The Institutional Support of Agricultural Loans and its Role in Czech Agriculture

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Abstract: The paper deals with the analysis of the institutional support of agricultural loans and its role in Czech agriculture based on the dynamic optimal model. The dynamic optimization problem is solved by the Lagrange method. The application of the theoretical model shows that the lower is the interest rate paid by the farmer the lower is the optimal consumption and consequently the farmer is willing to employ higher part of the capital in the production. Thus, the initial capital is more effectively employed. The time series analysis shows that the SGAFF's activities significantly support the farmer's investments. In spite of the problems in the setting of the SGAFF's policy, the role of the SGAFF in financing of agricultural activities can be regarded to be positive in the analyzed period.

Key words: SGAFF (Supporting and Guarantee Agricultural and Forestry Fund), dynamic optimization, agricultural output, investments.

1. INTRODUCTION

The quantity of capital employed and its financing are significant determinants of its productivity and efficiency, eventually, of the competitiveness of agricultural enterprises (among others). The external and internal financial resources are of several types. Bank loans can be ranked among the most important external resources in the Czech Republic. Bank loans are a cornerstone by planning cash flow on both the production level and the investment level. The credit market is, however, characterized by the asymmetric information that may result in credit rationing (see Čechura, 2006). The nature of agricultural activities reinforces the asymmetric information between farmers and banks and, thus, increases the likelihood of the external credit rationing occurrence. In the case of bank loans and farmers, one may also take into consideration the limiting collaterals, which may result in an internal credit rationing. Transactional costs are another problem. High transactional costs may also result in credit rationing. The shadow price of capital is then high. The SGAFF was founded to decrease the problems of asymmetric information or the occurrence of credit rationing, respectively. What is the role of the SGAFF in the financing of agricultural activities and in the future development of Czech agriculture? The object of this article is to find the answer to this question.

Activities of the SGAFF have been already analyzed by several authors in the Czech Republic, e.g. Bečvářová (1994), Čechura (2006, 2005), Janda, Čajka (2006,), Janda (2006), Šilar (1995), VÚZE (2001). The activities of the SGAFF appear to be efficient and to support competitiveness of agriculture from the view of the theoretical level. In practice, the efficiency of the SGAFF's activities depends on the efficiency of loans employment in the majority of cases. In general, the empirical evidence is the closer to the theoretical results the closer is the reality or economic agents' behaviour to the models' assumptions, respectively. This article views the problem from both theoretical and empirical level. Thus, the research problem is solved in a more complex way.

2. AIMS AND METHODOLOGY

The aim of the paper is to analyze the institutional support of agricultural loans and its role in Czech agriculture by the use of the derived dynamic model and to find theoretical-empirical consequences by employing the theoretical framework in the analysis of statistical data.

The hypothesis of the paper is as follows. If credits are significant part of farmer's capital, the SGAFF's activities contribute to the increase in the production and support the investment activities. Thus, the SGAFF supports the increase of effectiveness and competitiveness of Czech agriculture in the long run.

The content of the paper is as follows. Firstly, the theoretical model is derived. Then, the model is applied in the simulation. The results of the simulation will show the role of the SGAFF in financing of farmers' activities. Secondly, the empirical analysis is processed. Finally, the theoretical-empirical consequences are drawn and the role of agricultural subsidies in the future development of Czech agricultural is discussed. The hypothesis is concluded based on the results of the simulation and of the analysis of statistical data set.

The data set is available in the annual reports of the SGAFF 2000 – 2004 and in the "Green Report" (The annual report of the Czech agriculture) 1994 – 2004.

The theoretical model is defined in the form of dynamic optimization model. The Lagrange method is used to solve the optimization problem.

The empirical analysis uses the time series of the observed variables and some derived characteristics. The elementary time series analysis is processed in statistical software Statistica. The theoretical-empirical conclusions are drawn by the synthesis of results of the simulation and results of empirical analysis.

3. RESULTS AND DISCUSSION

3.1 Theoretical model

Theoretical model is based on the simple optimal dynamic model (see Chow, 1997), in which the economic agents solve the classical problem of resource allocation. The base model is adjusted and further developed to enable the analysis of the role of the SGAFF in financing agricultural activities. Thus, the model contains the investment aspects on the theoretical level.

It is assumed in the model that economic agents (in this case farmers) are rational, i.e. there is assumed the rationality of economic agents who optimize. The economic agents base their business decisions on the solution of dynamic optimization problem over T periods. The time horizon is middle run to long run, respectively. The model is general enough to comply with the characteristics of small farmers, as well as middle and large agricultural enterprises. This feature of the model is very important because the empirical analyses show (see e.g. Čechura, 2006) that the aggregate supply in Czech agriculture is significantly heterogeneous as far as the economic characteristics of economic agents are concerned.

Each farmer is endowed with capital k_0 and technology z_0 at the beginning of the period, i.e. in time t = 0. The capital can be employed in production to produce the output y_t. The transformation of capital into the output is described by the Cobb-Douglas production function, $y_t = \alpha k_t^{\beta} z_t l_t^{\gamma}$, with technology z_t. The labour is normalized to one without loss of generality, i.e. the production function can be written as $y_t = \alpha k_t^{\beta} z_t$. After the subtraction of costs n_t, the farmers solve the allocation problem. They are deciding which part of resources they invest in the next period and which part they consume in the period t. It follows from the

nature of the model that we can speak about the decision process of one farmer instead of all farmers without the loss of generality (see the assumption of rationality). Thus, the result for one farmer also holds for other farmers.

