CREDIT GUARANTEES IN A CREDIT MARKET WITH ADVERSE SELECTION

Karel JANDA*

Abstract:
This paper deals with government interventions in agricultural credit markets in the Czech Republic. I first describe the institutional setting and the empirics of agricultural credit in the Czech Republic. I explain the activities of the Czech Agricultural Guarantee Fund and compare it with similar institutions dealing with the support of agricultural credit in transition and developed market economies. Then I introduce an adverse selection model of credit provision with proportional credit guarantees. The model distinguishes two market regimes – a developed post-transition market economy and a transition economy. This distinction between transition and post-transition economies leads to different results generated by credit markets. Most notably, there is a failure of collateral as a screening instrument in credit markets of transition economies. With economic stabilization collateral resumes its role as a screening instrument.

Keywords: adverse selection, government intervention, agricultural credit

JEL Classification: D82, G38, P34, Q14

1. Introduction

This paper applies asymmetric information model to the provision of government guarantees in the agricultural credit markets in the Czech Republic. The motivation for this application is the institutional setting in the Czech Republic. There exists a well defined program of government support for Czech agricultural credit. At the same time, there is a manifested will of the government to support agriculture which suggests that the agricultural activities are considered to be socially desirable. The Czech approach to supporting agricultural credit is quite similar to approaches used in other transition economies in Central and Eastern Europe.

The transition from centrally planned to market economy in the East and Central Europe has been under way for more than 10 years. In the near future the first post-communist countries will become members of the European Union. This means that the economies of these countries will slowly evolve from the transition state into the

*) Institute of Economic Studies, Charles University, Opletalova 26, CZ – 110 00 Prague 1 and University of Economics, 4, W. Churchill Sq., CZ – 130 67 Prague 3 (e-mail: Karel-Janda@seznam.cz).

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post-transition state. This post-transition economy will be very similar to the long run stable economy, which is characteristic for Western Europe or North America.

In the standard situation of a long run stable economy, we can see that entrepreneurs who are engaged in some activity are self-selected into that activity. There is no rapid movement of entrepreneurs in or out of a given activity which means that people are specialized in a certain skill area and would be in a marked disadvantage compared to incumbents if they moved into a different line of activity. Low risk entrepreneurs are always more productive than high risk entrepreneurs in the sense that their expected return from their investment project is higher. This relative advantage of low risk entrepreneurs is higher when both types are engaged in the original self-selected activity than it would be if both types of entrepreneurs moved into some other activity.

The situation is different in a transition economy, especially in activities which experience large scale downsizing and outflow of labor. A prime example of such activity is agriculture. The stylized fact is that there were not enough incentives for those in the labour force to become enterprising farmers in the agricultural cooperatives under the centrally planned economy. The incentive schemes (wages and other means of renumeration and social recognition) were not strong enough to be really efficient. As a result, there was a general tendency towards average productivity and low variance in effort and the results of these efforts. The high level of specialization in agricultural cooperatives also made their members quite unqualified as independent farmers. This leads to a situation in which the different possibilities of success for the people with different abilities are relatively smaller in agriculture that outside of agriculture in a transition economy. In a transition economy people working in agriculture are aware of the fact that if they quit working in agriculture, the low risk entrepreneurs would became really successful while the people with low abilities would become really poor.

Based on the above given characteristics of a transition and a post-transition stabilized economy the analysis of this paper will be done for both of these situations. The distinction between a transition and a post-transition stabilized economy leads to different results generated by credit markets. Most notably, there is a failure of collateral as a screening instrument in credit markets of transition economies. In the absence of other possible screening instruments, this leads to the use of credit rationing as a mechanism to overcome information asymmetry. With the economic stabilization the collateral will resume its role as a screening instrument.

The rest of this paper is organized in the following way. First I describe the agricultural credit support programs in the Czech Republic. Then I compare them with similar programs in developed market economies and in transition economies. Then I provide an overview of the literature dealing with modelling credit markets under asymmetric information. As a next step I develop a formal model of credit provision in the situation of adverse selection. Then I use this model to analyse the proportional credit guarantees corresponding to the guarantees used by the Czech Support and Guarantee Fund for Farmers and Forestry. The conclusions are summarized in the final section of this paper.

2. Credit Support Programmes

2. 1 *Agricultural Credit in the Czech Republic*

Czech government involvement in the provision of credit and finance to the agricultural sector is primarily channelled through the Support and Guarantee Fund for Farmers and Forestry (SGFFF). This fund was established in September 1993. It

draws its resources from a combination of general government budget contributions and from its own financial portfolio. The direct government budget contribution was CZK 1.3 billion in 2001. The financial portfolio of the SGFFF is a combination of government bonds and shares. These shares are primarily shares of former state owned enterprises which have some connection to agriculture. The value of the financial portfolio of the SGFFF was CZK 8.3 billion as of December 31, 2001.

The SGFFF provides two main forms of assistance to the agricultural sector. These are the provision of interest rates subsidies and the provision of guarantees. Since the beginning of operations of the SGFFF up to December 31, 2001 the Fund received 18,458 applications for support. Overwhelming majority (17,043) of them were approved. Total volume of supported loans was CZK 74.5 billion for this period. The guarantee was extended for CZK 24.5 billion. The total volume of contracted subsidies was CZK 16.9 billion out of which CZK 13.4 billion was actually paid out by December 31, 2001.

To obtain finance from the SGFFF, farmers make loan applications to commercial banks. These are evaluated by banks using normal criteria for assessing whether to lend or not (e.g., the reason for applying for a loan, the viability of the proposed project, how re-payments will be made, proposed resources for re-payment, current and likely future profitability, collateral offered, past record of financial dealings). Projects must also not be eligible for alternative sources of funding (e.g., from Czech-Moravian Guarantee and Development Bank). Applicants must also derive more than 50 per cent of their total revenue from primary agriculture or forestry or to be active in the food processing or distribution.

