

# The Quantitative and Qualitative Analysis of the Budget Cost of the Czech Supporting and Guarantee Agricultural and Forestry Fund

Karel Janda \*

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## Abstract

The paper analyzes the government budget cost of credit guarantees and subsidies. The analysis is done both in a general qualitative manner and quantitatively for the case of Czech Supporting and Guarantee Agricultural and Forestry Fund(SGAFF). In the quantitative part of the paper we show that the portfolio of the SGAFF has a sufficient value to cover expected costs of credit guarantees and subsidies provided by the SGAFF. The qualitative theoretical model is dealing with government interventions designed to decrease the credit rationing of good farmers. The theoretical model shows that with uniform non-targeted supports the budget cost minimizing government unambiguously prefers lump-sum guarantees to interest rate subsidies. With supports targeted fully to disadvantaged farmers the government is indifferent between lump-sum guarantees, proportional guarantees and interest rates subsidies as far as the government budget costs are concerned.

**Keywords:** Transition, Credit, Subsidies, Guarantees.

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\*Department of Microeconomics and Mathematical Methods, Charles University, Opletalova 26, CZ-110 00 Prague 1 and Department of Banking and Insurance, University of Economics, W. Churchill Sq. 4, CZ-130 67 Prague 3.

E-mail: Karel-Janda@seznam.cz

# 1 Introduction

The government support of agriculture is currently one of the most discussed areas of economic policies of European Union (EU) and its member countries. Majority of the EU interventions and regulations of agriculture is carried in the Common Agricultural Policy (CAP) framework. But in addition to CAP programs there exist also a National Aid programs in EU member countries. One of the most important National Aid programs in the Czech agriculture is the support of commercially provided agricultural loans. This support is administered by the special fund called the Supporting and Guarantee Agricultural and Forestry Fund (SGAFF). In Czech it is known under the acronym PGRLF, which stands for Podporný a garanční rolnický a lesnický fond.

In this paper we first briefly describe the operations of this SGAFF fund and then we concentrate on the question of its funding and its budgetary costs. Subsequently we complement this quantitative analysis by a theoretical qualitative analysis of the budget cost of different government programs of agricultural credit support.

The problem of agricultural credit support is addressed by a number of papers in both academic and policy oriented literature. Comprehensive overview of credit policies is provided by Barry (1995). He analyzes public credit programs in the U.S. agriculture both from the empirical and the theoretical point of view. The credit provision in the U.S. agriculture is also discussed by Doucha (1993). The credit guarantees are further described by Navajas (2001), who discusses credit guarantee schemes used by farmers or small enterprises and by Gudger (1998), who concentrates on the use of credit guarantees in agriculture. In the context of the Czech Republic, the activities of SGAFF during first few year of its operations were empirically investigated by Janda, Sklenkova, and Vigner (1997).

The theoretical qualitative model in this paper is written in the tradition of asymmetric information approach to the explanation of the credit market imperfections. This approach

Table 1: Applications and Mediated Loans

| Year  | Number of applications | Of those approved | Approval ratio | Volume of loans mediated (CZK million) |
|-------|------------------------|-------------------|----------------|--|
| 1994  | 2605                   | 2388              | 0.92           | 6235                                   |
| 1995  | 2945                   | 2739              | 0.93           | 10129                                  |
| 1996  | 3426                   | 3252              | 0.95           | 14847                                  |
| 1997  | 2540                   | 2340              | 0.92           | 14622                                  |
| 1998  | 1934                   | 1735              | 0.90           | 9299                                   |
| 1999  | 1746                   | 1493              | 0.86           | 7695                                   |
| 2000  | 1539                   | 1425              | 0.93           | 5324                                   |
| 2001  | 1723                   | 1671              | 0.97           | 6369                                   |
| 2002  | 1993                   | 1920              | 0.96           | 7361                                   |
| 2003  | 1802                   | 1723              | 0.96           | 6088                                   |
| 2004  | 2657                   | 2471              | 0.93           | 7963                                   |
| Total | 24910                  | 23157             | 0.93           | 95932                                  |

Source: PGRLF (2005)

builds on earlier papers by Jaffee and Russell (1976), Stiglitz and Weiss (1981) and others to explain credit rationing and other imperfections as a rational, equilibrium-generating response to adverse selection problems attributable to asymmetric information between lenders and borrowers. Out of the classical papers dealing with credit contracts under asymmetric information the papers by Bester (1985) and Besanko and Thakor (1987) may be mentioned as relevant to the theoretical part of our paper. A comprehensive recent treatment of these theories is provided by Bolton and Dewatripont (2005) on a general contract theory level, by Freixas and Rochet (1997) and Bebczuk (2003) in the banking and finance environment context and by Cosci (1993) in a specialized setting of the credit rationing problem. Gale (1990, 1991), Smith and Stutzer (1989) and more recently Janda (2003, 2005) use this contract theory approach to analyze the government interventions in credit markets.

## 2 The Government Support of Agriculture Through SGAFF

The SGAFF was set up on the basis of a Czech government resolution in 1993 as a joint-stock company whose sole shareholder is the Czech Ministry of Agriculture. The main activity of the SGAFF is the provision of interest rate subsidies and loan guarantees. This provision is done through a number of specialized programs targeted either to a particular activity or to a particular type of recipients. More details about the creation and goals of credit support is provided in articles by Horcicova (1993) and Horcicova and Vaskova (1994). The evolution of the activities of SGAFF over the years of its operation is captured in the Table 1. The term "volume of mediated loans" used in this table means the total size of all loans supported by SGAFF.

