate on optimal structure of debts receivable is considerable: in some cases the change of the discount rate in specification II leads to the shifts of quarters-recipients to adjacent quarters. The arguments are obtained in favour of the hypothesis that the farms in the Moscow Region to some extent have adapted to the existing level of interest rate. After optimisation the efficiency of the operating capital is improved by 10…15% on average.

These conclusions are valid only for the set of six farms. In order to obtain more comprehensive evidence the similar study operating with the representative subset of the enterprises located in the Moscow Region is desired. However, it is problematic to access the necessary data.

In order to measure the losses rather than to approach their upper boundaries, a more advanced and detailed model is required that may be applied to a complete detailed data set. It would allow studying the factors of the losses thoroughly in order to propose a policy aimed at their reduction.

The detailed research of the losses caused by imperfect financing is topical. Apart of it, the outline of improvements of the model oriented on the preliminary study is developed. It includes simulation of various scenarios by: a) choosing other values of the discount factor to model different levels of opportunity cost of capital, b) introducing the possibility to optimise debt payable for each quarter so that it will be also involved into optimisation; c) fixing inflows for the particular period in order to measure the effect of severe financial constraints applied for particular periods and d) allowing for additional amounts of inflows or outflows. Thus, wider scope of opportunities to improve the financial performance of agricultural enterprises under different conditions can be identified. Another angle of improvement is introducing the variables (possibly qualitative) into the specification of $f(x)$, which would reflect the farm technological specifics and therefore reduce the error term of the model.

7. Acknowledgements

The authors thank Arie Oskam for his valuable comments to the earlier version of this paper. The comments of the participants of the conference "European Rural Policy at the crossroads", June 28-30, 2000, Aberdeen, Scotland and "XXIV International conference of agricultural economists", August 13-18, 2000, Berlin, Germany, and of an anonymous reviewer are also acknowledged.

8. References

1. Bezlepkina, I.V. & N.M. Svetlov 1997, *'Analiz vliianiia infliatsii na finansovoe sostoianie ZAO Chapaevets'* [An analysis of impact of inflation on the financial position of JSC Chapaevets, *in Russain*]. Sbornik studencheskikh nauchnykh rabot, vol. 3, pp. 222-226.
2. Epstein, D. & P. Tillack 1999, '*How Russian Enterprises are surviving (financial status of large agricultural enterprises, the case of enterprises in the St. Petersburg region)',* The economics in transition (forthcoming).
3. Geweke, J. 1989, *'Bayesian Inference in Econometrics Models Using Monte Carlo Integration'*, Econometrica, vol. 57, pp.1317-1339.
4. Goskomstat 1999, '*Rossiiskyi Statisticheskyi Ezhegodnik*' [Russian Statistical Yearbook, *in Russain*]. Moscow.
5. Gow, H.R. & J.F.M. Swinnen 1998, '*Agribusiness Restructuring, Foreign Direct Investment, and Hold-Up Problems in Agricultural Transition'*, European Review of Agricultural Economics, vol. 25, no. 3, pp.331-350.
6. Hazell, R.B.R. & R.D. Norton 1986, *Mathematical programming for economic analysis in agriculture,* Macmillian Publishing Company, New York.
7. Judge, G.G., R.C. Hill, W. Griffiths, H. Lutkepohl & T.-C. Lee 1988, *Introduction to the theory and practice of econometrics,* John Wiley & Sons.
8. Kantorovich, L.V. 1960, *Ekonomicheskii raschet nailuchshego ispol'zovaniia resursov* [Economic calculation for the best utilisation of resources]. Moscow, Izdatel'stvo AN SSSR.
9. Macours, K. & J. Swinnen 1999, '*Causes for output decline in economic transition: The case of central and Eastern European agriculture'*. Paper presented at the IX EAAE Congress 1999, Warsaw, Poland.
10. Moers, L. 1999, '*What determines Enterprise Performance in Russia? A Survey of the Evidence'*, Tinbergen Institute, discussion paper #1999-077/2.
11. Pederson, G. D., K. M. Brooks & O.P. Lekhtman 1998, '*Russian Farm Enterprise Performance and restructuring: a debt or profitability problem?*' Working Paper WP98-5, University of Minnesota.
12. Svetlov, N.M. 1995, *'Obosnovanie vesovykh koeffitsientov iskhodov v stokhasticheskikh modeliakh sel'skokhoziaistvennogo proizvodstva'* [Substantiation of weights attached to the cases of random conditions in the stochastic models of agrarian production, *in Russain*]. Doklady TSHA, vol. 266, pp. 190-195 [Accessible at http://thor.prohosting.com/~svetlov/sci/p16.pdf, October 01, 2000].
13. Svetlov, N.M. 2000, '*Metodika predvaritel'noi otsenki poter', obuslovlennykh neratsional'nym finansirovaniem sel'skokhoziaistvennykh predpriiatii'* [Methodology of preliminary evaluation of losses caused by irrational financing of agricultural enterprises, *in Russian*]. Working paper is published at RePEc file archive. RePEc serial: nos:ecomon:747321 [Accessible at http://www.ieie.nsc.ru/~adrepec/RePEc/data/747321.doc, October 01, 2000].
14. Van Empel, G. 1999, '*Preferential credits in countries in transition from the perspective of a commercial bank'*. Rabobank. Paper presented at the Experts in credit system Meeting, Moscow, January 12-13th, Russia.
15. Von Pischke, J.D. 1999, '*Predposylki sozdaniya ystoichivyh sistem selskohozyaistvennogo finansirovaniya i kreditovaniya*' [Development of stable systems of agricultural finance and credit, i*n Russian*]. Paper presented at the Experts in credit system Meeting, Moscow, January 12-13th, Russia.

