Theoretical-empirical analysis of the role of the SGAFF in financing of farmers' activities

Teoreticko-empirická analýza role PGRLF ve financování zemědělských aktivit

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Abstract: The paper deals with the theoretical-empirical analysis of the role of the SGAFF in financing of farmers' activities based on the dynamic optimal model and time series analysis. 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 a higher part of the capital in the production. Thus, the initial capital is more effectively employed. The empirical part shows that the SGAFF's activities significantly support the farmers' 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 as positive in the analyzed period. Moreover, the application of the theoretical model and the empirical analysis suggest that the SGAFF contributes to a more effective capital employment and thereby increases the competitiveness of Czech agriculture in the long run.

Key words: SGAFF (Support and Guarantee Agricultural and Forestry Fund), dynamic optimization, agricultural output, investments, the perspectives of Czech agriculture

Abstrakt: Příspěvek se zabývá analýzou role PGRLF ve financování zemědělských aktivit s využitím dynamického optimalizačního modelu. Optimalizační problém je řešen Lagrangeovou metodou neurčitých koeficientů. Z aplikace teoretického modelu plyne, že čím nižší je úroková sazba hrazená farmářem, tím nižší je optimální spotřeba, a tedy farmář je ochoten používat větší část kapitálu v produkci. Počáteční kapitál je tak efektivněji využit. Z analýzy časových řad dále plyne, že aktivity PGRLF významně podporují investiční činnost zemědělců. Roli PGRLF lze i přes analyzované problémy v nastavení subvenční politiky PGRLF hodnotit převážně pozitivně. Z aplikace teoretického modelu a z empirické analýzy tedy vyplývá, že aktivity PGRLF přispívají k efektivnějšímu využití kapitálu a tím k růstu konkurenceschopnosti českého zemědělství v delším období.

Klíčová slova: PGRLF (Podpůrný a garanční rolnický a lesnický fond), dynamická optimalizace, zemědělský produkt, investice, budoucnost českého zemědělství

Czech agriculture is at present in an important phase of its life cycle. The phase may be called the critical phase with respect to the future of Czech agriculture as a sector supplying the domestic market with agricultural (food) products. Several important determinants affecting the future development of Czech agriculture can be identified. Among the most important ones, we may rank the relations in the agri-food chain or the types of market structure and the nature of relations among the vertical related markets, respectively, then, the capital endowment of agricultural enterprises and the availability of resources, the effectiveness of production, etc. The relations in the agri-food chain significantly determine and will determine the situation on the partial markets of the vertical chain. The nature of relations and the type of market structure are important determinants of price movements (or variation) in the

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agricultural market. These problems are, however, the object of another article. The capital as a basic production factor is a none the less important factor determining the structure and development of Czech agriculture.

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 of 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 (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 farmers' activities? 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, 2006), Čechura (2006, 2005), Janda, Čajka (2006), Janda (2003, 2005, 2006), Šilar (1995), VÚZE (2001) and Medonos (2007). The activities of the SGAFF appear to be efficient (see also Latruffe, Frase 2002) and to support competitiveness of agriculture from the view of the theoretical level. In practice, the efficiency of the SGAFF activities depends on the efficiency of loans employment in the majority of cases. In general, the empirical evidence is that the closer to the theoretical results, the closer is the reality or the economic agents' behaviour to the models' assumptions, respectively. This article views the problem from both theoretical and empirical viewpoint. Thus, the research problem is solved in a more complex way.

AIMS AND METHODOLOGY

The aim of the article is to analyze the role of the SGAFF in financing agricultural activities by the use of the derived dynamic model and to find the theoretical-empirical consequences by employing the theoretical framework in the analysis of statistical data. Furthermore, the role of the SGAFF in the future development of Czech agricultural is discussed.

The hypothesis of the paper is as follows. If credits are a significant part of the farmers' capital, the SGAFF 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 article is as follows. Firstly, the theoretical model is derived (see also Čechura 2007). Then, the model is applied in the simulation. The results of the simulation will show the role of the SGAFF in financing farmers' activities. Secondly, the empirical analysis is processed (see also Čechura 2008). Finally, the theoretical-empirical consequences are drawn and the role of agricultural subsidies in the future development of Czech agriculture is discussed. The hypothesis is concluded based on the results of the simulation and of the analysis of the statistical data set.

The data set is available in the annual reports of the SGAFF 1999–2005 and in the "Green Report" (The Annual Report of the State of Czech agriculture) 1994–2006.