The very high approval ratio in the Table 1 is caused by the design of the SGAFF activities. SGAFF never intended to serve as a screening institution which would evaluate the quality of the submitted project and which would subsequently make a decision about the accepting or rejecting the project based on its economic viability. The SGAFF as a matter of its policy leaves the economic analysis of the business projects entirely on the commercial banks. In the case the project is approved by the commercial bank for financing, the SGAFF essentially automatically provides the support for the project as long as the project satisfies the generally given conditions and rules of SGAFF programs. This means that the rejected applications for SGAFF support were those which somehow violated these SGAFF rules. This policy explains the low administrative burden, simplicity and transparency of SGAFF operations and the enthusiastic reception of SGAFF both by farmers and bankers.

There are currently two groups of SGAFF main programs, investment and non-investment loans programs, which are supplemented by the program Youth. This supplementary program, which may be used by young farmers only in conjunction with some of the main

Table 2: Appropriations to SGAFF from the state budget

| Year          | —           | 1994 | 1995  | 1996 | 1997 | 1998  | 1999  | 2000 | 2001  | 2002 | 2003  | 2004  | 2005 |
|---------------|-------------|------|-------|------|------|-------|-------|------|-------|------|-------|-------|------|
| Appropriation | CZK billion | 2.60 | 2.10  | 2.77 | 4.21 | 3.61  | 2.39  | 2.18 | 1.31  | 1.25 | 0.72  | 0.63  | 0.60 |
| Change        | %           | —    | -19.2 | 31.9 | 52.0 | -14.3 | -33.8 | -8.8 | -39.9 | -4.6 | -42.4 | -12.5 | -4.8 |

Source: Czech State Budget Act (1994-2005)

programs, increases the rates of support provided under the main programs. The non-investment loans support is currently represented only by the Interest Burden Compensation Program. The goal of this program is to compensate for the interest rate difference between agricultural loans and the loans provided in other industries. The investment group consists of 5 programs. Three of them are designed according to the production vertical line as the Farmer, Processor, and Distribution Organization programs. The Hygiene program is oriented on the improvement of veterinary and hygienic conditions of processing animal and plant products according to EU and Czech regulations. The Land investment program supports the land purchases for agricultural operations.

This description of the programs of SGAFF indicates, that the term Forestry in the name of the SGAFF actually has no real meaning as far as the currently supported activities are concerned. SGAFF supports only agriculture and the activities related to agriculture now. In the past SGAFF also operated some programs related to non-production functions of agriculture, to multifunctionality and rural development, and to the forestry.

## 3 The Budget Impact of SGAFF

### 3.1 The Funding of SGAFF

The funding for the SGAFF is based on two main sources - the shares portfolio and the annual contribution from the state budget. At the time of its foundation the SGAFF was endowed with the portfolio shares of agricultural or agriculture related enterprises. These shares were obtained in two tranches. In 1994 the SGAFF obtained from the Fund of National Property shares in nominal value CZK 3.8 billion coming from the first wave of

voucher privatization. Janda (1996) estimates the market value of this initial portfolio of SGAFF to be in the range from minimum CZK 1.6 billion to maximum CZK 2.5 billion at the time of creation of SGAFF. In 1995 the SGAFF received from the Fund of National Property shares in nominal value CZK 1.865 billion coming from the second wave of voucher privatization. At the time of their transfer to the SGAFF the market value of these shares was again approximately one half of their nominal value. The SGAFF did not obtain the shares completely for free. It had to pay for them one thousandth ( $1/1000$ ) of their nominal value, i.e. CZK 5.665 million. The initial portfolio of the SGAFF is described in more detail by Janda (1994).

The most important source of SGAFF funding are the annual appropriations from the state budget. The time series of these appropriations is provided in the Table 2. When evaluating the dynamics of this time series, it should be kept in mind that the big upward jump in 1997 is partly caused by the special appropriation of CZK 750 mil for the provision of the flood relief for the farmers in areas damaged by 1997 summer floods. The steady decrease in annual government contributions which is especially pronounced since 2001 was partly connected with the decrease in the volume of support extended to farmers by SGAFF, partly was caused by the argument, that SGAFF has sufficient capital, so it does not need so high annual government contributions.

The comparison with the Table 1 shows that the period of high annual contributions from the state budget from 1996 to 1998 corresponds to the period of the highest activity of the fund in terms of volume of loans supported by SGAFF. While the volume of supported loans in 2004 is approximately half as compared with the peak year of 1996, the share of SGAFF in the total support of the Czech agriculture, shown in Table 3, decreased over the years much more significantly from 35 percent in 1994 to 3.5 percent in 2003.

Table 3: Government Support to Agriculture

| Type of expenditure  | 1994    |        | 1997    |        | 2000    |        | 2003    |        |
|----------------------|---------|--------|---------|--------|---------|--------|---------|--------|
|                      | CZK mil | %      |
| SGAFF                | 2654    | 35.25  | 3458    | 28.18  | 2175    | 10.92  | 720     | 3.51   |
| Market interventions | 1925    | 25.56  | 2404    | 19.59  | 2420    | 12.15  | 6730    | 32.79  |
| Direct subsidies     | 2139    | 28.41  | 3500    | 28.52  | 10848   | 54.45  | 7711    | 37.57  |
| Research             | 448     | 5.95   | 418     | 3.41   | 441     | 2.21   | 586     | 2.85   |
| Tax relief           | 264     | 3.51   | 1664    | 13.56  | 822     | 4.13   | 1597    | 7.78   |
| Others               | 100     | 1.33   | 827     | 6.74   | 3217    | 16.15  | 3182    | 15.50  |
| Total                | 7530    | 100.00 | 12271   | 100.00 | 19923   | 100.00 | 20526   | 100.00 |