Once a loan application has been approved by a bank, requests for the provision of subsidized loan or guarantee are made to the SGFFF. The SGFFF does not usually reject approved applications made by banks. The SGFFF aims to provide mechanism of support and not interfere in the selection criteria and thus minimizes government inference in the operation of this element of the market. It also does not issue any guidelines to banks on lending criteria (e.g., types of farmers to favour in the provision of loans, or the proportion of loan types – short, medium or long-term – that should be provided.) From the farmer's perspective the loan applications are made to and with banks and not the SGFFF. From the bank perspective, normal commercial criteria are applied to determine whether loans are provided. Of course with the backing of guarantees from the SGFFF and the relatively high level of interest rate subsidy available, it is clear that lending to agricultural sector is at a higher level than would otherwise occur if strictly commercial criteria and unsubsidized interest rates were applied. The implication of this is that other sectors receive less access to lending than would otherwise occur in the absence of government involvement.

2. 2 *The Programmes Similar to Support and Guarantee Fund for Farmers and Forestry*

2. 2. 1 *The Western Programmes*

The primary source of inspiration for the Guarantee Fund for Czech agricultural policymakers and agricultural economists was the U.S. Farmers Home Administration (FmHA). While the idea of the provision of loan guarantees and subsidies to the farmers is the same both in the USA and in the Czech Republic, there are significant differences between both countries' approaches. The most import difference is that the Czech borrowers who will be provided government support are selected by the commercial banks. The Guarantee Fund provides its support practically auto-

matically contingent upon the decision of the bank and upon the satisfaction of the general eligibility conditions. This feature is connected with the absence of the huge country-wide administration network of the support programme in the Czech Republic as opposed to the more than 2,000 offices with more than 11,000 full time employees in the U.S. FmHA (see FmHA, 1990).

The Czech Guarantee Fund is much more specialized in the provision of credit subsidies and guarantees to agriculture and forestry and does not provide direct loans or other types of support as FmHA. It also does not provide a wide array of support programme to non-agricultural business and social activities as is the case with FmHA. The Farm Credit System also plays an important role in the U.S. support of farmers, which does not have any counterpart in the Czech Republic.

The situation of farm credit in EU countries is different than the situation in the USA. Generally, there is much less attention devoted to the support of farm credit in the EU than in the U.S. Institutional representation of this difference is the fact that there is no special institution of farm credit support included in the Common Agricultural Policy (CAP) of the EU.

Nevertheless, there are farm credit programmes run on a national basis in individual Member States of the EU. But the weight given to these programmes is quite different in individual countries. It ranges from the strong interventions of government in France to the situation practically without any government run farm credit programme in United Kingdom.

The approach of the EU to farm credit programmes is especially important for transition economies preparing to join the EU in the near future. From this point of view, the most relevant is the approach to agricultural credit in Portugal, which became Member of EU in 1986. Similar to the Czech Republic, Portugal is a small country with a gross domestic product (GDP) much lower than the average of rich EU countries. The backward rural structure and the high share of informal credit in the total agricultural credit make Portugal also a bridging case between the conditions of European agricultural credit markets and the conditions in the rural credit markets in developing countries.

In the period before EU accession in 1986, some agricultural credit programmes were operational in Portugal. The most important of them was the Sources of Investment Funds for Agriculture in Portugal (SIFAP) programme of interest rates subsidies. As opposed to the Czech bank driven programmes, the SIFAP programme was subjected to extensive government approval procedures. Farmers intending to obtain SIFAP credit subsidies were required to submit a very detailed investment plan by completing a forty-page application form. These were then reviewed for approval by the supervisory government agency and by the staff of the commercial bank to which the loan application was submitted. This costly, bureaucratic set of procedures led to lengthy delays of approvals and created considerable uncertainty as to the chances for success of credit support application. Typically, only larger farmers who could more easily afford high transaction costs, were the recipients of the benefits of the SIFAP programme (see Pearson, Monke and Avillez, 1985).

The accession to the EU and to the CAP does not automatically imply the obligation to discontinue the national credit support programmes. The adoption of CAP requires only the abolition of all commodity-specific subsidies, except as permitted by individual CAP commodity regimes. Since the credit support programmes are usually not commodity-specific, they are allowed to coexist with the CAP. Nevertheless, after the accession of Portugal to the EU, the interest rate subsidies programme SIFAP was discontinued. It was replaced by the farm investment subsidies programme under the EC Regulation 797/1985. The 797 programme consists of capital subsidies through which the government pays a specified percentage of the capital

costs of qualifying investments directly. The very important institutional feature of the 797 programme is that the application process for 797 capital subsidies is much less cumbersome than was that for SIFAP interest subsidies.

The dominance of direct subsidies over interest rate subsidies was clearly revealed after 1991, when Portugal received a permition from the EU to offer farmers the choice between capital subsidies and interest rate subsidies. According to Monke et al. (1993), this permission did not lead to a switch from direct subsidies to interest rate subsidies. Portuguese banks did not show much interest in establishing agricultural lending programme using the interest rate subsidies. The farmers also preferred the direct capital subsidies which do not necessitate formal borrowing and which place a much lower administrative burden on farmers.

The Portuguese experience shows that the accession of the Czech Republic should not be by itself a reason for discontinuing of the credit guarantees and interest rate subsidies programmes. The low administrative requirements of the Czech Guarantee Funds programmes lead to the conjecture that it could overcome the problems which led to the death of Portuguese interest subsidies programme.

There also exist a number of non-agricultural credit guarantee schemes in the developed countries (USA, Canada, United Kingdom, Germany, France, Italy, Netherlands), as described by Levitsky and Prasad (1987) and by Barrett et al. (1990). These schemes are usually designed to help small and medium sized businesses. These schemes differ widely according to their definitions of small and medium sized businesses, according to types of projects eligible for support, according to the loan security and borrower commitments required and according to the level of guarantees and premium fees paid by the borrower.

