Institute of Economic Studies, Faculty of Social Sciences
Charles University in Prague

Credit Guarantees and Subsidies when Lender has a Market Power

Karel Janda

IES Working Paper: 18/2011

Institute of Economic Studies,
Faculty of Social Sciences,
Charles University in Prague

[UK FSV – IES]

Opletalova 26
CZ-110 00, Prague
E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

Institut ekonomických studií
Fakulta sociálních věd
Univerzita Karlova v Praze

Opletalova 26
110 00 Praha 1

E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

Bibliographic information:
Janda, K. (2011). "Credit Guarantees and Subsidies when Lender has a Market Power" IES Working Paper 18/2011. IES FSV. Charles University.

This paper can be downloaded at: http://ies.fsv.cuni.cz

Credit Guarantees and Subsidies when Lender has a Market Power

Karel Janda#

IES, Charles University Prague,
Faculty of Finance and Accounting, University of Economics, and
Affiliated Fellow at CERGE-EI
E-mail: Karel-Janda@seznam.cz

June 2011

Abstract:
Provision of credit guarantees or subsidies may remove an adverse selection leading to credit rationing. This paper concentrates on comparison of government budget costs of credit guarantees and subsidies in a monopolistic credit market. Different opportunity costs among entrepreneurs, which reflect different mixes of general and human specific capital, generate different outcomes in the model. As long as the participation costs of low-risk entrepreneurs are sufficiently close to the participation costs of high-risk entrepreneurs, the budget-cost minimizing government should prefer guarantees over interest rate subsidies as an intervention instrument.

Keywords: credit; subsidies; guarantees.

JEL: D82, G18, H25.

Acknowledgements:
The work on this paper was supported by the Czech Science Foundation, grant numbers 402/11/0948, 403/10/1235, 402/09/0380, and by the research project MSM0021620841.

1 *Introduction*

Credit markets serve as a classical example of markets in which information asymmetry plays a significant role. Market failures generated by asymmetric information, especially credit rationing (Stiglitz and Weiss [1981]), open a place for government policy interventions such as credit guarantees (Beck, Klapper, and Mendoza [2010]) or interest rate subsidies (Diamond [1997]). The need for these policy interventions is particularly pressing in times of financial and economic crisis, when many legal restrictions on state aid are lifted as documented in the sections "Aid in the Form of Guarantees" and "Aid in the Form of Subsidized Interest Rate" in the European Commission [2009] communication.

In this paper we show that adverse selection in a credit market with the market power of a lender may lead to inefficient credit rationing. We first characterize this market equilibrium and then we investigate two types of government interventions (credit guarantees and interest rate subsidies) that enable the financing of all socially efficient projects. Finally we compare the government budget costs of both of these interventions, and we conclude that in some situations credit guarantees are cheaper for government. In other situations it is less expensive to remove inefficient credit rationing through interest rate subsidies. This result provides theoretical support to the empirically observed fact that governments sometimes prefer subsidies, and sometimes guarantees.

The research presented in this paper is a part of a long term research project dealing with optimal credit contracting and adverse selection in credit markets Janda [2000, 2002, 2003, 2004, 2005b,a, 2006d,a,c, 2007, 2008b, 2009].

The problem of government interventions in credit markets under adverse selection has already been addressed in early theoretical models by Mankiw [1986], DeMeza and Webb [1987], Smith and Stutzer [1989], Gale [1990], and Innes [1991]. All of these papers deal with Bertrand competition on perfectly competitive markets as opposed to our assumption of lender's market power. They also did not investigate the government budget costs of the interventions they considered. The role of subsidies and guarantees considered in our model may be compared to the price subsidies which are used in monopoly regulation theory to induce the monopolist to produce a socially optimal quantity.

As opposed to our assumption of a fixed-size project, DeMeza and Webb [1987] and Innes [1991] focus their attention on the efficiency of public interventions connected with the variable size of investment projects. A comparative analysis of different forms of public support of credit provision was recently provided by Arping, Loranth, and Morrison [2010]. As opposed to our comparison of credit guarantees and subsidies, Arping et al. [2010] compare credit guarantees with co-funding of investment projects by credit support agencies. In a different setting from the one we consider they find that government support funds should be channeled first to credit guarantee schemes and co-funding should be supported only when the entrepreneurs start to substitute public for private collateral.