The farmer wishes to maximize her/his utility, which is given by (i). Since this is a dynamic process, the farmer wants to maximize her/his utility function over T+1 period.

(i) $$u_t = \sum_{t=0}^{T} \delta^t \ln c_t \quad .$$

It is assumed that the utility function is time separable. δ_t states for farmer's discount factor and c_t is the consumption in the time t.

The capital in the time t+1 is a function of capital in the time t and consumption c_t (see relation ii). The capital k_t is employed to produce output y_t in time t. The value of production depends on the price p_t. The part (1-ξ) is allocated either on investment (inv_t) or on consumption c_t. The investment inv_t is equal to the capital k_{t+1}. Thus, the farmer is deciding which part of the resources she or he invests into the next period. ξ states for the depreciation. The simple capital reproduction is assumed. The capital depreciation should be reflected by price p_t. p_t is supposed to be given by the market in time t. The ratio ξ is assumed to be constant given a technology z_t, i.e. ξ is a function of z_t. The capital costs are involved by the discount factor δ.

(ii) $$k_{t+1} = f(k_t, c_t) = p_t \alpha k_t^{\beta} z_t - n_t - c_t = (p_t - \xi)\alpha k_t^{\beta} z_t - c_t \quad ,$$

where

$n_t = \xi \alpha k_t^{\beta} z_t$, given the above stated assumption.

Assuming the rationality of farmers, the farmer optimizes (i.e. maximizes) her/his utility function in period 0 till T. That is, the farmer solves the dynamic optimization problem. This problem can be solved by Lagrange method (see Chow, 1997). The Lagrangian for our problem is as follows:

(iii) $$L = \sum_{t=0}^{T} \left\{ \delta^t \ln c_t - \delta^{t+1} \lambda_{t+1} [k_{t+1} - (p_t - \xi)\alpha k_t^{\beta} z_t + c_t] \right\} \quad ,$$

where the multiplicator λ_{t+1} expresses the dynamic constraints of variable k_{t+1}. That is by the use of the discount factor δ^{t+1} the multiplicator λ_{t+1} states for marginal contribution of variable k_{t+1} to the total utility in period 1,...T, which is evaluated in period T+1.

3.2 Application of theoretical model

The part of the application of the theoretical model shows the solution of optimization problem, its interpretation and the employment of the model in the analysis of several scenarios. The dynamic optimization problem as defined in (iii) can be solved by equating the partial derivatives of Lagrangian with respect to c_t and k_t to zero and solving them as a system of equations. The partial derivatives are as follows:

(iv) $$\delta^{-t} \frac{dL}{dc_t} = \frac{1}{c_t} - \delta \lambda_{t+1} = 0 \qquad t = 0, 1, ...,T \quad ,$$

(v) $$\delta^{-t} \frac{dL}{dk_t} = -\lambda_t + \delta \lambda_{t+1} (p_t - \xi)\alpha\beta k_t^{\beta-1} z_t = 0 \qquad t = 1, 2, ...,T \quad .$$

Since c_t is the control variable and k_t is the state variable, the solution of optimization can be found by solving equations (iv) and (v) for variables c_t and λ_t backward in time, i.e. starting in the time T.

As the capital in the time T+1 has no utility, k_{t+1} in equation (ii) is equal to 0. Expressing c_T in relation (ii) for the last period and substituting it into (iv), we can get $\delta\lambda_{T+1} = \left[(p_T - \xi)\alpha k_T^{\beta} z_T\right]^{-1}$. Then, we can substitute for $\delta\lambda_{T+1}$ in relation (v) and we get (vi).

(vi) $\lambda_T = \beta k_T^{-1}$

The relation (vi) can be used for the solution of the problem in the time T-1. By substitution for λ_T in (iv) and then for k_T from the equation (ii), we can obtain the relation (vii), which can be used for expressing λ_{T-1}, i.e. by the substitutions we may get relation (viii).

(vii) $c_{T-1} = (p_{T-1} - \xi)\alpha k_{T-1}^{\beta} z_{T-1}(1+\delta\beta)^{-1}$

(viii) $\lambda_{T-1} = \left[(p_{T-1} - \xi)\alpha k_{T-1}^{\beta} z_{T-1}(1+\delta\beta)\right]^{-1}(p_{T-1} - \xi)\alpha\beta k_{T-1}^{\beta-1} z_{T-1} = \beta k_{T-1}^{-1}(1+\delta\beta)$

Repetition of this process (algorithm) for large t results in:

(ix) $c_{T-t} = \left[1+\delta\beta+(\delta\beta)^2+(\delta\beta)^3+...\right]^{-1}(p_{T-t} - \xi)\alpha k_{T-t}^{\beta} z_{T-t} = (1-\delta\beta)(p_{T-t} - \xi)\alpha k_{T-t}^{\beta} z_{T-t}$

(x) $\lambda_{T-t} = \left[1+\delta\beta+(\delta\beta)^2+(\delta\beta)^3+...\right]\beta k_{T-t}^{-1} = (1-\delta\beta)^{-1}\beta k_{T-t}^{-1}$

The results of the optimization problem show that the optimal consumption is given by the value of output (without costs or depreciation, respectively) $(p_{T-t} - \xi)\alpha k_{T-t}^{\beta} z_{T-t}$ in the size of $(1-\delta\beta)$. The optimal consumption grows if the discount factor or capital productiveness or both go down. The marginal contribution of capital to the total utility is equal to $(1-\delta\beta)^{-1}\beta k_{T-t}^{-1}$. That is, the marginal contribution of capital to the total utility is the larger the higher is the productiveness of capital and/or the higher is the discount factor.