Sources: The Report on the State of the Czech Agriculture (1995, 1998, 2001, 2004)

### 3.2 The Main Budget Costs of SGAFF

From the point of view of the Czech government, the budget cost of SGAFF are equal to the annual contributions provided to SGAFF from the state budget through the Ministry of Agriculture which are given in Table 2. From the economic point of view, these amounts are just transfers from the state budget to the SGAFF budget. SGAFF is not obliged to spend the funds provided by government in a given year for the credit support during this year. From the logic of guarantees it follows that the guarantee institutions has to keep enough funds to be able to cover due amounts over the whole duration of the loan. Therefore the SGAFF has to have sufficient reserve funds available. According to PGRLF (2005) p.15, the value of SGAFF portfolio reached CZK 6.5 billion by December 31, 2004. Against these assets the future liabilities of the SGAFF have to be compared. According to PGRLF (2005) p.17, as of December 31, 2004 the contracted guarantees associated with loans outstanding were CZK 7239 million. At the same date, the total volume of subsidies granted and associated with loans outstanding was CZK 5586 million, of which approximately CZK 3849 million had been paid out already. To answer the question about the quality of the match between the value of portfolio and future liabilities, the terms structure of these liabilities and the expected rate of default ought to be known.

Unfortunately we do not have available data about current term structure of the future liabilities of the SGAFF with respect to contracted future interest rates subsidies and

Table 4: Supported Loans According to Their Duration

| Loan duration | Number of applications | Of which approved | Loan amount<br>(CZK million) | Guarantees amount<br>(CZK million) | Subsidy in total<br>(CZK million) | Subsidies paid out by<br>December 31, 2004<br>(CZK million) |
|---------------|------------------------|-------------------|------------------------------|------------------------------------|-----------------------------------|---|
| up to 1 yr.   | 7037                   | 6989              | 32097                        | 5476                               | 2032                              | 2028  |
| up to 2 yrs.  | 2844                   | 2825              | 9533                         | 3399                               | 1179                              | 1101  |
| up to 3 yrs.  | 1554                   | 1536              | 3900                         | 1168                               | 682                               | 678   |
| up to 4 yrs.  | 4362                   | 4327              | 13594                        | 4201                               | 3183                              | 3108  |
| up to 5 yrs.  | 1931                   | 1898              | 6461                         | 2056                               | 1394                              | 1176  |
| up to 6 yrs.  | 3121                   | 3064              | 13563                        | 4816                               | 3648                              | 3127  |
| up to 7 yrs.  | 1169                   | 1165              | 6941                         | 4032                               | 2609                              | 2319  |
| up to 8 yrs.  | 656                    | 642               | 5044                         | 2851                               | 2022                              | 1758  |
| up to 9 yrs.  | 119                    | 117               | 1265                         | 584                                | 503                               | 390   |
| up to 10 yrs. | 144                    | 140               | 1855                         | 899                                | 800                               | 559   |
| up to 11 yrs. | 16                     | 16                | 257                          | 173                                | 164                               | 124   |
| up to 12 yrs. | 6                      | 6                 | 64                           | 43                                 | 57                                | 42  |
| up to 13 yrs. | 3                      | 3                 | 22                           | 0                                  | 12                                | 10  |
| up to 14 yrs. | 6                      | 6                 | 23                           | 4                                  | 11                                | 2   |
| up to 15 yrs. | 18                     | 18                | 107                          | 18                                 | 49                                | 12  |
| up to 17 yrs. | 1                      | 1                 | 20                           | 0                                  | 14                                | 4   |
| up to 19 yrs. | 5                      | 5                 | 7                            | 0                                  | 4                                 | 0.02  |
| up to 20 yrs. | 18                     | 18                | 43                           | 0                                  | 22                                | 0.38  |

Source: PGRLF(2005)

Note: Out of the 23157 loans approved by December 31, 2004 only 22776 are included in this table.

outstanding amounts of guarantees. But we have available the aggregated historical data about duration structure of all loans supported by SGAFF since its foundation up to the end of the year 2004. This information is provided in the Table 4. The duration data in this table show that the majority of the supported loans is at most for two years. When measured by loan amount, the one and two-years loans account for 44% of all loans supported. Only very small share (5%) of the loan amount belongs to long term loans with the duration of nine or more years. Therefore, based on historical data we could say that the major expected cost and risk exposure of the SGAFF concentrates into a short term horizon up to two years with the rest essentially distributed in the medium term of 3–8 years.

As we argued in previous paragraphs, the annual transfers from state budget to SGAFF do not capture actual costs of SGAFF. It would be quite a complex problem to calculate

Table 5: Guarantees and Subsidies Contracted and Paid

| Year  | Guarantees<br>contracted<br>(CZK million) | Number<br>of defaults | Guarantee<br>payments<br>by SGAFF<br>(CZK million) | Subsidies<br>contracted<br>(CZK million) | Paid out from<br>the subsidies<br>contracted<br>(CZK million) |
|-------|---|-----------------------|--|--|---|
| 1994  | 1544                                      | 0                     | 0  | 1259                                     | 286   |
| 1995  | 4436                                      | 9                     | 28   | 2417                                     | 722   |
| 1996  | 8265                                      | 19                    | 69   | 4337                                     | 1819  |
| 1997  | 4788                                      | 61                    | 170  | 2964                                     | 2702  |
| 1998  | 2307                                      | 119                   | 677  | 1959                                     | 2682  |
| 1999  | 1138                                      | 191                   | 811  | 1394                                     | 2208  |
| 2000  | 876                                       | 181                   | 723  | 754                                      | 1606  |
| 2001  | 1129                                      | 99                    | 308  | 992                                      | 1333  |
| 2002  | 1365                                      | 60                    | 109  | 1008                                     | 1267  |
| 2003  | 1714                                      | 36                    | 131  | 606                                      | 964   |
| 2004  | 2306                                      | 40                    | 176  | 763                                      | 880   |
| total | 29869                                     | 815                   | 3201   | 18453                                    | 16469   |