The setting of our model is closest to Minelli and Modica [2006], who, in their model regarding lenders' market power, show that interest rate subsidies and loan guarantees are optimal credit policies from a government budget point of view. They are cheaper than investment subsidies or collateral provision. As opposed to our characterization of the risk through first order stochastic dominance, Minelli and Modica [2006] use a second-order-stochastic-dominance approach.

All of these papers, with the exception of Smith and Stutzer [1989], assume a uniform participation cost for all types of investment projects. In our model we follow the Becker [1964] distinction of general and specific human capital. We assume that different general human capital leads to differences in opportunity costs among different types of entrepreneurs, while specific human capital determines the success probability of investment projects under consideration. Consequently, different mixes of general and specific human capital generate different outcomes in our model.

Out of the empirical literature dealing with government interventions in credit markets, the papers by JANDA [2006b] and UESUGI [2008] are particularly relevant to our model. The Czech Supporting and Guarantee Agricultural and Forestry Fund investigated by JANDA [2006b] and the Japanese Special Credit Guarantee Program for Financial Stability analyzed by UESUGI [2008] both provide their support to eligible small or medium-sized enterprises essentially automatically, in the same way that our model works. In addition, interest rate subsidies and guarantees are provided by the Czech Supporting and Guarantee Agricultural and Forestry Fund without any fee or premium paid by the borrower or lender. They are pure transfer payments from a government agency exactly as they are implemented in our model.

The role of credit guarantees was recently investigated in empirically oriented papers by COWLING [2010], COLUMBA, GAMBACORTA, AND MISTRULLI [2010], and HONOHAN [2010]. COWLING [2010] shows that the loan guarantee scheme initiated by the UK government in 1981 succeeded in alleviating binding credit constraints. COLUMBA ET AL. [2010] consider the situation of information asymmetry between firms and banks similarly as we do in this paper. On a sample of Italian Mutual Guarantee Institutions they show that credit constraints caused by information asymmetry may be alleviated through these institutions which allow for credible signaling of creditworthiness of their members without a need for government involvement. HONOHAN [2010] presents in his survey of principles and practices of partial credit guarantees a list of difficulties associated with the practical evaluation of actual fiscal cost of credit guarantees. He also emphasizes that the attraction of credit guarantees for public policy can be misleading. He argues that the most attractive feature of credit guarantees for myopic politicians may be the ease with which the true costs of guarantees can be understated at the outset of the credit guarantee program.

2 The Baseline Model

We model the provision of credit in a principal-agent model of adverse selection. The setting of our model follows the classic papers by CHAN AND KANATAS [1985], BESTER [1985], BESANKO AND THAKOR [1987], and GALE [1990].

There are three classes of economic agents in our model. These are government, lenders, and borrowers. The government is modeled as a benevolent body whose only concern is an increase in social efficiency and whose only role is to distribute exogenously determined guarantees and subsidies. The role of lenders is to provide financial funds which are needed by borrowers in order to realize their projects. Risk-neutral lenders are effectively colluded and act as a single principal with a market power. The supply of funds facing lenders is perfectly elastic so that the lenders have any demanded amount of funds under the unit cost of ρ available.

There are two types of risk neutral borrowers in this model, indexed as Type 1 and Type 2. These two types are distinguished by different specific human capital which determines their chances of successfully finishing their project, denoted as $0 < \delta_1 < \delta_2 < 1$, and by different general human capital which determines their reservation utilities from not participating in the project, denoted as b_1 and 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 a random borrower facing a lender is a Type 1 borrower is θ, which is the proportion of Type 1 borrowers in the total population of borrowers.

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

$$\delta_i y > b_i + \rho. \tag{1}$$

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.

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

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 a pair (π_i, R_i), $i \in \{1, 2\}$ where the first term is the probability that the application of the borrower who chooses this contract will be satisfied and he will actually be loaned money and the second term is the interest factor (1 + interest rate), which is equal to the required repayment because of our normalization of the loan size to 1. The solution of our model will show that in equilibrium applicants are rejected or accepted with a probability of 1.