The results of the optimization can be analyzed from the view of capital resources and capital costs. Let us assume for simplicity but without the loss of generality, that farmer has only two available resources, shareholder's capital (vk_0) and bank loans (cr_0). The farmer prizes the cost of shareholder's capital on the level of required return on capital employed (i_0). The cost of bank loan is equal to loan interest rate (r_0) paid by the farmer. Then, the discount interest rate or the total capital costs respectively equal to the weighted average of the costs of the shareholder's capital and the loan interest rate. The discount factor, δ^t, is given by $\delta^t = (1+d)^{-t}$ for t = 0, 1,..., T, where d is the discount interest rate. Given these conditions we may analyze following scenarios.

Let in time t = 0, when the farmer solves the maximization problem, be $k_0 = vk_0$. This scenario represents the baseline. Thus, other scenarios are compared to this one. Since k_0 is the state variable, it is considered to be given. That is, there is not taken into account (explicitly) for a moment the decision about the initial (desired) size of capital. This can be done by the classical way or by the exploitation of the information theory (i.e. by considering the impact of asymmetric information on the decision about the size of bank loans). Having the initial capital $k_0 = vk_0$, the discount interest rate is equal to the costs of the shareholder's capital i_0. The discount factor, δ^t, is then given by $\delta^t = (1+i_0)^{-t}$ for t = 0, 1,..., T, assuming that farmer has adaptive expectation, i.e. it is supposed that all expectation are formed according to the formula: $f_{s+h} = f_s$ for *s* representing current period and h = 1,..., T. Let denote the baseline discount factor δ_*^t. The other parameters and variables are assumed to be the same in all scenarios unless it is said otherwise.

Scenario 1: Let in time t = 0 be $k_0 > vk_0$ and $r_0 > i_0$. Then, the farmer is endowed by k_0, which consists of the shareholder's capital vk_0 and the bank loan $cr_0 = k_0 - vk_0$. If $r_0 > i_0$, then the discount interest rate d_1 (the index indicates the scenario), as it is the weighted average of r_0 and i_0 with the weights *l* and *m*, is larger than d_* and, thus, the discount factor $\delta_* > \delta_1$, i.e. $(1+i_0)^{-1} > (1+li_0+mr_0)^{-1}$. The difference is equal to:

(xi) $$\delta_* - \delta_1 = \frac{(l-1)(i_0 - r_0)}{(1+i_0)(1+li_0+mr_0)} \quad .$$

It means given the relations (ix) and (x) that the optimal consumption is larger and the marginal contribution to total utility is smaller compared to the baseline. That is, the use of bank loan, when $r_0 > i_0$, motivates the farmer to a higher consumption. This effect comes into being if the other factors are constant. This situation may, thus, support the occurrence of moral hazard.

The margin between the optimal consumption in scenario 1 and the optimal consumption in the baseline is determined by the amount of the difference between the discount factors (see xi). The margin is expressed in (xii).

(xii) $$c^1_{T-t} - c^*_{T-t} = (p_{T-t} - \xi)\alpha\beta k^{\beta}_{T-t} z_{T-t}(\delta_* - \delta_1) = (p_{T-t} - \xi)\alpha\beta k^{\beta}_{T-t} z_{T-t} \frac{(l-1)(i_0 - r_0)}{(1+i_0)(1+li_0+mr_0)} > 0 \quad .$$

Scenario 2: Let in time t = 0 be $k_0 > vk_0$ and $r_0 < i_0$. The farmer is endowed again by bank loan $cr_0 = k_0 - vk_0$, but the loan interest rate is lower in this case than the shareholder's costs i_0. Thus, the discount interest rate d_2 is smaller than d_*. That is $\delta_2 = (1+li_0+mr_0)^{-1} > \delta_* = (1+i_0)^{-1}$. A larger discount factor leads to lower optimal consumption and higher marginal contribution of capital to total utility. In this situation, the farmer is motivated to use more capital in the production and the consumption is postponed. It means that the capital k_0 would be more effective in this scenario (in total) than in the baseline as well as in the scenario 1.

The margin between optimal consumption in scenario 2 and optimal consumption in the baseline is given by (xiii), which is an analogy to (xii).