The theoretical model is defined in the form of the dynamic optimization model. The Lagrange method is used to solve the optimization problem. The principle of the method is as follows (see e.g. Jehle, Reny 2001).

Let us have a function f to be maximized (the same can be done for minimization) subject to the constraint g, i.e. we have:

$$\max_{x_1,x_2} f(x_1, x_2) \text{ subject to } g(x_1, x_2) = 0$$

The Lagrange function or Lagrangian arises when we multiply the constraint g by a new variable λ and we add this product to the objective function. The Lagrangian is as follows:

$$L(x_1, x_2, \lambda) \equiv f(x_1, x_2) + \lambda g(x_1, x_2)$$

The values of x_1, x_2 and λ, which are candidates to solve the optimization problem, can be found by solving the system of equation resulting from partial derivatives of Lagrange function with respect to x_1, x_2 and λ and set them equal to zero. Thus, we get in this case three equations, which are solved simultaneously:

$$\frac{\partial L}{\partial x_1} = \frac{\partial f(x_1^*, x_2^*)}{\partial x_1} + \lambda \frac{\partial g(x_1^*, x_2^*)}{\partial x_1} = 0$$

$$\frac{\partial L}{\partial x_2} = \frac{\partial f(x_1^*, x_2^*)}{\partial x_2} + \lambda \frac{\partial g(x_1^*, x_2^*)}{\partial x_2} = 0$$

$$\frac{\partial L}{\partial \lambda} = g(x_1^*, x_2^*) = 0$$

(x_1^*, x_2^*) are a critical point of function *f*, i.e. the solution of optimization problem, if the solution satisfies the constraint or generally constraints and $dL = 0$, i.e. the objective function *f* cannot increase (assuming maximization problem) for small change in (x_1^* or x_2^*), which satisfies the constraint. That is, it must hold that:

$$dL = \frac{\partial f(x_1^*, x_2^*)}{\partial x_1} dx_1 + \lambda \frac{\partial f(x_1^*, x_2^*)}{\partial x_2} dx_2 = 0$$

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

RESULTS AND DISCUSSION

Theoretical model

The theoretical model is based on the simple optimal dynamic model (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 the 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 the 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.

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

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 time *t*.

The capital in time $t + 1$ is a function of capital in 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 $(1 - \xi)$ 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.

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

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 the period 0 till *T*. That is, the farmer solves the dynamic optimization problem. This problem can be solved by the Lagrange method (Chow 1997). The Lagrangian for our problem is as follows:

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

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 the period 1,...T, which is evaluated in period $T + 1$.

Application of theoretical model

The part of the application of the theoretical model shows the solution of the 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 the Lagrangian with respect to c_t and k_t to zero and solving them as a system of equations (see again Chow 1997). The partial derivatives are as follows:

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

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

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).

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

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 the relation (viii).

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

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

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

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

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

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 loss of generality, that the farmer has only two available resources, the shareholder's capital (vk_0) and bank loans (cr_0). The farmer prizes the cost of the shareholder's capital on the level of the required return on capital employed (i_0). The cost of bank loan is equal to the 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 the 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 the 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 the current period and $h = 1,..., T$. Let us denote the baseline discount factor d_*^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, it 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:

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

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 therefore 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).

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

Scenario 2: Let in time $t = 0$ be $k_0 > vk_0$ and $r_0 < i_0$. The farmer is endowed again by the 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 a lower optimal consumption and a higher marginal contribution of capital to the 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 the optimal consumption in scenario 2 and the optimal consumption in the baseline is given by (xiii), which is an analogy to (xii).

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

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 are equal, then the situation is the same as 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 a 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 include the collateral is through the discount factor. As the collateral increases the business risk, then the costs of the 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 the above stated (scenario 1 and 2), it follows that the collateral increases the optimal consumption and decreases the marginal contribution of capital to the total utility, ceteris paribus. The farmer is less motivated to productive employment of her/his capital.

The role of the SGAFF in financing agricultural activities is evident from the above stated (given the assumption of the 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 the case of both, i.e. the interest rate subsidy and the 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 the 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 the SGAFF's activities determine the agricultural sectors. This can be analyzed by generalisation of the model to *N* sector.