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

$$U_{ij} = \pi_j[\delta_i(y - R_j) - b_i]. \tag{2}$$

The lender's expected profit on one loan provided to a borrower of Type i is given as:

$$B_i = \pi_i[\delta_i R_i - \rho]. \tag{3}$$

We assume that in the case that a lender is indifferent between lending and not lending, he resolves this tie in favor of lending. Similarly, the borrower who is indifferent to accepting credit contract and abandoning his project will decide to take the contract.

3 Economy without Government Intervention

As a benchmark against which inefficiencies caused by information asymmetries can be evaluated, we first consider the symmetric information case. Under this scenario the lender has exactly the same information as borrowers and he is able to separate borrowers perfectly into two different markets. The optimal contract for the lender with market power is the one in which he maximizes his expected profit subject to individual rationality (participation) constraint for entrepreneurs who want to borrow money:

$$\max_{(\pi_i, R_i)} B = \pi_i[\delta_i R_i - \rho]$$

s.t.

$$\pi_i[\delta_i(y - R_i) - b_i] \geq 0, \quad \text{(IRi)}$$

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

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

The solution to this inequality constrained problem is given by:

$$\begin{aligned} R_i^* &= y - \frac{b_i}{\delta_i}, \\ \pi_i^* &= 1, \\ i &\in \{1, 2\}. \end{aligned} \tag{4}$$

As long as the lender has the same information as the borrower, he is able to extract the entire surplus. This means that the individual rationality constraints (IRi) of a borrower i is binding. There is no inefficiency in this case since the project is financed and undertaken if and only if the expected return of a project ($\delta_i y$) is equal or bigger than the social cost ($b_i + \rho$). Therefore under our Assumption 1 of the positive net present value the project would be financed by the lender who is able to costlessly distinguish between good and bad entrepreneurs. The financing decision of the lender is the efficient one and consequently there is no efficiency reason for government intervention in this case.

In the rest of this paper we will investigate the cases when the introduction of information asymmetry between borrower and lender may lead to the rejection of the project. When such a rejection happens we will suggest possible government interventions which would enable the financing of socially efficient projects which would not be undertaken otherwise because of information asymmetry.

Under asymmetric information, the lender does not know ex ante the type of entrepreneur who asks for a loan. There is a possibility that the entrepreneur will misrepresent his type. Consequently, the lender in his maximization problem has to take into account the borrower's incentive compatibility constraints, which we denote (IC1) and (IC2) in the following formalization of the lender's maximization problem:

PROBLEM 1

$$\begin{aligned}\max_{(\pi_1,R_1,\pi_2,R_2)} B &= \theta B_{11} + (1-\theta)B_{22} \\ &= \theta\pi_1[\delta_1 R_1 - \rho] + (1-\theta)\pi_2[\delta_2 R_2 - \rho]\end{aligned}$$

s.t.

$$\begin{aligned}\pi_i[\delta_i(y-R_i)-b_i] &\geq 0, && \textit{(IRi)} \\ \pi_1[\delta_1(y-R_1)-b_1] &\geq \pi_2[\delta_1(y-R_2)-b_1], && \textit{(IC1)} \\ \pi_2[\delta_2(y-R_2)-b_2] &\geq \pi_1[\delta_2(y-R_1)-b_2], && \textit{(IC2)}\end{aligned}$$

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

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

The optimal contract for the lender under symmetric information shows that the ratio b_i/δ_i of opportunity cost b_i and success probability δ_i determines according to Equation 4 the required repayment for a Type i borrower. This ratio will also be important to the solution of Problem 1. As we already mentioned in the Introduction, we assume that the success probability δ_i reflects specific human capital of the entrepreneur (skills and knowledge useful primarily for the particular project), while his opportunity cost b_i are given by his general human capital (skills and knowledge useful for any activities). According to this interpretation the lower the b_i/δ_i ratio, the higher the incentive for the entrepreneur i to undertake the investment project under consideration as opposed to becoming engaged somewhere else with an outside opportunity b_i.