2. 2. 2 *The Programmes in Transition and Developing Economies*

Credit subsidies and guarantees for agriculture are provided in all Central and Eastern European transition countries. In Bulgaria, the credit subsidies programme was established in 1995. It pays 50 per cent of interest rate for agricultural seasonal credit. In Hungary Rural Credit Guarantee Fund, established in 1991, provides guarantees up to 50 per cent of principal and interest over the first year of use of credit. Polish Agency for the Restructuring and Modernization of Agriculture, established in 1994, provides favourable interest rates and guarantees up to 80 per cent. Since 1994, there are two programmes in operation in Romania. The Guarantee Fund for Agricultural Credit provides up to 60 per cent guarantees. The programme of credit subsidies through state Banca Agricola provides 60 per cent interest rate subsidies for short term credit and up to 75 per cent subsidies for medium and long-term credit. Similar programmes are in operation in Slovakia, Slovenia, and Baltic countries. More details on these programmes are provided by Swinnen and Gow (1999), Serova and Ianbykh (1999) and papers in OECD (1999, 2001).

There also exists a number of rural credit support schemes in the developing countries all around the world. The empirical experience from those programmes is collected by Adams, Graham and Von Pischke (1983), and by Von Pischke (1992). The general lesson from developing countries is that the default rates are typically very high and that many of the benefits of these programmes appear to go to the wealthier farmers.

3. Relation to the Existing Literature

The imperfections in credit markets caused by information asymmetries are the source of a huge amount of an academic and a practical literature. A few represen-

tative papers on the information economics of credit markets are: Besanko and Thakor (1987), Schmidt-Mohr (1997), Villas-Boas and Schmidt-Mohr (1999), DeMeza and Webb (1999, 2000), Cressy and Toivanen (2001), Janda (2002) and Berger and Udell (2002). All these papers are primarily engaged in a positive analysis of credit market imperfections and are not concerned with government interventions alleviating these imperfections. The use of collateral as a screening device in credit markets is extensively analysed by Coco (1999, 2000). Different solutions to credit market imperfections when collateral is not available are suggested by Loranth (2000).

Compared to a huge literature on credit market imperfections, the literature on government interventions dealing with these imperfections is relatively small. DeMeza and Webb (1987) and Innes (1991) are primarily concerned with efficiency results and with government interventions connected with the size of investment, as opposed to my paper which takes investment as a constant of a unit size. The analysis of DeMeza and Webb (1987) is further extended in Hellmann and Stiglitz (2000). Similar topics are also covered by DeMeza (2002), Cressy (2002) and Lerner (2002). Williamson (1994) and Wang and Williamson (1998) are, as opposed to my model's pure adverse selection setting, concerned with government interventions connected with asymmetries created by costly state verification.

The papers most related to my model are Gale (1990a, 1991) and Smith and Stutzer (1989). The model of Smith and Stutzer is a special case of my model in the case which I label as a "transition economy" case. Smith and Stutzer do not consider collateral in their main model, and as a justification for doing so they use the empirical fact that small businesses usually do not have sufficient wealth to use as collateral. As an alternative explanation, Smith and Stutzer assume the existence of a special class of borrowers owning collateralizable wealth which enables them to separate from other borrowers who are unable to pledge collateral. My model provides an endogenous explanation why in some cases collateral is not used even if all potential borrowers have non-zero collateralizable wealth. Gale (1990) provides quite a detailed analysis of credit market interventions in a developed market economy. The interventions analyzed by Gale are general loan guarantees under unlimited collateralizable wealth and government-guaranteed loans given to borrowers denied credit under a limited availability of collateral.

Calomiris, Kahn and Longhofer (1994) provide an analysis of government interventions in the housing financing market. Their emphasis is mainly on "cultural affinity" and the different levels of a wealth explanation of a credit rationing of minorities and poor. They also pay attention to the moral hazard sources of credit rationing.

The paper by Lacker (1994) also has a relevance to the topic of my paper. Lacker's model uses a generic setup of the standard adverse selection credit market models. The differences from my model are especially the assumption that the borrowers are able to costlessly hide the return to their project, and the assumption, that the borrowers have an unlimited amount of a wealth to use as a collateral. As opposed to my model, which is based on bilateral contracting between borrower and lender, Lacker also uses a multilateral contracting approach. The inclusion of the notion of the coalition of lenders leads Lacker to the conclusion that there is no need for government interventions in the credit market in his model. Government interventions in the agricultural credit market under asymmetric information are explicitly considered in Innes (1990).

A different strand of related literature is represented by Herr (1994), who analyzes the agricultural credit market and credit rationing as a disequilibrium phenomena explainable by the standard microeconomic analysis without taking into an account the aspects of information asymmetry.

Related literature on rural credit markets is represented by Besley (1994), Bose (1998), or by the papers collected in Hoff, Braverman and Stiglitz (1993). The distinguishing feature of this literature is the emphasis on informal credit sources, peer monitoring and linked contracts. My understanding of stylized facts is that the situation in European transition economies is very different from the rural credit markets in developing countries. While credit market imperfections, both their sources and results, are remarkably similar in transition and developing economies, many of the signalling or screening instruments analyzed in the rural credit markets literature are just not available or not feasible or not efficient in European transition economies. Nevertheless some of the arrangements for overcoming information asymmetries in the credit market used in developing countries could be applied in the European transition countries as well as it is discussed in Scholten (2000) for the case of Rotating Savings and Credit Associations.

My modelling approach to credit markets and government interventions, which I use in this model is quite different from the continuous-time finance models of the valuation of credit guarantees. This class of models is based on the Merton's (1990) extension of Black and Scholes's (1973) model of option valuation.

4. Model

The model used in this paper is an extension of the model provided by Janda (2002). I model the provision of credit under adverse selection. My model has two time periods which are referred to as ex ante and ex post. There are three classes of economic agents in this model. These are government, lenders, and borrowers. The government is modelled as a benevolent body whose only concern is an increase in social efficiency and the only role is to distribute exogenously determined guarantees and subsidies. The introduction of the government extends the model of the adverse selection credit market presented by Janda (2002).