Source: PGRLF(2005)

true economic costs of SGAFF if we would consider all direct and indirect costs. In this paper we will restrict our attention just to the direct costs. Nevertheless even the quantification of all direct costs of SGAFF would not be easy task even if we had available the internal accounting data of SGAFF. Since we do not have access to these proprietary data, we focus just on the direct cost of the main activities of SGAFF in this paper.

As we already mentioned the principal activity of SGAFF is the support of agricultural commercial loans through interest rates subsidies and guarantees. Therefore the main budget costs of the SGAFF are the payments of interest rate subsidies and the guarantee payments for defaulted loans. These payments are given in the Table 5 for the period from 1994 to 2004.

It may be seen from the Table 5 that both the total cost of guarantee payments and the number of defaulted guaranteed loans were increasing with the sharp acceleration during the period 1998–2000. The reaction to this trend was the steady decrease in the size of contracted guarantees with the minimum achieved in in the year 2000. By comparing the total guarantee payments with the total volume of guarantees contracted since the beginning of SGAFF to the end of the year 2004, we find out that the average share of

paid guarantees with respect to the guarantees provided in the contracts over the years of the operations of SGAFF was slightly higher than 10 percent. As long as we take these historical data as a good prediction for expected future, we may expect that the cost of CZK 7.239 billion guarantees outstanding as of December 31, 2004 will be around CZK 0.7 billion in the terms of expected actual guarantee payments by SGAFF. When we add the CZK 1.737 billion of contracted interest rate subsidies outstanding, we see that the CZK 6.5 billion value of the portfolio of SGAFF is sufficiently high to support the major mission of SGAFF no matter what are the operational institutional costs of running the SGAFF operations and administration.

This comparison of the value of portfolio and expected cost of core activities of SGAFF explains the reasons of decreasing government budget contributions presented in the Table 2. It also explains the insistence of the Czech Ministry of Agriculture on the SGAFF taking part in additional supporting activities in addition to its main mission of providing credit guarantees and interest rate subsidies.

SGAFF obviously has also operational and administrative costs connected with its functioning as an institution and the financial costs of active management of its portfolio. It also incurs significant costs connected with a number of ad hoc activities imposed upon it by its sole shareholder — the Czech Ministry of Agriculture. These ad hoc activities range from the purchases of receivables to be received by primary agricultural producers from processing firms during 1994–1999 to the flood relief loans for 1997 and 2002 floods. The most recent example is the involvement of SGAFF in the agricultural insurance support since 2004. This support of agriculture insurance seems to be a lasting activity which could become one of the major SGAFF lines of business.

While Czech Supreme Audit Office (1997, 1999) or Silar (1996) mentioned and criticized a number of inefficiencies connected both with the main activities of SGAFF and all those supplementary activities, we left all these legitimate concerns aside in this paper and we restricted our attention just to the interest rates subsidies and guarantees payments

summarized in the Table 5. We will continue to keep this concentration on guarantees and interest rate subsidies in the following sections in which we switch our focus from the empirical quantitative investigation to the theoretical qualitative mode of analysis.

## 4 The Model of Credit Rationing under Asymmetric Information

In this section we incorporate the problem of budget costs of the government intervention into the simplified version of the model of credit market under asymmetric information developed by Janda (2003, 2005). This abridged model concentrates on inefficiencies caused by credit rationing and therefore does not deal with efficiency losses caused by collateralized debt contracts, which are analyzed by Janda (2003, 2005).

There are two types of risk neutral borrowers in this model, indexed as a type 1 and a type 2. These two types are distinguished by their probability of successfully finishing their project, denoted as  $0 < \delta_1 < \delta_2 < 1$ , and by their reservation utilities, denoted as  $b_1 < b_2$ . The probability that the random borrower facing lender is of a type 1 is  $\theta$ .

The borrower can either undertake one risky project, which yields  $y$  in the case of a success and 0 in the case of a failure, or he obtains the reservation utility  $b_i$ ,  $i \in \{1, 2\}$ . When the project is completed, the outcome of the project is freely observed by borrower, lender, and government.

In order to undertake the project the borrower has to borrow one unit of money from the lender. The unit cost of funds for risk neutral lenders engaged in Bertrand competition is denoted as  $\rho$ . The contracts among lender and borrower are standard debt contracts. This means that in the case of the success of the project the lender receives a constant repayment  $R$ . Each lender offers two types of contract. Each contract is a pair  $(\pi_i, R_i)$ ,  $i \in \{1, 2\}$  where  $R_i$  is the required repayment and  $\pi_i$  is the credit rationing probability,

that is, the probability that the application of the borrower who chooses this contract will be satisfied.