It is natural that in some industries the level of specific human capital needed for achieving success is more important than in other industries. For example NIELSEN [2002] in his empirical study of 15 500 Danish start-up enterprises found that specific human capital in wholesale, retail trade, hotels and restaurants, and in business services is less important for success (survival) than in other industries. In the context of our model with two types of entrepreneurs, we will use a ratio of the general human capitals of these two types (b_2/b_1) as a fixed reference point. Based on this reference point we will identify an industry in which success is highly sensitive to differences in specific human capital as a one in which ($\delta_2/\delta_1 > b_2/b_1$). In the following discussion we will denote this situation with a high heterogeneity of success probabilities ($\delta_2/\delta_1 > b_2/b_1$) as a high project-diversity case. The opposite situation when the chances of success are relative close ($\delta_2/\delta_1 \leq b_2/b_1$) will be referred to as low project-diversity scenario.

The empirical identification of industries with high or low heterogeneity of specific human capital as compared to general human capital is obviously a dynamic and country-specific phenomenon. For example, increases in general wage inequality across time or countries leading to a higher ratio of returns to general human capital (b_2/b_1), will favor our low project-diversity scenario. This is a situation particularly characteristic for periods of significant structural and social changes (like the transition from centrally planned to market economy) when the outside opportunities are widely opened and small differences in talent or ability (captured in δ_2/δ_1 ratio) lead to relatively large differences in outside opportunity (characterized by b_2/b_1 ratio). The importance of diverse outside opportunities is particularly strong for entrepreneurs engaged in industries which experience large scale downsizing and outflow of labor. A prime example of such activity was agriculture in the times of industrialization or transition to market economy.

The distinction between high and low project-diversity cases is used in the following Proposition 1 which provides a solution to the Problem 1.

PROPOSITION 1 *In the high project-diversity case the contractual interest factors R_i and* *probabilities of obtaining credit* π_i, $i \in \{1,2\}$, *which solve the Problem 1 are:*

$$R_1^* = \begin{cases} y - \frac{b_1}{\delta_1} & \text{if } \pi_1^* \neq 0, \\ \text{any value} & \text{if } \pi_1^* = 0, \end{cases} \tag{5}$$

$$R_2^* = \begin{cases} y - \frac{b_1}{\delta_1} & \text{if } \pi_1^* = 1, \\ y - \frac{b_2}{\delta_2} & \text{if } \pi_1^* = 0, \end{cases} \tag{6}$$

$$\pi_1^* = \begin{cases} 1 & \text{if } \delta_1 y - b_1 - \rho \geq \frac{1-\theta}{\theta}\delta_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2}), \\ 0 & \text{otherwise}, \end{cases} \tag{7}$$

$$\pi_2^* = 1. \tag{8}$$

In the low project-diversity case the solution is:

$$R_1^* = \begin{cases} y - \frac{b_2}{\delta_2} & \text{if } \pi_2^* = 1, \\ y - \frac{b_1}{\delta_1} & \text{if } \pi_2^* = 0, \end{cases} \tag{9}$$

$$R_2^* = \begin{cases} y - \frac{b_2}{\delta_2} & \text{if } \pi_2^* \neq 0, \\ \text{any value} & \text{if } \pi_2^* = 0, \end{cases} \tag{10}$$

$$\pi_1^* = 1, \tag{11}$$

$$\pi_2^* = \begin{cases} 1 & \text{if } \delta_2 y - b_2 - \rho \geq \frac{\theta}{1-\theta}\delta_1(\frac{b_2}{\delta_2} - \frac{b_1}{\delta_1}), \\ 0 & \text{otherwise}. \end{cases} \tag{12}$$

PROOF See the Appendix.

Proposition 1 shows that the lender always makes a decision between asking for a lower repayment, which will be accepted by both types of borrower, or requiring higher repayment, which will be accepted only by one type of borrower. From the point of view of standard monopoly theory this is an usual trade-off faced by a monopolist who is not able to price discriminate. In our model the redlined borrower is always the one with a lower symmetric-information repayment (4). The borrower who is willing to pay the higher repayment and who always obtains the credit is the one with human capital structured more toward the specific human capital, i.e. the one with lower b_i/δ_i ratio.