Empirical analysis – evidence

The agricultural support in the form of the partial subsidised and guaranteed loan was introduced in the Czech Republic in the first half of the nineties to improve the effectiveness of agricultural support. The most important reasons in favour of this kind of support are according to Šilar (1995): a) the bank loan ensures the market allocation of capital into agriculture, b) the bank loan supports market allocation of capital inside the agricultural sector and c) the risk is distributed among the bank, the state and the farmer.

The SGAFF (Support and Guarantee Agricultural and Forestry Fund) was founded on 23rd June 1993 to support the loan accessibility in Czech agriculture through a partially subsidised interest rate and/or a 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. Three basic programs were set out in 1994: OPERATION, FARMER and SERVICES. These programs were subsequently supplemented by specific sub-programs, which had also a single object. The program EXPORT was approved in 1997. It was the first program through which the non-agricultural entrepreneurs could get support. The program INVESTMENTS with the subprograms FARMER, MARKETING ORGANISATION, PROCESSING ORGANISATION 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 accession of the Czech Republic into the EU. The program OPERATION, which provided farmers with the support to loans for operating activities, was abolished by the entrance into the EU. The supports were granted in the frame of the 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 the form of the partially subsidised interest rate and/or partially guaranteed loan was chosen to maintain the criterial function of a bank loan and an interest rate. In other words, the SGAFF supports may decrease the effect of asymmetric information in the agricultural loan market but they do not fully eliminate 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 the interest rate subsidy. Credit rationing is here defined in two forms: external credit rationing and internal credit rationing. The SGAFF activities may reduce both forms of the credit rationing. However, the effects on each of the forms differ due to their different nature. What were the conditions of the agricultural credit market and what was the role of the SGAFF in financing agricultural activities in the period of 1994–2006? To find the answers is the object of this part of the paper.

The development of agricultural loans in the 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 the 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: $y = 0{,}94t^3 - 236{,}68t^2 + 17\ 276\text{t} + 497\ 713$. 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 in the loan market is thus made for these phases which are characterised by different conditions in the loan market. The product cycle and the corresponding setting of the 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 monetary policy performed its basic target, i.e. the maintenance of the stable price level. Among others, through the credit channel of the monetary transmission, the Central Bank determined the loan creation in the loan market.

The conditions in the loan market are important for the precise analysis of the agricultural loan and

the evaluation of the role of the SGAFF in the analyzed period. Therefore, we will briefly describe the economic characteristics of the defined phases.

The first phase is characterised by the positive development of the macroeconomic variables and optimistic expectations of economic agents. The amount of bank loans increased nearly in all sectors (except the sector of households). This development was a result of several factors. The economy was in the growth phase and a number of investment projects were realized. Nevertheless, a lot of enterprises, which were privatized, had serious economic problems especially due to the unfinished or badly performed restructuring. These enterprises had debts from the past that they were not able to pay off. The old debts, which had the form of loans, were renewed and thus transferred to the future. However, due to the low efficiency, enterprises ran furthermore into higher debts. Moreover, the interest rate was too high according to the author's opinion and also the opinions of other economists (especially liberal economists). The costs of external recourses were in most cases higher than the capital profitability (even several times higher) that resulted in the additional increase of indebtedness of enterprises and then in the problem with solvency. The banks were not careful enough in this phase and provided the economy with the necessary liquidity. The credit policy was also influenced by the political scene that indirectly advocated a sufficient availability of financial resources (especially till the year 1996). The loan market was then all the more important when the capital market did not provide the enterprises with the capital, generally speaking. The credit policy was also determined by the fact that the main part of the banks was not privatized yet. The Central Bank changed its policy in autumn 1996 due to the persisting external and internal imbalance of Czech economy. That is, the Central Bank started the restrictive monetary policy to support the balancing processes. The monetary turbulences occurred in the middle of 1997 that caused the discomposure in the financial market. The credit policy was also influenced. Banks started to revaluate their credit portfolios due to several reasons. Among others, we can name the increase of the classified and irredeemable loans, maturity of many investment loans, the uncertain development of enterprises and the need to improve the portfolio due to the successful privatization.