The expected utility of a borrower of type  $i$  who applies for a contract designed for a borrower of a type  $j$  is given as incremental expected utility:

$$U_{ij} = \{\pi_j[\delta_i(y - R_j)] + (1 - \pi_j)b_i\} - b_i,$$

which may be simplified as

$$U_{ij} = \pi_j[\delta_i(y - R_j) - b_i]. \quad (1)$$

This definition of utility function leads naturally to the participation constraint in the form

$$U_{ij} \geq 0.$$

We assume that each project is socially efficient, that is  $\delta_i y > b_i + \rho$ . The only informational asymmetry in the model is that ex ante lenders and government do not know the type of borrower.

The government may attempt to reduce the inefficiencies created by credit rationing by three types of interventions, which were motivated by the programs used by the Czech SGAFF.

Under the proportional guarantees program, the government guarantees the payment of the fraction  $\alpha_i$  of the contracted loan repayment in the case of zero return from a project. The expected profit to a lender is

$$B_i = \pi_i[\delta_i R_i + (1 - \delta_i)\alpha_i R_i - \rho]. \quad (2)$$

Under the lump-sum guarantees program the government guarantees the payment of an exogenously determined lump-sum  $g_i$  in the case of zero return from project. The expected profit to a lender is

$$B_i = \pi_i[\delta_i R_i + (1 - \delta_i)g_i - \rho]. \quad (3)$$

The last considered type of an intervention is an interest rate subsidy  $s_i$ , which is paid only in the case of project's success, as opposed to guarantees, which are paid in the case of failure. While the subsidy reduces the interest rate paid by a borrower, we can treat it analytically just like an exogenous supplement to a repayment to a lender. Therefore the expected profit to a lender is

$$B_i = \pi_i[\delta_i(R_i + s_i) - \rho]. \quad (4)$$

In accord with the practice of the SGAFF, these supports are provided by the government for free. This means that the borrower does not have to pay any guarantee (or subsidy) fee to the government, which is in the Czech reality represented by SGAFF. This is in a sharp contrast with the usual commercially provided guarantees.

## 5 The Optimization Problem and Its Solution

Since the focus of our attention in this paper is on the budget costs of the government intervention, we only briefly state the solutions of the model under three different considered interventions here. The detailed solution of the full unabridged model with the relevant proofs is provided by Janda (2003, 2005). Those papers consider our three types of government interventions but do not deal with their government budget impact, which is the point of interest in this article. In this paper we will analyze only the situation when the values of the reservation utilities and likelihood of success parameters are such that  $\frac{b_2}{b_1} \geq \frac{\delta_2}{\delta_1}$ . This situation corresponds to the transition economy case in the terminology of Janda (2003, 2005).

The lender under asymmetric information does not know ex ante the risk class of a borrower. Because of the competition from other lenders, each lender attempts to offer to each type of the borrower as good conditions as possible. If the lump-sum guarantees are provided, the maximization problem of a lender is given by:

$$\begin{aligned}
\max_{\begin{pmatrix} \pi_1, R_1 \\ \pi_2, R_2 \end{pmatrix}} M &= \theta U_{11} + (1 - \theta) U_{22} \\
&= \theta \pi_1 [\delta_1 (y - R_1) - b_1] + \\
&\quad (1 - \theta) \pi_2 [\delta_2 (y - R_2) - b_2]
\end{aligned}$$

s.t.

$$\pi_1 [\delta_1 (y - R_1) - b_1] \geq \pi_2 [\delta_1 (y - R_2) - b_1], \quad (\text{IC1})$$

$$\pi_2 [\delta_2 (y - R_2) - b_2] \geq \pi_1 [\delta_2 (y - R_1) - b_2], \quad (\text{IC2})$$

$$U_{ii} \geq 0, \quad (\text{IRi})$$

$$0 \leq \pi_i \leq 1,$$

$$\delta_i R_i + (1 - \delta_i) g_i - \rho = 0, \quad (5)$$

$$i \in \{1, 2\}.$$

Equation (5) is a zero profit condition for lenders, which explicitly prohibits a cross-subsidization. This means that it is not possible for lenders to suffer a loss on a contract to one type of a borrower and to enjoy a positive profit on a contract to another type of a borrower. Zero profit constraint puts a bound on the ability of lender to offer the most attractive contract to the borrower when the lender competes for him with the other lenders.

When the proportional guarantees are used, the lender's zero profit condition (5) is replaced by

$$\delta_i R_i + (1 - \delta_i) \alpha_i R_i - \rho = 0. \quad (6)$$

When the interest rate subsidies are used the lender's zero profit condition (5) is replaced by

$$\delta_i(R_i + s_i) - \rho = 0. \quad (7)$$

By solving this optimization problem we find out the following characteristics of the optimal solution.

For the government support realized through lump-sum guarantees the contracts for high-risk (indexed as borrower 1) and low risk borrower (indexed as borrower 2) are given by:

$$\pi_1^* = 1, R_i^* = \frac{\rho - (1 - \delta_i)g_i}{\delta_i}, \quad i \in \{1, 2\}. \quad (8)$$

$$\pi_2^* = \frac{\delta_1 y - \rho - b_1 + (1 - \delta_1)g_1}{\delta_1 y - \frac{\delta_1}{\delta_2}\rho - b_1 + \frac{\delta_1(1-\delta_2)}{\delta_2}g_2}. \quad (9)$$

For the government support realized through proportional guarantees the contracts for high-risk (indexed as borrower 1) and low risk borrower (indexed as borrower 2) are given by:

$$\pi_1^* = 1, R_i^* = \frac{\rho}{\delta_i + (1 - \delta_i)\alpha_i}, \quad i \in \{1, 2\}. \quad (10)$$

$$\pi_2^* = \frac{\delta_1 y - b_1 - \frac{\delta_1 \rho}{\delta_1 + (1 - \delta_1)\alpha_1}}{\delta_1 y - b_1 - \frac{\delta_1 \rho}{\delta_2 + (1 - \delta_2)\alpha_2}}. \quad (11)$$