The redlining of the borrower with a more favorable (from the point of view of the borrower) symmetric-information contract is qualitatively the same result as we would obtain in the perfectly competitive banking market. The intuitive logic behind this outcome is making the more favorable contract, which would be designed for one type of borrower, to be less attractive for the other type of borrower. In the competitive market this would be done by credit rationing (by decreasing the probability of granting the attractive contract). In our model with the market power of the lender, the lender is either willing to let one of the borrower types get a positive surplus or the lender completely redlines this borrower.

The pair of credit contracts including the explicit redlining of one type of borrower coupled with an arbitrary interest rate payment for the redlined borrower is, according to Proposition 1, equivalent to a single contract which simply states a uniform interest rate. When this uniform interest rate is $R^* = y - b_2/\delta_2$ for the high project-diversity case or $R^* = y - b_1/\delta_1$ for the low project-diversity case, only one type of borrower will accept the contract while the other type is deterred by the too-high interest rate and he rejects the contract.

4 Government Interventions

The credit rationing of high risk borrowers caused by the informational asymmetry between lender and borrower could be eliminated by government intervention. Government interventions analyzed in this paper operate through the increase of the lender's expected return so that the appropriate credit provision condition in Equation 7 or 11 is satisfied. We consider two different ways of increasing the lender's expected return: credit guarantees and interest rate subsidies. The government support in our model is provided to all applicants without any discrimination. This corresponds to real-life credit support schemes in which all entrepreneurs in particular line of business (for example in farming) are provided government support as long as a commercial bank is willing to credit a government-supported applicant.

Interest rate subsidy s is paid only in the case of the 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 repayment to a lender. The expected profit in Equation 3 is then modified as:

$$B_i = \pi_i[\delta_i(R_i + s) - \rho]. \tag{13}$$

Under the guarantee program the government guarantees the payment of an exogenously chosen amount g in the case of zero return from the project. In practice this guarantee amount is determined as a given percentage of the loan principal, which is equal to 1 under our normalization. The lender's expected profit in Equation 3 is modified as:

$$B_i = \pi_i[\delta_i R_i + (1 - \delta_i)g - \rho]. \tag{14}$$

The expected utility of a borrower, under both types of interventions, is still given by Equation 2 since the interventions influence the borrower's utility only indirectly through their impact on the lender's profit.

The main idea behind government interventions analyzed in this section is to decrease the critical level of the expected return required by a lender in order to provide loans to borrowers with a lower interest repayment in the case of symmetric information. The optimal level of government support equates this critical level with the symmetric information state so that all socially efficient projects are undertaken. This intervention mechanism is similar to price subsidies which are used in standard monopoly regulation theory to induce the monopolist to produce a socially optimal quantity of his product. In our model, guarantees and interest rate subsidies play the role of price subsidies that compensate the monopolist for lost profits on the volume of production he would otherwise be selling with higher prices.

In the following subsections we implement this general approach in the analysis of credit market equilibrium and the government budget impact of credit guarantees and interest rate subsidies.

4.1 Economy with High Diversity of Projects

4.1.1 Credit Guarantees

As long as the government guarantees the payment of an exogenously determined amount g in the case of zero return from a project, the maximization problem of the lender under this intervention is:

PROBLEM 2

$$\begin{aligned} \max_{(\pi_1,R_1,\pi_2,R_2)} B &= \theta B_{11} + (1-\theta)B_{22} \\ &= \theta\pi_1[\delta_1 R_1 + (1-\delta_1)g - \rho] + (1-\theta)\pi_2[\delta_2 R_2 + (1-\delta_2)g - \rho] \end{aligned} \tag{15}$$

subject to the same conditions as in the case without an intervention.

The solution to this problem is provided in the following proposition:

PROPOSITION 2 *The credit contract with credit guarantees that solves Problem 2 is:*

$$R_1^* = \begin{cases} y - \frac{b_1}{\delta_1} & \textit{if } \pi_1^* \neq 0, \\ \textit{any value} & \textit{if } \pi_1^* = 0, \end{cases} \tag{16}$$

$$R_2^* = \begin{cases} y - \frac{b_1}{\delta_1} & \textit{if } \pi_1^* = 1, \\ y - \frac{b_2}{\delta_2} & \textit{if } \pi_1^* = 0, \end{cases} \tag{17}$$

$$\pi_1^* = \begin{cases} 1 & \textit{if } \delta_1 y - b_1 - \rho \geq \frac{1-\theta}{\theta}(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2})\delta_2 - (1-\delta_1)g, \\ 0 & \textit{otherwise}, \end{cases} \tag{18}$$

$$\pi_2^* = 1. \tag{19}$$

PROOF See the Appendix.