(xiii) $$c^2_{T-t} - c^*_{T-t} = (p_{T-t} - \xi)\alpha\beta k^{\beta}_{T-t} z_{T-t}(\delta_* - \delta_2) = (p_{T-t} - \xi)\alpha\beta k^{\beta}_{T-t} z_{T-t} \frac{(l-1)(i_0 - r_0)}{(1+i_0)(1+li_0+mr_0)} < 0 \quad .$$

Scenario 3: Let in time t = 0 be $k_0 > vk_0$ and $r_0 = i_0$. If the farmer's initial capital consists of $cr_0 = k_0 - vk_0 > 0$ and the costs of shareholder's capital and bank loan equal, then the situation is the same like in the baseline.

Scenario 4: So far, we considered that the bank loan is characterised only by its cost, i.e. by the interest rate. However, banks usually ensure for the case of defaults of their clients. Thus, the bank requires collateral. If the bank loan is characterised by the interest rate r_0 and by the collateral in the amount of a_0, then this must be taken into account in the analysis. The collateral a_0 increases the uncertainty of the farmer about the future size of her/his consumption. In other words, the collateral a_0 increases the business risk level for the farmer compared to the situation when the business risk is on the bank. One way to take in the collateral is through the discount factor. As the collateral increases the business risk, then the costs of bank loan can be given as $r_* = r_0 + \sigma_0$, where σ_0 represents the increased business risk after introducing of the collateral into the model. It means if the bank loan is characterized by the interest rate r_0 and the collateral a_0, then the discount interest rate d is larger than in the situation without the collateral. From above stated (scenario 1 and 2), it follows that the collateral increases the optimal consumption and decreases the marginal contribution of capital to total utility, ceteris paribus. The farmer is less motivated to productive employment of her/his capital.

The role of the SGAFF in financing of agricultural activities is evident from the above stated (given the assumption of rationality of economic agents). The interest rate subsidies decrease the interest rate r_0 paid by the farmer (the client of the SGAFF). Thereby, the activities of the SGAFF decrease the discount interest rate or increase the discount factor, respectively. It leads to a lower optimal consumption and a larger marginal contribution of capital to the total

utility. It means that the resources are employed more effectively than in the situation, when the farmer is not a client of the SGAFF. The similar effect has the loan guarantee provided by the SGAFF. The loan guarantee decreases not only the occurrence of the external and/or internal credit rationing (this is not deeply analyzed in this article) but it also decreases the business risk resulting from the use of bank loans and thereby it increases the discount factor, which has the above mentioned effects. In case of both, i.e. the interest rate subsidy and loan guarantee, the above stated effects are further reinforced.

Technology z_t and price of the production p_t have been considered to be constant so far. However, they may play an important role in reality. The technology determines the output in time t and, thus, the optimal consumption. The price of production and its variability significantly determine both the profitability and the value of the output in the model and the risk level. In consequence, the higher is the risk level the higher might be i_0 and also r_0. Higher i_0 and r_0 result in higher d_t, which has above stated consequences. Moreover, if we take into consideration different agricultural sectors, the sector's profitability and risk level may determine the farmer's product portfolio. Then, according to the setting of farmer's portfolio the above analyzed effects of different scenarios or SGAFF's activities determine the agricultural sectors. This can be analyzed by generalisation of the model to N sector.

3.3 Empirical analysis - evidence

The system of agricultural subsidies during the period 1991 – 1993 that was especially by the Ministry of Finance regarded to be inefficient arose a discussion about the change in the system of the support of Czech agriculture and forestry. The change should lead to a more effective factors employment.

The partial subsidised and guaranteed loan seemed to be more effective way of agricultural support compared to other alternatives. The most important reasons can be concluded as follows (see Šilar, 1995): a) the bank loan ensures the market allocation of capital into the agriculture, b) the bank loan supports the market allocation of capital inside the agricultural sector and c) the risk is distributed among the bank, the state and the farmer.

The SGAFF (Supporting and Guarantee Agricultural and Forestry Fund) was founded on 23th June 1993 to support the loan creation in Czech agriculture in the form of partially subsidised interest rate and/or partially guaranteed loan. The loan guarantee and interest rate subsidy have been granted to agriculture from 1994 according to the defined rules and in the frame of the defined programs, i.e. for a specified purpose. The three basic programs were set out in 1994: OPERATION, FARMER and SERVICES. These programs were subsequently supplemented by specific programs, which had also one-shot object. The program EXPORT was approved in 1997. It was the first program in which the non-agricultural entrepreneurs could get the support. The program INVESTMENTS with subprograms FARMER, MARKETING BOARD, PROCESSER was approved in 1999 and the program HYGIENE on 1st July 2000. The supplementary program YOUTH was set out to support young farmers. The important change occurred due to the entrance of the Czech Republic into the EU. The program OPERATION, which provided farmers with loans for operating activities, was abolished by the entrance into the EU. The supports were granted in frame of programs INVESTMENTS, YOUTH and OFFSET OF INTEREST RATE CHARGE in 2005. As far as the further details about the programs are concerned, they are not introduced due to the object of the analysis.