The role of lenders is to provide financial funds which are needed by borrowers in order to realize their projects. Risk neutral lenders are engaged in Bertrand competition, leading to zero profits on lent sources. The supply of funds facing lenders is perfectly elastic, so that the lenders have available any demanded amount of funds under the unit cost of ρ.

There are two types of risk neutral borrowers in this model, indexed as a type 1 and a type 2. The 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 from not participating in the project, denoted as $b_1 < b_2$. A type 1 borrower is labeled as a high risk borrower and a type 2 borrower as a low risk borrower. The probability that the random borrower facing lender is of a type 1 is θ, which is the proportion of a type 1 borrowers in the total population of borrowers.

The assumption of risk neutrality of borrowers serves to emphasize the adverse selection aspects of this model. In this way I do not confuse the exposition with the implications of the well known result, that the optimal risk sharing arrangement between risk neutral and risk adverse agents is to have the risk neutral agent to bear all the risk. On the intuitive level I can support the assumption of the risk neutrality of the borrower by pointing out, that the borrower in this model does not ask for a consumption loan, but for a loan for production purposes. The production activity of the borrower is strictly separated from his personal life (I am using the framework of the limited liability company). This assumption is empirically especially true in the case of agricultural cooperatives, where the ownership of assets (particularly of land) is strictly separated from the business activities of the cooperative and is not legally attachable.

The borrower can either undertake one risky project, which yields y in the case of success and 0 in the case of a failure, or he can become engaged in some other activity, which yields an expected return of b_i, $i \in \{1,2\}$.

In order to undertake the project the borrower has to borrow a fixed amount of money from the lender. The size of this loan is normalized to 1.

Each borrower is endowed with a non-stochastic endowment $W < \rho$, which will become available ex post in the second period regardless if the project will be undertaken or not and regardless the outcome of the project. This assumption means that the borrower's own wealth is too low to finance his own project through a riskless loan.

The flow of funds from lenders to borrowers and the repayment of these funds is governed by contracts. Each lender offers two types of contract. Each contract is three-tuple (π_i, C_i, R_i), $i \in \{1,2\}$ where π_i is the probability that the application of the borrower who chooses this contract will be satisfied and he will be really lend money; C_i is required collateral; and R_i is the interest factor (1 + interest rate), which is equal to the required repayment because of my normalization of loan size to 1.

It is possible that the both types of contracts will be the same, which would mean that there will be only one contract pooling all borrowers together.

The interpretation of π_i as a probability that the lender randomly chooses some observationally equivalent borrowers applying for the same contract to be provided a loan and some to be rejected a loan, could seem to be a purely theoretical and artificial abstraction. Nevertheless, the stylized facts of the Czech agricultural credit market support the empirical relevance of this modelling device. The Czech loan officers admit that very often they are faced with a number of applications for loans for agricultural projects and they are just not able to determine which of these projects have a chance to succeed. Given the limited time, human capital and financial resources of the Czech loan officers, they are in the best case just able to state a risk class of farmers in the given region as a group, but they are not able to distinguish between risk classes inside the farmers population. In this situation, the limited resources devoted to agricultural credit are very often allocated on a subjective basis depending on the loan officer's discretion with a high level of a randomness in the decision to grant a loan to one farmer and to deny a loan to another farmer

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

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

Strictly speaking, the expected utility given by (1) is an incremental expected utility given as [expected utility after applying for credit] – [utility in the case of non-participating], that is:

$$\pi_j [\delta_i(y - R_j) - (1 - \delta_i)C_j - b_i] = \{\pi_j [\delta_i(y - R_j) - (1 - \delta_i)C_j + W] + (1 - \pi_j)(W + b_i)\} - (W + b_i)$$

The lender's valuation of a collateral is given as βC_i, where $\beta \in (0; 1)$. This means that any equilibrium involving a use of a collateral is not socially efficient, since the amount of $(1 - \beta)\ C_i$ is wasted.

I assume that each project is socially efficient, that is $\delta_i y > b_i + \rho$. This means that any equilibrium involving a credit rationing with $\pi_i < 1$ is not socially efficient.

The values of all parameters are known by borrowers, lenders and government. The only informational asymmetry in the model is that lenders or government do not know the type of borrower.

The expected profit to a lender on one loan provided to a borrower of a type i is under asymmetric information given as:

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

I assume that in the case that a lender is indifferent between lending and not-lending, he resolves this tie in the favour of lending.

The government can attempt to reduce the inefficiencies created by the use of collateral and by credit rationing by implementing a proportional guarantees programme. Under this programme the government guarantees the payment of the fraction α_i of the contracted loan repayment in the case of zero return from a project. The contracted collateral is passed to the government. The expected profit equation (2) is modified as:

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

The expected utility of a borrower is still given by equation (1) since the interventions influence the borrower's utility only indirectly through their impact on the lender's profit.

I assume that the legislative status of the interventions is such that all loans provided to borrowers in a certain line of business (agriculture in my application) are subjected to a given intervention, that is, all lenders lending in a given area participate in a government programme. It is not possible for the government to reject a guarantee for loans provided by some lenders when giving subsidies or guarantees to other lenders offering the same contract. The participating lenders are obliged to use government support schemes when offered.

The different assumptions about the relations of probabilities of successfully finishing the project in a given branch of a national economy and the opportunity costs of remaining in that branch of a national economy, which gave rise to our distinction of two market regimes of a "transition economy" and a post-transition "stabilized economy", are formally expressed in a following way: if $\frac{b_2}{b_1} \geq \frac{\delta_2}{\delta_1}$, then the model is in a "transition economy" regime; otherwise, it is in a post-transition "stabilized economy" regime.