Appendix

Table A.1. The structure of gross farm production

Average for the period 1995…1998, %

Farm number	Milk	Cattle meat	Other livestock production	Potato and cereals	Vegetables	Other crop production	Total
№1	43.6	4.9	3.4	8.0	30.6	9.5	100.0
№2	0.0	92.0	7.7	0.2	0.0	0.1	100.0
№3	21.2	2.9	0.4	9.2	64.2	2.1	100.0
№4	16.5	4.9	0.1	13.4	64.0	1.0	100.0
№5	36.0	12.5	0.2	45.1	4.1	2.1	100.0
№6	20.9	3.7	0.3	8.5	64.7	1.8	100.0

Table A.2. The data set

Farm number, year	Variables									
	π	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
№1, 1995	-0.0576			0.2624	-0.1877				0.2028	0.4009
№2, 1995									0.1418	0.3143
№3, 1995	0.5753			0.1738	0.5006				0.3365	0.9405
№4, 1995	0.3879			0.5119	0.2505				0.2984	0.2686
№5, 1995	0.1833				0.2140				0.2821	0.1432
№6, 1995	0.8498								0.4574	1.2651
№1, 1996	-0.3126			-1.0854		0.0981			0.2502	0.8182
№2, 1996	-0.0907			-0.3218	-0.2525		0.0415	0.0797	0.0639	0.4852
№3, 1996	0.0396			0.2186	0.1295	0.1974	0.1930	0.2610	0.2167	1.0455
№4, 1996	0.0846	0.0114	-0.0735	0.1490	0.0336	0.2679	0.1430	0.2776	0.2458	0.4687
№5, 1996	-0.0805	0.0387			-0.0260	0.1531	0.1558	0.0947	0.1258	0.3366
№6, 1996	-0.0894	0.2282	-0.4546	-0.7051	3.4477	0.2680	0.1628	0.1841	0.1648	0.4215
№1, 1997	-0.2366	-0.4406	-0.3612	-0.4142			0.1754	0.1973	0.1966	1.0219
№2, 1997	-0.7228	-0.1653	0.5311			0.0870	0.1095		0.1047	0.8831
№3, 1997	0.0216	0.0089	-0.1335	-0.1964	0.4059	0.2574	0.2218	0.2849	0.2349	1.4125
№4, 1997	0.0784	0.0313	0.0317	0.0477	0.2965	0.1657	0.1716	0.2125	0.1495	0.4988
№5, 1997	0.0797	-0.1263	-0.0378	0.2855	0.2478	0.0846	0.0858	0.0465	0.0236	0.4133
№6, 1997	-0.4605	-0.4238	-0.2954	-0.4985	-0.1259	0.1665	0.1525	0.2118	0.2392	0.6883
№3, 1998	0.0101	0.0476	-0.0392	0.0198	-0.0026	0.1879	0.2090	0.2843	0.2276	1.3344
№4, 1998	0.1242					0.1318	0.1626	0.4567	0.3329	0.4775
№5, 1998	0.0040	0.0560	0.3407	-0.2401	-0.0040	0.0299	0.0905	0.1757	0.1067	0.7437
№6, 1998	0.0408	-0.27	-0.2375	-0.0749	0.3496	0.1042	0.1321	0.2435	0.0048	0.9607
Number of missing values	1	10	11	6	6	8	7	8	0	0

π is profit per operating capital; $x_1 \ldots x_4$ are profit to total costs ratios for quarters I…IV respectively; $x_5 \ldots x_8$ are debt receivable to operating capital ratios at the end of quarters I…IV respectively; x_9 is a debt payable to operating capital ratio at the end of quarter IV.

Blank cells represent missing data.