The support in form of partially subsidised interest rate and/or partially guaranteed loan was chosen to maintain the criterial function of bank loan and interest rate. In other words, the SGAFF's supports may decrease the effect of asymmetric information on the agricultural loan

market but they do not eliminate fully the result of the presence of asymmetric information. Thereby farmers have an access to bank loans, i.e. the occurrence of credit rationing is reduced. But herewith the market allocation of loans into agriculture works because the bank shares the business risk. Then, the efficiency of this allocation is significantly determined by the setting of the size of loan guarantee and interest rate subsidy. The credit rationing is defined here in two forms external credit rationing and internal credit rationing. External credit rationing is a situation a farmer or a group of farmers are able to apply for a loan but do not receive it. Internal credit rationing means that farmer or a group do not apply for a loan although they wish to. Farmers are not able to fulfil the loan conditions (characteristics) (see e.g. restricted collaterals) or they are discouraged because of high costs they would face during the application process or subsequently (see Latruffe et. al, 2002). The SGAFF's activities may reduce both forms of the credit rationing. However, the effects on each of the forms differ due to their different nature. What was the role of the SGAFF in financing of agricultural activities in the period of 1994 – 2006? To find the answer is the object of this part of the article.

The development of agricultural loan in period of 1993 – 2006 can be divided into three phases. The division into three parts was based on the calculation of the roots of the fitted polynomial trend function of total loans in economy (in mil. CZK). The polynomial trend function of the third order explains the variation in total loans from 94% and has the following form: $y = 0{,}94t^3-236{,}68t^2+17276t+497713$. The first phase is from January 1993 till May 1997, the second phase from June 1997 till June 2002 and the third phase is from July 2002 till June 2006. The analysis of the farmers' position on the loan market is thus made for these phases, which are characterised by different conditions on the loan market. The product cycle and the corresponding setting of fiscal and monetary policy and the form of ownership of large banks were the most important determinants of different conditions in the loan market in the analysed period.

The table 1 contains the trend function of total loans in all branches in economy, the trend function of total loans in agriculture and in food-processing industry. The total loans in all branches increased in the first period. The fitted trend function shows that the annual increase was 6 411.7 mil. CZK. The increase is typical for nearly all branches in economy in this phase. The agriculture is not an exception. The fitted agricultural trend function shows the growing trend with the slope of 157.29. It means that the annual increase of total agricultural loans was 157.29 mil. CZK according to the fitted trend function.

The second phase has opposite patterns. The time series of total loans in all branches has a decreasing trend with the annual decline of 2 343.6 mil. CZK. Nearly all branches exercised the decreasing trend of total loans in this phase. The agricultural trend function has the slope -268.91, i.e. the annual decline of 268.91 mil. CZK.

The third phase is characterized by a further change in the loan market. That also follows from the above described economic conditions of the analyzed period and from the way of the determination of analyzed phases. The time series of total loans in all branches have the annual increase 7 364.9 mil. CZK. The total agricultural loans increase as well, annually by 124.04 mil. CZK.

The trend analysis shows that agriculture copied the established tendencies in economy. However, it does not tell us anything about the position of farmers in the loan market. To answer the question at least partly, we may analyze the development of ratio of total agricultural loans on total loans.

Table 1 (in its second part) presents the trend function of the ratio of total agricultural loans on total loans. The slopes of fitted trend functions in analysed phases suggest that ratio of total

agricultural loans on total loans went down in all phases. However, the decline in the third phase is slight. It suggests that farmers had a worse position on the loan market compared to other economic agents from other branches. It implies that farmers faced the credit rationing phenomenon with a higher probability. The worse position of agricultural enterprises was probably caused by a higher rate of indebtedness of agricultural enterprises, a low level of profitability of agricultural activities and in general a higher riskiness of agricultural activities. However, the slight decrease of the ratio in the last phase (see the slope of the trend function) suggests that the rate of agricultural loan in total credit portfolio of non-financial enterprises stabilized on the level of approximately 2.4 %. Thus, we may deduce that only competitive agricultural enterprises remained among the bank clients after the revaluation of the credit portfolio. Consequently, the presence of credit rationing might have been less probable. But it is not the case of internal credit rationing. Thus, the existence of the SGAFF cannot be omitted in this phase of the analysis.

Table 1: Trend functions of total (state) loans (in mil. CZK)

Trend functions of total (state) loans (in mil. CZK)			
Phase	Total loans (all branches)	Agriculture, hunting and fishery	Food-processing industry
01/1993 - 05/1997	y = 592 869 + 6 411.7t; R^2=0.98	y = 24 108 + 157.29t; R^2=0.61	y = 25 411 + 478.86t; R^2=0.98
06/1997 - 06/2002	y = 920 368 – 2 343.6t; R^2=0.82	y = 33 020 – 268.91t; R^2=0.9	y = 55 457 – 396.75t; R^2 = 0.8
07/2002 - 06/2006	y = 690 235 + 7364.9t; R^2=0.93	y = 17 004 + 124.04t; R^2=0.88	y = 23 601 + 58.642t; R^2=0.44
Trend functions – the ratio of the branch on total loans			
01/1993 - 05/1997	x	y = 0.0407 – 0.0001t; R^2=0.27	y = 0.0439 + 0.0002t; R^2=0.81
06/1997 - 06/2002	x	y = 0.0363 – 0.0002t; R^2=0.88	y = 0.0611 – 0.0003t; R^2=0.67
07/2002 - 06/2006	x	y = 0.0242 – 5E-05t; R^2=0.29	y = 0.0332 – 0.0002t; R^2=0.77

Source: own calculation

The specific models show that the credit rationing of farmers is determined by limited supply, limited farmer‘s collaterals and transactional costs. The SGAFF partly solves these problems by subsidizing of the interest rate and loan guaranteeing. That is, the activities of the SGAFF should reduce the presence of credit rationing or in general the effects of asymmetric information on the loan market, respectively. The activities of the SGAFF can be analyzed as follows.