This approach takes the relative chances of success in agriculture to be independent of the state of the transition. That is, I take the ratio $\frac{\delta_2}{\delta_1}$ as a constant, which is the same for both transition and post-transition economy. I assume that these chances of success are basic characteristics of people and that they do not depend on the state of the economy. On the other hand, I assume that the opportunity costs are dependent on the state of the economy.

I assume that transition leads to a big stratification of the society. From government-imposed equality to a market driven inequality. During transition there are substantial possibilities for people to either become very rich or very poor, depending on their abilities. I assume that this process of polarization of society is much more stronger in the transition, than it is in a usual stable market economy. So I assume that during the transition the ratio $\frac{b_2}{b_1}$ is high. This assumption captures the notion that very able people, people with good entrepreneurial skills, will become very rich (b_2) and form the upper-level class. People with not so good entrepreneurial skills (b_1) will remain as workers or they drop to the bottom of the society as unemployed. The possibility of becoming quite rich or quite poor during transition is also connected with the huge structural changes in the economy. Since the pre-transition structure of the economy was artificially created by centrally planning government in the conditions of isolation from the world markets, the structure of the

economy changes during the transition in ways which are difficult to predict. I assume that the people with good entrepreneurial skill are also good in finding which sectors will be profitable and viable in the future.

Once the first stages of the transition are over and the economy stabilizes to the shape of a "normal" market economy, the differences between opportunity costs are not so big any more. The possibility to became quickly rich overnight is gone. Also the structure of economy became more transparent and stabilized so that everybody essentially knows which sectors are viable and which sectors are due to decline or already diminished in importance. This means that I assume that in the post-transition period the ratio $\frac{b_2}{b_1}$ is lower than it was during transition.

I assume that dividing line between high relative differences in opportunity cost in transition period and low relative differences in post-transition is given by the ratio $\frac{\delta_2}{\delta_1}$. This means that I assume that in post-transition period the relative difference in opportunity cost for good and not so good entrepreneurs are not higher than their relative chances for success in agriculture.

5. Credit Market without Intervention

The lender under asymmetric information does not know ex ante the risk class of a borrower. The maximization problem of a lender in the absence of a government support is given by:

$$\max_{\left(\substack{\pi_1,R_1,C_1\\ \pi_2,R_2,C_2}\right)} M = \theta U_{11} + (1-\theta) U_{22}$$

$$= \theta\pi_1[\delta_1(y-R_1) - (1-\delta_1)C_1 - b_1] + (1-\theta)\pi_2[\delta_2(y-R_2) - (1-\delta_2)C_2 - b_2]$$

s.t.

$$\pi_1[\delta_1(y-R_1) - (1-\delta_1)C_1 - b_1] \geq \pi_2[\delta_1(y-R_2) - (1-\delta_1)C_2 - b_1], \quad (IC1)$$

$$\pi_2[\delta_2(y-R_2) - (1-\delta_2)C_2 - b_2] \geq \pi_1[\delta_2(y-R_1) - (1-\delta_2)C_1 - b_2], \quad (IC2)$$

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

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

$$0 \leq C_i \leq W,$$

$$\delta_i R_i + (1-\delta_i)\beta C_i - \rho = 0, \quad i \in \{1, 2\} \quad (4)$$

Equation (4) 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.

The solution to this problem consists of 4 possible cases, which I label as cases A – D. The equilibrium contract for a high risk borrower in cases A, B, C is identical with the high risk borrower's contract under full information. That is:

$$C_1^* = 0, \ \pi_1^* = 1, \ R_1^* = \frac{\rho}{\delta_1}$$

Case A:

This is the case of a transition economy defined by $\frac{b_2}{b_1} \geq \frac{\delta_2}{\delta_1}$. An equilibrium contract of a low risk borrower is given by:

$$C_2^* = 0$$
$$\pi_2^* = \frac{\delta_1 y - \rho - b_1}{\delta_1 y - \frac{\delta_1}{\delta_2}\rho - b_1} < 1$$
$$R_2^* = \frac{\rho}{\delta_2}$$

The equilibrium value of $\pi_2^* < 1$ means that there is always credit rationing in the case of a competitive credit market under an asymmetric information in the transition economy.

Case B:

This is the case of a stabilized economy defined by $\frac{b_2}{b_1} < \frac{\delta_2}{\delta_1}$ with an additional provision that the collateral is unconstrained. The low risk borrower's contract is, in this case, given by:

$$C_2^* = \frac{\rho(\delta_2 - \delta_1)}{(1-\delta_1)\delta_2 - \delta_1(1-\delta_2)\beta} > 0$$
$$\pi_2^* = 1$$
$$R_2^* = \frac{\rho}{\delta_2} - \frac{(1-\delta_2)\beta C_2^*}{\delta_2} = \frac{\rho[(1-\delta_1)+\beta(\delta_2-1)]}{(1-\delta_1)\delta_2 - \delta_1(1-\delta_2)\beta} > 0$$

Case C:

This is the case of a stabilized economy defined by $\frac{b_2}{b_1} < \frac{\delta_2}{\delta_1}$ with an additional provision that the collateral is constrained by the level of wealth which is of the intermediate level so that

$$W < \frac{\rho(\delta_2 - \delta_1)}{(1-\delta_1)\delta_2 - \delta_1(1-\delta_2)\beta} \tag{5}$$

$$W \geq \frac{\delta_2\left[\left(\delta_2 y - \frac{\delta_2}{\delta_1}\rho - b_2\right)\left(\delta_1 y - \frac{\delta_1}{\delta_2}\rho - b_1\right) - (\delta_1 y - \rho - b_1)(\delta_2 y - \rho - b_2)\right]}{\left(\delta_2 y - \frac{\delta_2}{\delta_1}\rho - b_2\right)[\delta_2(1-\delta_1) - \delta_1(1-\delta_2)\beta] - \delta_2(1-\delta_2)(1-\beta)(\delta_1 y - \rho - b_1)} \tag{6}$$

The low risk borrower's contract is in this case given by:

$$C_2^* = W$$

$$\pi_2^* = \frac{\delta_1 y - \delta_1 R_1^* - b_1}{\delta_1 y - \delta_1 R_2^* - b_1 - (1-\delta_1)W}$$

$$= \frac{\delta_1 y - \rho - b_1}{\delta_1 y - \frac{\delta_1}{\delta_2}\rho - b_1 - \frac{[\delta_2(1-\delta_1) - \delta_1(1-\delta_2)\beta]W}{\delta_2}} \in (0,1)$$

$$R_2^* = \frac{\rho - (1-\delta_2)\beta W}{\delta_2} > 0$$

Case D:

In the case of a stabilized economy with a very low level of wealth, which does not satisfy restriction (6), the credit market breaks down and no lending is realized, $\pi^*_1 = \pi^*_2 = 0$. Proof: see Janda (2002).