For $g = 0$, we obtain the same result as in the case without intervention and Condition 18 will be identical to the corresponding Condition 7 in the case without government intervention. The term $(1 - \delta_1)g$ by which these two conditions differ when a positive guarantee is provided, expresses incremental expected payoff to the lender per each high-risk borrower to whom he would extend additional credit as a result of a government guarantee.

The effect of credit guarantees on the cut-off value of social surplus determining the redlining of a high-risk borrower is nonambiguous and it is immediately obvious. Taking the derivative of a right hand side of Condition 18 with respect to g, which is equal to $(\delta_1 - 1)$, we see that an increase in a guarantee increases the chance that a loan to a high-risk borrower will be granted for sure. Solving the inequality in Condition 18 as an equation provides the smallest value g for which loans to a high-risk borrower will be always granted with a probability of $\pi_1^* = 1$:

$$g = \frac{\frac{1-\theta}{\theta}\delta_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2}) - (\delta_1 y - b_1 - \rho)}{1 - \delta_1}. \tag{20}$$

The provision of a higher guarantee than the one in Equation 20 would just amount to a wealth transfer toward the lender without any impact on social efficiency. Any guarantee lower than Expression 20 would lead to an unjustified use of public money since such a low guarantee would not provide sufficient incentive for the lender to decrease the required interest rate payment to the symmetric information interest rate of a high-risk borrower $y - b_1/\delta_1$. With too low a guarantee the lender would keep charging high interest rate accessible only to low-risk borrowers; high-risk borrowers would be still redlined and the lender would increase his expected profit.

4.1.2 Interest Rate Subsidies

The provision of interest rate subsidies most directly addresses the basic mechanism leading to credit rationing. Credit rationing appears when the lender obtains a higher profit by charging a high interest rate, which drives part of the borrowers' population out of the market, rather than by charging lower interest rate acceptable to all borrowers. Since the interest rate subsidy directly increases the return to the lender on each loan provided without imposing any costs on the borrower, the lender is better off by accepting all credit applications than by rejecting some of them as long as the credit subsidy is sufficiently high. When a sufficiently high interest rate subsidy is available, the lender does not have any incentive to increase the interest rate (and loose some clients) because he receives the interest rate subsidy anyway and he keeps all of the clients.

The maximization problem of the lender under the interest rate subsidies is given by:

Problem 3

$$\begin{aligned} \max_{(\pi_1,R_1,\pi_2,R_2)} B &= \theta B_{11} + (1-\theta)B_{22} \\ &= \theta\pi_1[\delta_1(R_1+s)-\rho] + (1-\theta)\pi_2[\delta_2(R_2+s)-\rho] \end{aligned} \tag{21}$$

s.t. the same conditions as in the case without an intervention.

The subsidy is paid only in the case of the project's success, as opposed to guarantees which are paid in the case of failure. The subsidy is just an exogenous supplement to a repayment to a lender and it does not enter into the (IC) and (IR) constraints of a borrower.

Proposition 3 *The credit contract with interest rate subsidies which solves Problem 3* *is:*

$$R_1^* = \begin{cases} y - \frac{b_1}{\delta_1} & \text{if } \pi_1^* \neq 0, \\ \text{any value} & \text{if } \pi_1^* = 0, \end{cases} \tag{22}$$

$$R_2^* = \begin{cases} y - \frac{b_1}{\delta_1} & \text{if } \pi_1^* = 1, \\ y - \frac{b_2}{\delta_2} & \text{if } \pi_1^* = 0, \end{cases} \tag{23}$$

$$\pi_1^* = \begin{cases} 1 & \text{if } \delta_1 y - b_1 - \rho \geq \frac{1-\theta}{\theta}\delta_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2}) - \delta_1 s, \\ 0 & \text{otherwise}, \end{cases} \tag{24}$$

$$\pi_2^* = 1. \tag{25}$$

Proof See the Appendix.