Table 2: The supported total loans by the SGAFF, subsidised interest rate and average interest rate in economy

Supported total loans by SGAFF in period of 1994-2005 (mil. CZK, %)												
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
The number of application	2605	2945	3426	2540	1934	1746	1539	1723	1993	1802	2657	1917
Supported total loans	6235	10130	14847	14622	9299	7695	5324	6369	7361	6088	7963	5098
Supported investment loans	4302	6787	9100	5088	4709	2008	2931	4012	4699	3045	4825	3371
Interest rate subsidies (prepaid)	1118	1008	2827	2700	2682	2208	1610	1333	1267	964	880	609
The size of loans guarantee	1544	4436	8265	4788	2307	1138	876	1129	1365	1714	2306	605
Subsidised interest rate by the SGAFF	x	x	x	x	12	9.3	9.7	9	8.1	6.9	5.8	3.49
The average interest rate paid by clients of the SGAFF	2.7	3.8	3.2	6.4	5.2	2.4	2	1.8	1.5	1.4	1.7	1.98
The average bank interest rate for clients of the SGAFF	x	x	x	x	17.2	11.6	11.6	10.7	9.6	8.3	7.5	6.72
The average bank interest rate in economy	13.1	12.8	12.5	13.2	12.9	8.7	7.2	6.8	5.2	4.5	4.7	4.2
Inflation	10	9.1	8.8	8.5	10.7	2.1	3.9	4.7	1.8	0.1	2.8	1.9

Source: Annual Reports SGAFF 2000-2004, Green Reports for years 1994-2004

Table 2 contains the data about the supported total loans by the SGAFF, subsidised interest rate and the average interest rate in economy. Table 3 presents the history of agricultural loans and table 4 contains the indicators, which can be used for a deeper examination of the role of the SGAFF in financing agricultural loans in the analyzed period.

The average bank interest rate for clients of the SGAFF exceeded highly the average bank interest rate in economy in all years. The average difference was 3.79 %. The subsidised interest rate by SGAFF had a decreasing trend from 1998. The decreasing trend is an analogy of the decreasing trend of the financial market interest rate. The decline in the financial market interest rate determined the fall of loan interest rates (see transmission mechanism). As the decrease in the average bank interest rate for the clients of the SGAFF was larger than the decrease in the subsidised interest rate, the average interest rate paid by the clients of the SGAFF went down from 1998 as well. This decreasing trend was exercised till 2003 when the average bank interest rate for the clients of the SGAFF reached the level of 1.4 % which was 3.1 % less than the average bank interest rate in economy. That is, the farmers or clients of the SGAFF, respectively, faced a higher interest rate than other clients in the economy. However, if the farmer took part in the programs of the SGAFF and received a loan subsidy, the interest rate paid by farmer was significantly lower. The average interest rate paid by the clients of the SGAFF was lower than the average bank interest rate in the economy in all years and even lower than the rate of inflation in most of the years. It means that the real interest rate was negative in most of the years of the analyzed period (especially till 2002).

The size of supported total loans grew up till 1996, in which it reached 14 847 mil. CZK. After 1997 the supported total loans went down significantly. The supported total loans reached minimum in 2000. From 2001 till 2004, the supported total loans moved inside the interval of 6 000 till 8 000 mil. CZK. The size of loans guarantee had the similar patterns. The important point of the analysis is, however, the relation among the described time series with the variables on loan market and/or with the development of investments in agriculture.

Table 3 shows the development of total loans in agriculture and the agriculture investment loans. As was stated above, according to the trend functions the total loans in agriculture copied the tendencies in the economy as a whole. Thus, the size of agricultural loans reached the maximum in 1996 and minimum in 2001. The total loans in agriculture stagnated inside the interval of 11 000 till 12 500 mil. CZK in period 2000 – 2003 and then they grew up to the level of 14 706 mil. CZK in 2005. Table 4 shows the structure of agriculture loans. The ratio of agricultural investment loans in total agricultural loans increased during the analyzed period. It was around 65 % in period of 2001 – 2005. The ratio of agricultural investment loans in total agricultural loans reached during nineties the level of the structure of supported total loans, i.e. the level of the ratio of supported investment loans in supported total loans. Moreover, the table 4 shows that the ratio of supported total loans in total agricultural loans was in most of the years inside the interval of 30 and 40 %. It can be regarded as a very high percentage with respect to the fact that the agricultural loans are state value. Thus, we may deduce that the majority of agricultural loans were supported and/or guaranteed by the SGAFF. The next characteristics in table 4 are related to investment loans and also to the agricultural investments. According to the calculated ratios, we may conclude that investment loans were an important part of financing of agricultural investments.