The credit market equilibria under asymmetric information presented in this subsection exhibit always some inefficiencies. In the case of transition it is credit rationing of low risk borrowers. In the case of stabilized economy three possible outcomes exist, depending on the level of collateralizable wealth *W* available. All of these three outcomes contain some inefficiencies.

The most inefficient case is when the collateralizable wealth is so low, that the credit market breaks down and no lending is realized, despite the model's assumption that each project is socially efficient. Under the unlimited collateral available, the project is always realized, but the use of collateral implies social inefficiency, since the lender values collateral less than borrower. With the intermediate level of collateral, the inefficiency caused by the use of collateral is complemented by the inefficiency caused by the credit rationing of low risk borrower.

The analysis of government guarantees aimed at alleviating these inefficiencies is the subject of the next section of this paper.

6. Government Guarantees

The maximization problem for lenders is the same as in the case without an intervention. The only change is in the zero profit condition for lenders where equation (4) is replaced by

$$\delta_i R_i + (1 - \delta_i)\alpha_i R_i - \rho = 0 \tag{7}$$

Collateral is passed to the government. The government guarantees the payment of fraction α_i of the contracted loan repayment in the case of 0 return from the project.

The solution to the maximization problem is given according to the following three cases.

In all cases I have:

$$C_1^* = 0,\ \pi_1^* = 1,\ R_i^* = \frac{\rho}{\delta_i + (1-\delta_i)\alpha_i} \tag{8}$$

In a transition economy, I have $\frac{b_2}{b_1} \geq \frac{\delta_2}{\delta_1}$, which leads to:

$$C_2^* = 0 \tag{9}$$

$$\pi_2^* = \frac{\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_1 + (1-\delta_1)\alpha_1}}{\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2}} \tag{10}$$

In a stabilized economy I have two cases depending on the size of collateralizable wealth and the size of collateral required with proportional guarantees:

If $\frac{b_2}{b_1} < \frac{\delta_2}{\delta_1}$ and collateral is unconstrained, then:

$$C_2^* = \frac{\delta_1 \rho}{1-\delta_1}\left[\frac{1}{\delta_1 + (1-\delta_1)\alpha_1} - \frac{1}{\delta_2 + (1-\delta_2)\alpha_2}\right]$$

$$= \frac{\delta_1 \rho[(\delta_2 - \delta_1) + (1-\delta_2)\alpha_2 - (1-\delta_1)\alpha_1]}{(1-\delta_1)[\delta_1 + (1-\delta_1)\alpha_1][\delta_2 + (1-\delta_2)\alpha_2]} \tag{11}$$

$$\pi^*_2 = 1 \tag{12}$$

If $\frac{b_2}{b_1} < \frac{\delta_2}{\delta_1}$, collateral is constrained, and collateralizable wealth W is such that (IC2) is satisfied, then:

$$C_2^* = W \tag{13}$$

$$\pi_2^* = \frac{\delta_1 y - \dfrac{\delta_1 \rho}{\delta_1 + (1-\delta_1)\alpha_1} - b_1}{\delta_1 y - \dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2} - b_1 - (1-\delta_1)W} \tag{14}$$

Proof: It is done according to the lines of the case without intervention.

Welfare Properties: the utility of a high risk borrower under proportional guarantees is given by

$$U_{11} = \delta_1 y - \frac{\delta_1 \rho}{\delta_1 + (1-\delta_1)\alpha_1} - b_1$$

The utilities of a low risk borrower under the proportional guarantees are as follows:

a) Transition economy:

$$U_{22} = \frac{\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_1 + (1-\delta_1)\alpha_1}}{\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2}}\left[\delta_2 y - b_2 - \frac{\delta_2 \rho}{\delta_2 + (1-\delta_2)\alpha_2}\right]$$

b) Stabilized economy with an unconstrained collateral:

$$U_{22} = \delta_2 y - b_2 - \rho\frac{\delta_2(1-\delta_1)[\delta_1 + (1-\delta_1)\alpha_1] + (1-\delta_2)\delta_1[\delta_2 - \delta_1 + (1-\delta_2)\alpha_2 - (1-\delta_1)\alpha_1]}{(1-\delta_2)[\delta_1 + (1-\delta_1)\alpha_1][\delta_2 + (1-\delta_2)\alpha_2]}$$

$$= \delta_2 y - b_2 - \rho\frac{[\delta_1 + (1-\delta_1)\alpha_1](\delta_2 - \delta_1) + (1-\delta_2)\delta_1[\delta_2 + (1-\delta_2)\alpha_2]}{(1-\delta_1)[\delta_1 + (1-\delta_1)\alpha_1][\delta_2 + (1-\delta_2)\alpha_2]}$$

c) Stabilized economy with a constrained collateral and wealth W such that (IC2) is satisfied:

$$U_{22} = \frac{\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_1 + (1-\delta_1)\alpha_1}}{\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2} - (1-\delta_1)W}$$

$$\left[\delta_2 y - b_2 - \frac{\delta_2 \rho}{\delta_2 + (1-\delta_2)\alpha_2} - (1-\delta_2)W\right]$$

I look at the impact of proportional guarantees on the social inefficiencies according to the three cases outlined above.