The second phase, from June 1997 till June 2002, can be divided into two parts according to the course of the monetary policy. In the first part, i.e. from June 1997 till autumn 1998, the Central Bank exercised the restrictive monetary policy. The banks continued the improvement of their credit portfolios. The revaluation of credit portfolio and other important determinants caused the change of the bank credit policy, which was characterized by risk aversion. That is, banks tried to target on less risky clients, i.e. to minimize their business risk. The change can be observed from the time series of the total loans of the individual sectors and branches of Czech economy. The second part of this phase, i.e. from autumn 1998 till June 2002, is characterised by the expansive monetary policy. The change from the restrictive to expansive monetary policy was determined by the positive figures of inflation and the need to support economic growth. Large banks were already in the hands of private capital in this period and continued in the careful credit policy aiming at the risk minimization. The empirical evidence is the drop of the total loans in the sector of non-financial enterprises and the significant increase of the total loans in the sector of government and households. Moreover, according to this, it can be deducted that the group of small and middle enterprises faced the credit rationing phenomenon (at least internal).

The third phase is defined from July 2002 till June 2006. The amount of the total loans increased in this phase. The total loans of all branches went up as well (see the trend function in Table 1). The increase of the total loans was determined by the positive economic environment, the expansive monetary policy and the softer bank credit policy to the sector of non-financial enterprises (especially to the group of small- and mid-sized economic agents).

After the brief characterisation of economic environment and loan market, the loan time series in the individual branches of Czech economy with the particular interest in agriculture can be analysed in a greater detail. The analysis is based on the fitted trend functions for the relevant phase of the analyzed period. The trend functions are all linear and in most cases fit well to the analysed time series.

Table 1 contains the trend function of the total loans in all branches of the economy, the trend function of the 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 of the economy in this phase. Agriculture is not an exception. The fitted agricultural trend function shows the growing trend with a slope of 157.29. It means that the annual increase of the total agricultural loans was 157.29 mil. CZK according to the fitted trend function.

The second phase has opposite patterns. The time series of the total loans in all branches has a decreasing trend with the annual decline of 2 343.6 mil. CZK.

Nearly all branches exercised a decreasing trend of the 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 results from the above described economic conditions of the analyzed period and from the way of the determination of the analyzed phases. The time series of the total loans in all branches show an annual increase of 7 364.9 il. 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 the 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 the share of the total agricultural loans in the total loans.

Table 1 (in its second part) presents the trend function of the share of the total agricultural loans in the

Table 1. Trend functions of total (state) loans

Phase	Total loans (all branches)	Agriculture, hunting and fishery	Food-processing industry
Trend functions – total (state) loans (in mil. CZK)			
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

Table 2. The supported total loans by the SGAFF, subsidised interest rate and average interest rate in economy in period of 1994–2005 (mil. CZK*, %**)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
The number of application*	2 605	2 945	3 426	2 540	1 934	1 746	1 539	1 723	1 993	1 802	2 657	1 917
Supported total loans*	6 235	10 130	14 847	14 622	9 299	7 695	5 324	6 369	7 361	6 088	7 963	5 098
Supported investment loans*	4 302	6 787	9 100	5 088	4 709	2 008	2 931	4 012	4 699	3 045	4 825	3 371
Interest rate subsidies (prepaid)*	1 118	1 008	2 827	2 700	2 682	2 208	1 610	1 333	1 267	964	880	609
The size of loans guarantee*	1 544	4 436	8 265	4 788	2 307	1 138	876	1 129	1 365	1 714	2 306	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 1999–2005, Green Reports for years 1994–2006

total loans in the sector of non-financial enterprises. The slopes of the fitted trend functions in the analysed phases suggest that the percentage of the total agricultural loans in the total loans went down in all phases. However, the decline in the third phase is slight. It suggests that farmers had the worst position in the loan market compared to the economic agents from other branches. Moreover, it implies that farmers faced the credit rationing phenomenon with a higher probability. The worst 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, by 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 the 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. Though, this is not the case of the internal credit rationing. Since the SGAFF was founded to support the creation of agricultural loans, its existence cannot be omitted in this phase of the analysis.

The specific models of credit rationing show that its occurrence is determined by the limited supply, the limited farmer's collaterals and transactional costs. The SGAFF partly solves these problems by the interest rate subsidizing 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 in the loan market, respectively. The activities of the SGAFF can be analyzed as follows.

Table 2 contains data about the supported total loans by the SGAFF, the subsidised interest rate and the average interest rate in the 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 the clients of the SGAFF highly exceeded the average bank interest rate in the economy in all years. The average difference was 3.79%. The subsidised interest rate by the 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 the loan interest rates (see the 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%, being 3.1% less than the average bank interest rate in the economy. That is, farmers or the clients of the SGAFF 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 subsidy, the interest rate paid by him/her 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 the greater part of the analyzed period (especially till 2002).