Table A.3. Descriptive statistics of the model variables and quantiles

	Variables									
	π	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
Distribution*	N	N	N	N	N	Γ	Γ	Γ	Γ	Γ
Number of quantiles	4	3	3	3	4	3	3	3	4	4
Mean	0.020	-0.084	-0.066	-0.117	0.100	0.157	0.147	0.215	0.200	0.697
Variance	0.109	0.042	0.086	0.173	0.050	0.005	0.002	0.011	0.012	0.135
Mean of quantile 1, $m_{n,1}$	-0.399	-0.308	-0.386	-0.571	-0.184	0.084	0.097	0.113	0.084	0.300
Mean of quantile 2, $m_{n,2}$	-0.087	-0.084	-0.066	-0.117	0.027	0.146	0.142	0.200	0.151	0.530
Mean of quantile 3, $m_{n,3}$	0.128	0.141	0.253	0.337	0.173	0.241	0.205	0.324	0.217	0.756
Mean of quantile 4, $m_{n,4}$	0.440				0.384				0.327	1.209

*N denotes Normal distribution, Γ denotes Gamma distribution.

π is profit per operating capital; $x_1 \ldots x_4$ are profit to total costs ratios for quarters I…IV respectively; $x_5 \ldots x_8$ are debt receivable to operating capital ratios at the end of quarters I…IV respectively; x_9 is a debt payable to operating capital ratio at the end of quarter IV.

Blank cells represent missing data.

Table A.4. The data set prepared for use in Bayesian inference

The values of z_n for each x_n

Farm number, year	Variables									
	π	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
№1, 1995	2.14			2.84	1.00				2.78	1.44
№2, 1995									1.86	1.06
№3, 1995	4.00			2.64	4.00				4.00	3.41
№4, 1995	3.83			3.00	3.37				3.74	1.00
№5, 1995	3.18				3.20				3.59	1.00
№6, 1995	4.00								4.00	4.00
№1, 1996	1.28			1.00		1.22			3.30	3.14
№2, 1996	1.99			1.55	1.00		1.00	1.00	1.00	1.81
№3, 1996	2.59			2.74	2.70	2.54	2.80	2.49	2.99	3.64
№4, 1996	2.80	2.42	1.98	2.59	2.04	3.00	2.01	2.62	3.26	1.73
№5, 1996	2.03	2.55			1.75	2.07	2.22	1.00	1.62	1.16
№6, 1996	1.99	3.00	1.00	1.00	4.00	3.00	2.33	1.82	2.21	1.53
№1, 1997	1.52	1.00	1.08	1.34			2.53	1.97	2.69	3.59
№2, 1997	1.00	1.64	3.00			1.04	1.27		1.31	3.28
№3, 1997	2.51	2.41	1.79	1.82	4.00	3.00	3.00	2.68	3.16	4.00
№4, 1997	2.77	2.51	2.31	2.36	3.59	2.20	2.47	2.10	1.98	1.86
№5, 1997	2.78	1.81	2.09	2.89	3.36	1.00	1.00	1.00	1.00	1.49
№6, 1997	1.00	1.00	1.28	1.16	1.28	2.21	2.17	2.10	3.20	2.70
№3, 1998	2.45	2.58	2.08	2.30	1.86	2.44	3.00	2.68	3.10	4.00
№4, 1998	2.98					1.76	2.32	3.00	4.00	1.77
№5, 1998	2.42	2.62	3.00	1.73	1.85	1.00	1.00	1.72	1.34	2.95
№6, 1998	2.59	1.17	1.46	2.09	3.84	1.32	1.78	2.35	1.00	3.45

Table A.5. Quarterly values of debt receivable: actual and modelled using model specification II

Thousand roubles

Farm number, year	*Actual*				*Scenario 1*				*Scenario 2*			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
№1, 1997	n.a.*	1807	2033	2026	1454	1916	2782	2237	1454	1916	2782	2237
№2, 1997	399	502	n.a.	480	387	652	0	386	387	652	0	386
№3, 1997	4403	3794	4874	4018	3690	3375	4827	3714	3664	3416	4605	3854
№4, 1997	2395	2480	3071	2161	2142	2599	2576	3048	2531	2555	3082	2433
№5, 1997	802	814	441	224	800	1009	1385	798	800	1397	1894	798
№6, 1997	1600	1466	2035	2299	1659	1519	1986	2087	2007	1866	2491	2087
№3, 1998	4615	5134	6983	5590	4648	5029	7001	5525	5478	4861	5536	5333
№5, 1998	263	796	1546	939	742	855	1600	830	747	901	1553	934
№6, 1998	1183	1500	2765	54	1057	1614	2596	955	1663	1621	2185	1433

*n.a. = not available from the quarterly reports

Chart 1. Values of profit to operating capital ratios: actual and modelled under actual cash flow and debt state