The proportional guarantees provided to a low risk borrower increase the required collateral in the case of a stabilized economy with non-binding collateral restrictions or decrease the probability of granting credit in the cases of a transition economy or a stabilized economy with a binding collateral restriction. That means that proportional guarantees targeted to a low risk borrower decrease efficiency.

In all three cases the increase in proportional guarantees provided to a high risk borrower, keeping proportional guarantees to a low risk borrower constant, increases efficiency.

If the proportional guarantees are non-targeted and provided to everybody on the same level, then a welfare improving effect of guarantees to high risk borrowers prevails and the overall result is an increase in efficiency.

In the following part of this section I show these results formally according to all three cases outlined above.

If the economy is in "transition" regime $\left(\dfrac{b_2}{b_1} \geq \dfrac{\delta_2}{\delta_1}\right)$, then:

$$\left.\frac{\partial \pi_2^*}{\partial \alpha_1}\right|_{(\alpha_2=\text{const.})} = \frac{1}{\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2}} \frac{\delta_1 \rho (1-\delta_1)}{[\delta_1 + (1-\delta_1)\alpha_1]^2} > 0$$

Proof: The denominator $\left[\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2}\right]$ is positive since $\dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2} <$

$< \rho \Leftrightarrow \alpha_2 > \dfrac{\delta_1 - \delta_2}{1-\delta_2} < 0$

Q.E.D.

Proportional guarantees targeted towards a high risk borrower decrease the credit rationing of a low risk borrower.

$$\left.\frac{\partial \pi_2^*}{\partial \alpha_2}\right|_{(\alpha_1=\text{const.})} = \left[\delta_1 y - b_1 - \frac{\delta_1 \rho}{\delta_1 + (1-\delta_1)\alpha_1}\right] \frac{\dfrac{-\delta_1 \rho (1-\delta_2)}{[\delta_2 + (1-\delta_2)\alpha_2]^2}}{\left[\delta_1 y - b_1 - \dfrac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2}\right]^2} < 0$$

Proof: The first term in square brackets $\left[\delta_1 y - b_1 - \frac{\delta_1\rho}{\delta_1 + (1-\delta_1)\alpha_1}\right]$ is positive since $\frac{\delta_1\rho}{\delta_1 + (1-\delta_1)\alpha_1} < \rho \Leftrightarrow \alpha_1 > 0$.

Q.E.D.

Proportional guarantees to a low risk borrower increase the credit rationing of a low risk borrower. It means that targeting proportional guarantees towards low risk borrowers would not be advisable if the goal of the government intervention is an improvement of the social efficiency of the credit market equilibrium.

$$\left.\frac{\partial \pi_2^*}{\partial \alpha}\right|_{(\alpha=\alpha_1=\alpha_2)} = \frac{\frac{\delta_1\rho(1-\delta_1)}{[\delta_1 + (1-\delta_1)\alpha]^2}\left[\delta_1 y - b_1 - \frac{\delta_1\rho}{\delta_2 + (1-\delta_2)\alpha}\right]}{\left[\delta_1 y - b_1 - \frac{\delta_1\rho}{\delta_2 + (1-\delta_2)\alpha}\right]^2} - \frac{\left[\delta_1 y - b_1 - \frac{\delta_1\rho}{\delta_1 + (1-\delta_1)\alpha}\right]\frac{\delta_1\rho(1-\delta_2)}{[\delta_2 + (1-\delta_2)\alpha]^2}}{\left[\delta_1 y - b_1 - \frac{\delta_1\rho}{\delta_2 + (1-\delta_2)\alpha}\right]^2} > 0$$

Proof: Since $\frac{\delta_1\rho(1-\delta_1)}{[\delta_1 + (1-\delta_1)\alpha]^2} > \frac{\delta_1\rho(1-\delta_2)}{[\delta_2 + (1-\delta_2)\alpha]^2}$ and $\delta_1 y - b_1 - \frac{\delta_1\rho}{\delta_2 + (1-\delta_2)\alpha} > \delta_1 y - b_1 - \frac{\delta_1\rho}{\delta_1 + (1-\delta_1)\alpha}$, the numerator of $\frac{\partial \pi_2^*}{\partial \alpha}$ is positive.

Q.E.D.

Uniform untargeted proportional guarantees decrease the credit rationing of low risk borrower.

If the economy is in "stabilized" regime $\left(\frac{b_2}{b_1} < \frac{\delta_2}{\delta_1}\right)$ and collateral is unconstrained, then:

$$\left.\frac{\partial C_2^*}{\partial \alpha_1}\right|_{(\alpha_2=\text{const.})} = -\frac{\delta_1\rho}{[\delta_1 + (1-\delta_1)\alpha_1]^2} < 0$$

Proportional guarantees to a high risk borrower decrease the volume of collateral required from the low risk borrower.

$$\left.\frac{\partial C_2^*}{\partial \alpha_2}\right|_{(\alpha_1=\text{const.})} = \frac{\delta_1\rho(1-\delta_2)}{(1-\delta_1)[\delta_2 + (1-\delta_2)\alpha_2]^2} > 0$$

Proportional guarantees targeted to a low risk borrower increase the volume of collateral he has to provide.

$$\left.\frac{\partial C_2^*}{\partial \alpha_2}\right|_{(\alpha=\alpha_1=\alpha_2)} = \frac{\delta_1\rho}{(1-\delta_1)}\left\{-\frac{1-\delta_1}{[\delta_1 + (1-\delta_1)\alpha]^2} + \frac{1-\delta_2}{[\delta_2 + (1-\delta_2)\alpha]^2}\right\} < 0$$

Untargeted proportional guarantees decrease the volume of collateral provided by a low risk borrower.