For the government support realized through interest rates subsidies the contracts for high-risk (indexed as borrower 1) and low risk borrower (indexed as borrower 2) are given by:

$$\pi_1^* = 1, R_i^* = \frac{\rho}{\delta_i} - s_i, \quad i \in \{1, 2\}. \quad (12)$$

$$\pi_2^* = \frac{\delta_1 y - \rho - b_1 + \delta_1 s_1}{\delta_1 y - \frac{\delta_1}{\delta_2}\rho - b_1 + \delta_1 s_2}. \quad (13)$$

In the next section we will use these equilibrium values of the required repayments  $R_i^*$  and credit rationing probabilities  $\pi_i^*$ ,  $i \in \{1, 2\}$ , to evaluate the budget cost of different types of interventions.

## 6 Budget Cost of Interventions

From the welfare point of view the absolute volume of the government money spent on the interventions really does not matter as long as we take it as a pure transfer without any transaction cost. We do not include into this model any formal considerations of the cost of obtaining money for the the government budget neither do we model the cost of transferring money from the government budget to the hands of lenders and borrowers. This means that we do not answer the question if (taking into account the cost of obtaining and transferring money) it is socially efficient for the government to engage in credit market interventions. In accord with actual situation of the Czech agricultural policies and government decision making, we take it as a given fact that based on political reasons the government decides to undertake a credit market intervention. Nevertheless we assume that government would like to achieve its goals in the improving efficiency of credit markets with as little government budget outlays as possible. (It is a very obvious assumption, but it is not trivial. It could be possible that for some political economy reasons the government would follow some additional goals besides improving the efficiency of credit markets and those goals would not be compatible with the government budget cost minimization.) Consequently, the government is very much interested in the expected budget impact of its interventions, which is the subject of the following analysis. This means that we compare here only relative efficiency (from the budget cost perspective) of different credit market interventions.

The expected budget cost of different forms of government interventions  $G_m$ ,  $m \in \{\alpha, g, s\}$  are given by the following formulas:

Proportional guarantees:

$$G_\alpha = \theta\pi_1^*(1 - \delta_1)\left[\alpha_1\frac{\rho}{\delta_1 + (1 - \delta_1)\alpha_1}\right] + (1 - \theta)\pi_2^*(1 - \delta_2)\left[\alpha_2\frac{\rho}{\delta_2 + (1 - \delta_2)\alpha_2}\right]. \quad (14)$$

Lump-sum guarantees:

$$G_g = \theta\pi_1^*(1 - \delta_1)g_1 + (1 - \theta)\pi_2^*(1 - \delta_2)g_2. \quad (15)$$

Interest rate subsidies:

$$G_s = \theta\pi_1^*\delta_1s_1 + (1 - \theta)\pi_2^*\delta_2s_2. \quad (16)$$

Under the assumptions of our model in the first-best full information case all the projects would be realized. This means that asymmetric information leading to equilibrium credit rationing generates welfare loss.

In the remainder of this section we consider the following scenario. We assume that government determines the target level of credit rationing which the government would like to achieve. To get to this target level government is able to use different credit support instruments.

Given a required target level of efficiency (determined by the level of  $\pi_2^*$ ) denoted as  $\pi_h$ , we can determine the level of intervention  $m_1(m_2, \pi_h)$ , where  $m \in \{\alpha, g, s\}$ , needed to achieve this required target.

We will compute these levels of intervention and subsequently we will use them to compare the budget impact of different types of interventions under the condition of the same achieved target level of efficiency.

For proportional guarantees we express from equation (11) the formula for a proportional guarantee to a high risk borrower  $\alpha_1$  as a function of the target level of credit rationing  $\pi_h$  and the proportional guarantee to a low risk borrower  $\alpha_2$ :

$$\pi_h \left[ \delta_1 y - b_1 - \frac{\delta_1 \rho}{\delta_2 + (1 - \delta_2)\alpha_2} \right] = \delta_1 y - b_1 - \frac{\delta_1 \rho}{\delta_1 + (1 - \delta_1)\alpha_1(\alpha_2, \pi_h)},$$

which leads to:

$$\alpha_1(\alpha_2, \pi_h) = \frac{\delta_1 \left\{ \rho - \left[ \delta_1 y - b_1 - \pi_h \left[ \delta_1 y - b_1 - \frac{\delta_1 \rho}{\delta_2 + (1 - \delta_2) \alpha_2} \right] \right] \right\}}{(1 - \delta_1) \left[ \delta_1 y - b_1 - \pi_h \left[ \delta_1 y - b_1 - \frac{\delta_1 \rho}{\delta_2 + (1 - \delta_2) \alpha_2} \right] \right]}. \quad (17)$$

The size of a lump-sum guarantee for a high risk borrower  $g_1$ , given as a function of the targeted level of credit rationing  $\pi_h$  and the lump-sum guarantee for a low risk borrower  $g_2$ , is obtained from equation (9) as:

$$g_1(g_2, \pi_h) = \frac{\pi_h \left[ \delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1 + \frac{\delta_1 (1 - \delta_2)}{\delta_2} g_2 \right] - \delta_1 y + \rho + b_1}{1 - \delta_1}. \quad (18)$$