The size of the 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 their minimum in 2000. From 2001 till 2004, the supported total loans moved inside the interval of 6 000 to 8 000 mil. CZK. The size of the loans guarantee showed similar patterns. The important point of the analysis is, however, the relation among the described time series with the

Table 3. The development of total agricultural bank loans (mil. CZK)

	1993	1994	1995	1996	1997	1998	1999
Total loans – agriculture	26 351	25 749	30 942	32 154	31 647	27 999	26 106
From that – investment loans	2 497	3 112	6 325	7 254	10 049	12 845	13 009
	2000	2001	2002	2003	2004	2005	
Total loans – agriculture	21 699	17 290	17 893	19 290	21 729	22 608	
From that – investment loans	11 394	11 138	12 130	12 348	13 352	14 706	

Source: Green Reports for years 1994–2006

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
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
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
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
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
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

variables in the loan market and/or with the development of investments in agriculture.

Table 3 shows the development of the total loans in agriculture and the agricultural 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 its maximum in 1996 and minimum in 2001. The total loans in agriculture stagnated inside the interval of 11 000 to 12 500 mil. CZK in the period 2000–2003 and then they grew up to the level of 14 706 mil. CZK in 2005. Table 4 shows the structure of agricultural loans. The share of the agricultural investment loans in the total agricultural loans increased during the analyzed period. It was around 65% in the period of 2001–2005. The share of the agricultural investment loans in the total agricultural loans reached during the nineties the level of the supported total loans, i.e. the level of the share of the supported investment loans in the supported total loans. Moreover, the Table 4 shows that the ratio of the supported total loans in the 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 agricultural loans are a state value. Thus, we may conclude that the large part 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 the SGAFF may have played an important role in the loan creation during the period 1994–2006, i.e. the fund may have reduced the problem of the occurrence of credit rationing. Moreover, since investment loans were an important part of financing of agricultural investments, the SGAFF significantly determined the investment activity in Czech agriculture.

CONCLUSION – THEORETICAL-EMPIRICAL CONSEQUENCES

The results of the theoretical model and the empirical analysis have the following theoretical-empirical consequences. Generally speaking, the SGAFF activities make the loans more 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 the whole 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. A higher discount factor produces a lower optimal consumption and consequently the farmer is willing to employ

a higher part of capital in the production. Thus, the initial capital k_0 is more effectively employed over the period $t = 1, ..., T$. That is, the loan subsidies for the SGAFF clients result in a higher or a 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 activities significantly support the farmers' investments. Then, the increase in investments results in the growth of farmers' output in the 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 supports. The setting of the SGAFF supports is an important aspect in the evaluation of the role of the SGAFF in financing agricultural activities. The derived theoretical model does not allow for 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 the whole 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 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 the 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 such a 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 this 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 may have resulted in the 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 issues from the difference between the average bank interest rate for the clients of the SGAFF and the average bank interest rate in the economy as a whole 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 thehigher profitability and the lower risk level of non-agricultural activities on the one side and the higher propensity to spending determined by the low subsidised interest rate and the 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 the clients of the SGAFF was lower than the cost of the shareholder's capital (when we construct the cost of the shareholder's capital in usual way, i.e. as the sum of the 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 agriculture. We can talk about a different kind of moral hazard.

The effects of the above described two aspects are the stronger the higher is the interest rate subsidy. It also follows from the 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 a similar effect on the farmer's decision about the allocation of resources as the subsidised interest rate. 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 the loan guarantee is again a 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 the loan guarantee should not be in any case 100% as it occurred in several cases in the analyzed period.

A further aspect of the SGAFF policy is the special purpose of the programmes, which can disturb the allocation of resources inside the agricultural sector, i.e. the best projects mazy not 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 (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, the abolishment of the interest rate subsidy should be considered 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 policy, the role of the SGAFF in financing agricultural activities can be regarded as 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 activities provided against a higher drop of agricultural loans even if the total support was lower compared to the first phase. The increase of the the investment loans in the structure of preferential loans is an evidence of it. Thus, in the situation which is called a credit crunch the SGAFF significantly supported agricultural activities. In the third phase, the support went up again. The SGAFF increased the support of investments with respect to the changes in the loan market, in the agricultural policy and with respect to the accession into the EU.

To sum up, the application of the theoretical model and the empirical analysis suggest that the SGAFF contributes to a more effective capital employment. The SGAFF has increased 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.

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