If the economy is in "stabilized" regime $\left(\frac{b_2}{b_1} < \frac{\delta_2}{\delta_1}\right)$, collateral is constrained, and W is such that (IC2) is satisfied, then:

$$\left.\frac{\partial \pi_2^*}{\partial \alpha_1}\right|_{(\alpha_2=\text{const.})} = \frac{1}{\left[\delta_1 y - \frac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2} - b_1 - (1-\delta_1)W\right]} \frac{\delta_1 + (1-\delta_1)\rho}{[\delta_1 + (1-\delta_1)\alpha_1]^2} > 0$$

Proportional guarantees targeted to a high risk borrower increase the probability that a low risk borrower will be provided credit and in this way increase the social efficiency of the resulting equilibrium.

$$\left.\frac{\partial \pi_2^*}{\partial \alpha_2}\right|_{(\alpha_1=\text{const.})} = \left[\delta_1 y - \frac{\delta_1 \rho}{\delta_1 + (1-\delta_1)\alpha_1} - b_1\right] \frac{-\frac{\delta_1 \rho (1-\delta_2)}{[\delta_2 + (1-\delta_2)\alpha_2]^2}}{\left[\delta_1 y - \frac{\delta_1 \rho}{\delta_2 + (1-\delta_2)\alpha_2} - b_1 - (1-\delta_1)W\right]^2} < 0$$

Proportional guarantees provided to a low risk borrower increase the credit rationing of a low risk borrower.

$$\left.\frac{\partial \pi_2^*}{\partial \alpha}\right|_{(\alpha=\alpha_1=\alpha_2)} = \frac{\frac{\delta_1 \rho (1-\delta_1)}{[\delta_1 + (1-\delta_1)\alpha]^2}[\text{denom.}] - [\text{numer.}]\frac{\delta_1 \rho (1-\delta_2)}{[\delta_2 + (1-\delta_2)\alpha]^2}}{[\text{denom.}]^2} > 0$$

Proof: The terms [denom.] and [numer.] refer to a denominator and a numerator of formula (14) for a probability π_2^*. Because a probability has to be smaller or equal to one, the denominator of (14) cannot be smaller than the numerator of (14). Since in addition $\frac{\delta_1 \rho (1-\delta_1)}{[\delta_1 + (1-\delta_1)\alpha]^2} > \frac{\delta_1 \rho (1-\delta_2)}{[\delta_2 + (1-\delta_2)\alpha]^2}$, I know, that $\left.\frac{\partial \pi_2^*}{\partial \alpha}\right|_{(\alpha=\alpha_1=\alpha_2)} > 0$.

Q.E.D.

Untargeted guarantees increase the social efficiency since the credit rationing of low risk borrower is diminished.

7. Conclusion

In this paper I have analyzed the inefficiencies connected with credit provision in a model based on an asymmetric information. Under first-best full information case all the projects would be realized and no collateral would be used. This means that there are two sources of welfare loss in the asymmetric information case. They are the credit rationing and dead weight loss of collateralization. This means that there is a scope for inefficiencies in the credit markets operating under a Bertrand competition in my model. These inefficiencies can be alleviated by government interventions which decrease (or eliminate) credit rationing and level of collateralization. Under Bertrand competition, it is possible to fine tune the size of government interventions according to a desired level of improvement in efficiency.

Depending on the relationship between the probabilities of a success in a given area of the economy and the opportunity costs of staying in this area, I distinguish

two market regimes: a transition economy and a post-transition stabilized economy. In the context of a competitive credit market, the principal difference between a stabilized economy and a transition economy is the use of different instruments to sort borrowers into risk classes under the conditions of informational asymmetry between a lender and a borrower.

In the post-transition stabilized economy this sorting is realized primarily through a collateral requirement, and a credit rationing is used only if the required collateral would be higher than an available wealth of a borrower. On the contrary, in the transition economy the credit rationing is preferred to collateralization as a sorting instrument. This means that a transition economy is in equilibrium characterized by the credit rationing no matter what is the level of collateralizable wealth.

There are two kinds of inefficiency which call for government intervention in the competitive credit market in my model. In a transition economy, it is credit rationing. In a stabilized economy, it is the use of collateral which is accompanied by a credit rationing if the collateralizable wealth of a borrower is lower than collateral required to provide credit to all applicants. In the case of a post-transition stabilized economy, this collateralizable wealth could be so low that the credit market breaks down and nobody is given a loan.

The borrower who is under informational asymmetry in all cases either rationed or required to provide collateral is a low risk borrower. A high risk borrower in all cases (with an exception of the case in which the credit market breaks down and nobody gets any loans) gets his perfect information credit contract. This is a standard feature of models of a credit market under an adverse selection. Different conclusion is obtained in the model of a credit market with a moral hazard, where Chan and Kanatas (1985) show that if collateral is used as an incentive for the borrower not to default, then the lower-quality borrowers will be required to provide collateral.

The general feature of government interventions under the conditions of adverse selection is that separate interventions targeted at low risk borrowers only increase inefficiency. The interventions targeted at high risk borrowers improve efficiency. The uniform interventions given to both types without distinction improve efficiency.

In the case of a post-transition stabilized economy, I analyze proportional guarantees both with and without sufficient collateralizable wealth. But it would be possible to eliminate the occurrence of the case of interventions under insufficient collateralizable wealth since the high enough intervention will lead to so low collateral requirement that the wealth constraint will not be binding.

From the point of view of practical implementation and political feasibility, the use of uniform interventions for all types of borrowers is empirically preferred in Czech agricultural interventions programmes. My model shows that under nontargeted guarantees the positive efficiency effect of support given to high risk borrowers outweighs the negative efficiency effect of support given to low risk borrowers.The net effect is then an enhancement of efficiency. The results of my paper show that there could be a theoretic rationale for the types of interventions used by the Czech Agricultural Guarantee Fund, which is my example of applications of government interventions in credit markets under asymmetric information.

This paper doesn't deal with political economy considerations of credit support policies. Obviously these considerations are of prime importance especially in the determination of government interventions into rural and agricultural credit markets and they could be addressed in the future extensions of this paper.

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