Similarly, the interest rate subsidy for a high risk borrower, given as a function of  $\pi_h$  and  $s_2$ , is obtained from equation (13) as:

$$s_1(s_2, \pi_h) = \frac{\pi_h \left( \delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1 + \delta_1 s_2 \right) - \delta_1 y + \rho + b_1}{\delta_1}. \quad (19)$$

The budget cost of a lump-sum guarantee intervention, given as a function of  $\pi_h$  and  $g_2$ , are obtained by substituting  $g_1(g_2, \pi_h)$  from (18) and  $\pi_1^* = 1$  from (8), into (15):

$$\begin{aligned} G_g &= \theta \left\{ \pi_h \left[ \delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1 + \frac{\delta_1 (1 - \delta_2)}{\delta_2} g_2 \right] - \delta_1 y + \rho + b_1 \right\} + \\ &\quad (1 - \theta) \pi_h (1 - \delta_2) g_2 \\ &= \theta \left\{ \pi_h \left[ \delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1 \right] - \delta_1 y + \rho + b_1 \right\} + \\ &\quad \theta \pi_h \frac{\delta_1 (1 - \delta_2)}{\delta_2} g_2 + (1 - \theta) \pi_h (1 - \delta_2) g_2. \end{aligned}$$

The budget cost of an interest rate subsidy, given as a function of  $\pi_h$  and  $s_2$ , are obtained by substituting  $\pi_1^* = 1$  from (12) and  $s_1(s_2, \pi_h)$  from (19), into (16):

$$\begin{aligned} G_s &= \theta \left[ \pi_h \left( \delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1 + \delta_1 s_2 \right) - \delta_1 y + \rho + b_1 \right] + (1 - \theta) \pi_h \delta_2 s_2 \\ &= \theta \left\{ \pi_h \left[ \delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1 \right] - \delta_1 y + \rho + b_1 \right\} + \theta \pi_h \delta_1 s_2 + (1 - \theta) \pi_h \delta_2 s_2. \end{aligned}$$

The comparison of the budget cost for the targeted lump-sum guarantees and for the targeted interest rate subsidies shows that:

$$G_s - G_g = \pi_h \left\{ s_2 [\theta \delta_1 + (1 - \theta) \delta_2] - g_2 \left[ \theta \frac{\delta_1 (1 - \delta_2)}{\delta_2} + (1 - \theta) (1 - \delta_2) \right] \right\} > 0$$

$$\Leftrightarrow s_2 > \frac{g_2(1 - \delta_2)[\theta \frac{\delta_1}{\delta_2} + 1 - \theta]}{\theta \delta_1 + (1 - \theta) \delta_2} = g_2 \frac{1 - \delta_2}{\delta_2}.$$

So, intuitively plausible, if  $s_2$  is sufficiently high relative to  $g_2$ , then  $G_s > G_g$ . This means that if the government is targeting support both to low and high risk borrowers, the comparison of budget impacts of lump-sum guarantees and interest rate subsidies depend on the size of support provided directly to low risk borrowers. The intervention with lower support targeted to low risk borrowers will be cheaper for the government budget.

For the optimal solution with  $s_2 \rightarrow 0$ ,  $g_2 \rightarrow 0$  we get  $\lim_{s_2 \rightarrow 0} G_s = \lim_{g_2 \rightarrow 0} G_g$ .

For  $\alpha_2 \rightarrow 0$ , the budget cost is given as:

$$\lim_{\alpha_2 \rightarrow 0} G_\alpha = \theta \left[ \pi_h(\delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1) - \delta_1 y + \rho + b_1 \right] \Rightarrow \lim_{\alpha_2 \rightarrow 0} G_\alpha = \lim_{s_2 \rightarrow 0} G_s = \lim_{g_2 \rightarrow 0} G_g.$$

For the optimal interventions with negligible volume of support targeted to low risk borrower the government is indifferent among all three analyzed types of intervention as far as the government budget impact of these interventions is concerned.

In the case of lump-sum guarantees and interest rate subsidies we can also easily express  $g = g_1 = g_2$  and  $s = s_1 = s_2$ :

$$g(\pi_h) = \frac{\delta_2[\pi_h(\delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1) - (\delta_1 y - \rho - b_1)]}{(1 - \delta_1)\delta_2 - \pi_h \delta_1(1 - \delta_2)}.$$

$$s(\pi_h) = \frac{\pi_h(\delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1) - (\delta_1 y - \rho - b_1)}{\delta_1(1 - \pi_h)}.$$

The comparison of the cost of non-targeted lump-sum guarantees and non-targeted interest rate subsidies shows that:

$$\begin{aligned} G_s - G_g &= [\pi_h(\delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1) - (\delta_1 y - \rho - b_1)] \cdot \\ &\quad \frac{[\delta_2(1 - \delta_1) - \pi_h \delta_1(1 - \delta_2)][\theta \delta_1 + (1 - \theta) \delta_2 \pi_h] - \delta_1 \delta_2(1 - \pi_h)[\theta(1 - \delta_1) + (1 - \theta) \pi_h(1 - \delta_2)]}{\delta_1(1 - \pi_h)[\delta_2(1 - \delta_1) - \pi_h \delta_1(1 - \delta_2)]} \\ &= [\pi_h(\delta_1 y - \frac{\delta_1}{\delta_2} \rho - b_1) - (\delta_1 y - \rho - b_1)] \frac{(\delta_2 - \delta_1) \pi_h [\delta_1 \theta + \delta_2(1 - \theta)]}{(1 - \pi_h)[\delta_2(1 - \delta_1) - \pi_h \delta_1(1 - \delta_2)]}. \end{aligned}$$