Table 3: The development of total agricultural bank loans

Mil. CZK	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total loans - agriculture	26351	25749	30942	32154	31647	27999	26106	21699	17290	17893	19290	21729	22608
From that – investment loans	2497	3112	6325	7254	10049	12845	13009	11394	11138	12130	12348	13352	14706

Source: Green Reports for years 1994-2004

Table 4: Chosen characteristics of agricultural loan market and operation of SGAFF (%)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
The ratio of agricultural investment loans on total agricultural loans	12.09	20.44	22.56	31.75	45.88	49.83	52.51	64.42	67.79	64.01	61.45	65.05
The ratio of agricultural investment loans on total value of new tangible property	32.38	50.63	56.89	71.79	117.84	127.84	115.13	94.64	103.27	117.81	x	x
The ratio of total agricultural investment loans on the creation of GFC	19.88	34.91	30.47	67.11	80.84	114.95	82.33	59.38	61.87	85.29	79.70	102.40
The ratio of supported loans on total agricultural loans	24.21	32.74	46.17	46.20	33.21	29.48	24.54	36.84	41.14	31.56	36.65	22.55
The ratio of supported agricultural investment loans on total supported agricultural loans	69.00	67.00	61.29	34.80	50.64	26.09	55.05	62.99	63.84	50.02	60.59	66.12
The ratio of supported agricultural investment loans on total agricultural investment loans	x	x	x	50.63	36.66	15.44	25.72	36.02	38.74	24.66	36.14	22.92
The ratio of supported agricultural investment loans on total value of new tangible property	44.76	54.33	71.36	36.35	43.20	19.73	29.62	34.09	40.01	29.05	x	x
The ratio of supported agricultural investment loans on the creation of GFC	27.48	37.46	38.23	33.98	29.64	17.74	21.18	21.39	23.97	21.03	28.80	23.47

Source: own calculation

4. CONCLUSION

The results of the theoretical model and the empirical analysis have following theoretical-empirical consequences. Generally speaking, the SGAFF's activities make the loan accessible and cheaper. The loan guarantees decrease the effects of asymmetric information and the interest rate subsidies decrease the interest rate paid by the farmers that is bellow the average bank interest rate in economy in all years. The application of the theoretical model shows that the lower is the interest rate paid by the farmer the higher is the discount factor. Higher discount factor produces lower optimal consumption and consequently the farmer is willing to employ higher part of capital in the production. Thus, the initial capital k_0 is more effectively employed over period t = 1, ...,T. That is, the loan subsidies for the SGAFF's clients result in higher or more effective employment of the capital, respectively. The loan guarantees have besides the reduction of credit rationing the same effect as the subsidised interest rate. The loan guarantee decreases the farmer's risk level from the bank's point of view and thereby increases the discount factor that has the above presented effects. The time series analysis showed that the SGAFF's activities significantly support the farmer's investments. Then, the increase in investments results in the growth of farmer's output in time t and of the optimal consumption without the impact on the marginal contribution of capital to the total utility. The support of agricultural investment can be generally regarded as being important with respect to the increase in effectiveness and competitiveness of Czech agriculture or with respect to the production capability in the long run.

These general results have to be, however, deeply analyzed due to the importance of the setting of the SGAFF's supports. The setting of the SGAFF's supports is an important aspect in the evaluation of the role of the SGAFF in financing of agricultural activities. The derived theoretical model does not allow the analysis of indirect effects of the different setting of supports with respect to its simplicity. However, their omission could distort the above stated conclusions.

As stated above, the subsidised interest rate results in the more effective employment of the initial capital. In the empirical part it was shown that the subsidised interest rate was bellow the average bank interest rate in economy in all years and even lower than the rate of inflation in most of the years. It means that the real interest rate for the SGAFF's clients was negative

in most of the years. The setting of the interest rate subsidy that results in the decrease of the interest rate paid by the client of the SGAFF below the level of the average bank interest rate in economy is not a problem. It can be even desirable with respect to the lower profitability and higher risk level of agricultural activities. This kind of agricultural support preserves the operation of market mechanisms. However, the problem arises when the agricultural support is set in that way that the interest rate looses its function as a criterion (see the rate of return). It occurs if the real interest rate is negative. From whence it follows that the setting of the interest rate subsidy was wrong in most of the years and relaxed the function of market mechanism, which results in inefficient allocation of resources.

The further aspects of this problem are the sharing of the interest rate subsidy with the bank and the loan employment or its possible crowded out effect, respectively. It implies from the difference between the average bank interest rate for clients of the SGAFF and the average bank interest rate in economy that the bank risk premium is overcharged. As a result of it the subsidy is shared by the bank. In other words, the bank increases its profit or profit margin by the subsidy, respectively.

As far as the loan employment is concerned, as stated above, the drop in r_0 results in the increase of δ and, thus, in the increase of the production. However, if we take into account that the agricultural product portfolio consists also of non-agricultural activities (productions) then the subsidy may support the non-agricultural activities because of both higher profitability and lower risk level of non-agricultural activities on the one side and higher propensity to spending determined by the low subsidised interest rate and high loan guarantee on the other side. This can be seen from the analysed scenario, in which $r_0 < i_0$. In reality, the average interest rate paid by clients of the SGAFF was lower than the cost of shareholder's capital (when we construct the cost of shareholder's capital in usual way, i.e. as the sum of riskless interest rate plus the risk premium). In other words, the farmer is motivated by the subsidised interest rate to ask for the preferential loan even if she/he could finance the project fully or partially from other resources. Then, these resources may be used for financing of non-agricultural projects that are usually more profitable and less risky. Thereby the financial resources are crowded out from the agriculture. We can talk about a different kind of moral hazard.

The effects of above described two aspects are the stronger the higher is the interest rate subsidy. It also follows from above stated that the interest rate subsidy was too high in the analyzed period and it should be decreased in the future.

The loan guarantee has the similar effect on the farmer's decision about the allocation of resources as the subsidised interest rate has. Besides it causes the reduction of the effects of asymmetric information because it decreases the risk level of the bank. The setting of the level of loan guarantee is again crucial problem with respect to the function of the loan as a criterion (see the capital return). The high loan guarantee decreases the function of the loan and results in the inefficient allocation of resources. On the contrary, the low loan guarantee may not reduce the credit rationing. The setting of loan guarantee would not be in any case 100 % as it occurred in several cases in the analyzed period.

The further aspect of the SGAFF's policy is the special purpose of the programmes, which can disturb the allocation of resources inside the agricultural sector, i.e. the best projects needn't be carried out if they are not the subject of the programs. Thus, the role of the state is reinforced in the development of Czech agriculture (see Šilar, 1995).

Taking into account both the problems of the interest rate subsidy (see the sharing of the subsidy by the bank and the crowded out effect) and the effects of the loan guarantee it should be considered the abolishment of the interest rate subsidy in the future. Moreover, the special

purpose of the programmes should be also removed with respect to the efficient allocation of resources and the reinforcement of the individual decision.

In spite of the problems in the setting of the SGAFF's policy, the role of the SGAFF in financing of agricultural activities can be regarded to be positive in the analyzed period. In the first phase of the analyzed period, the SGAFF provided Czech agriculture with the important support in the situation of the lack of financial resources for both operational activities and investments. In the second phase, the SGAFF's activities provided against the higher drop of agricultural loans even if the total support was lower compared to the firs phase. The increase of the investment loans in the structure of preferential loans is an evidence of it. Thus, in the situation, which is called credit crunch the SGAFF significantly supported the agricultural activities. In the third phase, the support went up again. The SGAFF increased the support of investments with respect to the changes on the loan market, in the agricultural policy and with respect to the entrance into the EU.

To sum up, the application of the theoretical model and the empirical analysis suggest that the SGAFF contributes to more effective capital employment. The SGAFF increases the competitiveness of Czech agriculture in the long run by the support of investments. In the future development of Czech agriculture the SGAFF should further support the investments and, thereby, support the increase in the technical efficiency of the agricultural enterprises as a basic assumption of their competitiveness. Thus, the article's hypothesis cannot be rejected.

REFERENCES

Bečvářová, V.: Záruky jako cesta přílivu kapitálu do zemědělství, *Agricultural Economics – Czech*, 1994, Vol 40, issue 3 – 4, pp. 255 – 260

Cipra, T.: Matematika cenných papírů, Praha, HZ Praha, 2000, ISBN 80-86009-35-1

Čechura, L.: The role of credit rationing in Czech agriculture – the case of large agricultural enterprises, *Agricultural Economics – Czech*, 2006, Vol 52, issue 10, pp. 477-488

Čechura, L.: Vybrané aspekty úvěrové politiky obchodních bank a jejího vlivu na ekonomickou rovnováhu v zemědělství, nepublikovaná doktorská práce, PEF ČZU v Praze, 2005

Chow, G.C.: *Dynamic Economics – Optimization by the Lagrange Method*, New York, Oxford University Press, 1997, pp. 234, ISBN 0195101928

Janda, K.: Analysis of the Budgetary Costs of the Supporting and Guarantee Agricultural and Forestry Fund, *Czech Journal of Economics and Finance*, 2006, 56 (9-10), pp. 416-434

Janda, K., Čejka : Státní podpora českého zemědělského úvěru v období před vstupem do Evropské unie, IES WP 15/2006, Praha, 2006

JEHLE, G.A., RENY, P.J.: *Advanced Microeconomic Theory*, Boston, Addison-Wesley, 2001, pp. 535, ISBN 0321079167

Latruffe, L., Fraser, R.: Reducing farm credit rationing: an assessment of the relative effectiveness of two government intervention schemes, INRA, WP 02-02, Rennes, 2002

Medonos, T.: Investiční aktivita a finanční omezení českých zemědělských podniků právnických osob, nepublikovaná disertační práce, PEF ČZU v Praze, 2007

Pánková, V.: Nelineární optimalizace pro ekonomy, Praha, Proffessional Publishing, 2003, ISBN 80-86419-50-9

Šilar, J.: Analýza činnosti Podpůrného a garančního rolnického a lesnického fondu (PGRLF), MFF ČR, informační a výzkumné materiály č. 3/1995, Praha, 1995

VÚZE: Analýza účinnosti podpor Podpurného a garančního rolnického a lesnického fondu, a.s. v roce 2000, Výzkuný ústav zemědělské ekonomiky, Praha, 2001

Výroční zprávy PGRLF za roky 1999-2004

Zpráva o stavu zemědělství ČR za roky 1994-2004, MZe, Praha.