Since the denominator term  $(1 - \pi_h)[\delta_2(1 - \delta_1) - \pi_h\delta_1(1 - \delta_2)]$  may be shown to be positive, the entire fraction is positive. The sign of the difference  $(G_s - G_g)$  therefore depends on the leading term  $[\pi_h(\delta_1 y - \frac{\delta_1}{\delta_2}\rho - b_1) - (\delta_1 y - \rho - b_1)]$ , which is positive if  $\pi_h > \frac{\delta_1 y - \rho - b_1}{\delta_1 y - \frac{\delta_1}{\delta_2}\rho - b_1}$ . This fraction is equal to the size of credit rationing in the absence of government intervention. Since in our model any meaningful intervention leads to the decrease in the credit ration (meaning the increase in the  $\pi_h$ ), the leading term and the whole expression will be positive. Therefore  $(G_s - G_g) > 0$ . This argument also confirms that the formulas for uniform interventions  $g(\pi_h)$  and  $s(\pi_h)$  derived in this section take only positive values. The fact that the uniform interest rate subsidies are more expensive than the uniform lump-sum guarantees means that that with the non-targeted supports, the budget cost minimizing government unambiguously prefers lump-sum guarantees to interest rate subsidies.

Our theoretical results may be compared with the empirical evidence of the loan support provided by the operations of the Czech SGAFF. The SGAFF started with heavy emphasize on guarantee provision (as witnessed by its name which remains the same since the birth of the SGAFF), when the rate of guarantees was quite high, in some cases up to 100 percent of the contracted loan repayment. All the initial programs of SGAFF were providing either only guarantees or guarantees and subsidies. There was no program providing only interest rates subsidies among the initial programs. The exception were only supplementary programs (Landscape, Youth, and Agro-region), which were designed as supplementary programs to be used by eligible farmers only in conjunction with some of the principal programs. These supplementary programs provided additional interest rate subsidies.

After a few initial years both the rate of guarantees and the volume of provided guarantees decreased relative to the provision of the subsidies. This quantitative evidence of a shift of emphasize to interest rates subsidies was quite consistent up to the year 2004. The decrease in the provision of guarantees, which we discussed in the section 3.2, was caused primarily by the increase in the guarantee payments from the SGAFF budget since

1998. Through the combined effects of the decrease of the guarantees and better active management of its portfolio of defaulted loans SGAFF managed to avoid a danger of massive default wave connected with the huge guarantee payments. Since the year 2001 the guarantee payments of SGAFF decreased to the level prevailing before 1998. This created a favorable environment for the revival of the credit guarantees as a major part in the operations of the SGAFF. Therefore in the year 2004 a reversal of a trend of a decreasing role of the guarantees happened towards the higher emphasize on guarantees, as measured by their volume provided.

By the years 2004 and 2005 the guarantees provided by SGAFF are usually up to 30 percent of the contracted loan repayment, in some programs up to 50 percent. This means that they are still set more conservatively than in the first years of the SGAFF operations. Up to 2004 non-investment loans were supported only by interest rates subsidies, currently they are supported by both subsidies and guarantees. Among the investment loan programs, three of them provide for both interest rates subsidies and guarantees, one provides only subsidies and one provides only subsidies in some investment areas and both subsidies and guarantees in other investment areas.

## 7 Conclusions

In our paper we described the Czech institution of agricultural credit support SGAFF. We showed the evolution of its activities, funding, and outlays over time. Our empirical analysis shows that while both its absolute volumes and its relative importance in total government support to agriculture decreased after the year 2000 as compared to second half of nineties, it still remains as an important institution of agricultural credit support. It is likely to remain active at current level at least up to the end of 2006. We have shown that the value of the SGAFF portfolio is sufficiently high to cover the expected costs of credit guarantees and subsidies provided by the SGAFF so far.

In the second half of this paper we augmented the empirical quantitative analysis by a theoretical qualitative analysis. We started from the idea, that the government credit support may decrease the inefficiencies caused by credit rationing based on incomplete information of lenders about the quality of the farmers. We introduced the government interventions - credit guarantees and interest rates subsidies - modeled according to their Czech empirical counterparts. Our analysis was based on the comparison of direct budget cost required by different types of interventions for a given reduction of credit rationing.

Our analysis have shown that as long as the government is perfectly targeting its interventions to the disadvantaged high risk farmers with the goal to reduce credit rationing caused by asymmetric information, the considered types of interventions are perfectly equivalent from the point of view of direct government budget cost. If the government is targeting support both to low and high risk farmers then the comparison of lump-sum guarantees and interest rates subsidies depends on the size of support provided to low risk farmers. If the subsidy rates provided to these good farmers are sufficiently high relative to the lump-sum guarantees provided to these farmers, then the budget costs are higher for subsidies. As long as the credit support is provided uniformly to all types of farmers, the budget cost minimizing government unambiguously prefers lump-sum guarantees to interest rate subsidies.

Our qualitative theoretical results have a mixed empirical evidence support. Since the actually used guarantees and subsidies are uniform, our model predicts that the most efficient way for the government to decrease credit rationing is to prefer guarantees over subsidies. This is what happened in the evolution of the Czech SGAFF fund during the first years of its operations and what seems to be happening again recently. In the middle years of the evolution of the SGAFF the fear of the uncertainty connected with the extended guarantees was stronger than our intuitively plausible theoretical argument and the SGAFF curbed the provision of the guarantees. The successful management of the guarantees and defaulted loans by the end of nineties and by the beginning of this century

was probably the most important factor leading to the current renaissance of the SGAFF credit guarantees.

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