In the same way as in the cases of guarantees, we obtain the same result as in the credit market without intervention if $s = 0$. Taking the derivative of the right hand side of Equation 24 with respect to s, which is equal to $(-\delta_1)$, we immediately see that an increase in interest payment subsidies increases the chance that a loan to a high-risk borrower will be granted for sure. Solving inequality in Expression 24 as an equation provides the smallest value s for which credit rationing of a high-risk borrower will be eliminated:

$$s = \frac{\frac{1-\theta}{\theta}\delta_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2}) - (\delta_1 y - b_1 - \rho)}{\delta_1}. \tag{26}$$

Similarly to the case of guarantees, the expected value $\theta\delta_1 s$ of the subsidies provided to all high-risk borrowers who would be redlined in the absence of government intervention is exactly equal to the wedge between informational rent for low-risk borrowers $(1-\theta)\delta_2(b_1/\delta_1 - b_2/\delta_2)$ and the social surplus $\theta(\delta_1 y - b_1 - \rho)$ associated with the redlined high-risk projects.

4.1.3 Government Budget Impact of Interventions

In order to compare the government budget impact of both types of interventions we consider such values G_s and G_g of subsidies s and guarantees g which make sure that a loan to a Type 1 borrower will be always granted for sure. From Equation 21 we get the expected budget cost of government subsidies:

$$G_s = \theta\delta_1 s + (1-\theta)\delta_2 s = s[\theta\delta_1 + (1-\theta)\delta_2]. \tag{27}$$

The expected budget cost G_s is computed as the optimal size of subsidy s weighted by a population-wide average probability of success.

From Equation 15 we get the expected budget cost of credit guarantees:

$$G_g = \theta(1-\delta_1)g + (1-\theta)(1-\delta_2)g = g\{1 - [\theta\delta_1 + (1-\theta)\delta_2]\}. \tag{28}$$

The expected budget cost G_g is given as the optimal size of guarantee g weighted by population-wide average probability of invoking the guarantee.

The comparison of the budget costs of subsidies and guarantees shows that:

$$G_s - G_g = \theta[\delta_1 s - (1-\delta_1)g] + (1-\theta)[\delta_2 s - (1-\delta_2)g]. \tag{29}$$

Substitution for g from Equation 20 and for s from Equation 26 shows that expression in the first square brackets on the right hand side of Equation 29 vanishes. Since $\delta_2 > \delta_1$ this also implies that the expression in the second square brackets on the right hand side of Equation 29 is positive. Therefore $G_s - G_g > 0$, which means that guarantees are a cheaper form of intervention than interest rate subsidies.

When we compare the expected budget cost of subsidies and guarantees, we have to keep in mind that the absolute size of the funding gap which has to be transferred to the lender in order to entice him to provide the credit under terms affordable for the high-risk borrower is the same in both cases. What is different are the ways in which this sum is transferred. The absolute value of monetary transfer required for making the loan to the (otherwise redlined) Type 1 borrower sufficiently attractive to lender is the same for subsidies and guarantees. The difference in government costs is therefore caused by the provision of government support to a Type 2 borrower who is observationally indistinguishable from a Type 1 borrower. This subsidy to Type 2 borrowers is provided in the case of success, therefore the expected value of this subsidy is bigger than the expected value of the subsidy provided to Type 1 borrowers. On the contrary, the expected value of the guarantee provided to Type 2 borrowers is lower than the expected value of the guarantee provided to Type 1 borrowers. Therefore the guarantee has to be cheaper for the government. This comparison between subsidies and guarantees is summarized in the following proposition.

PROPOSITION 4 *Assume that project-diversity is high in the sense of high differences in specific human capital of entrepreneurs. Then, from the point of view of government budget costs, the use of guarantees is a cheaper way to achieve the realization of all projects with a positive net present value than the use of subsidies.*

The major intuitive argument often used by policy makers in favor of guarantees is that guarantees lead to government budget expenses only in the case of project's failure while the subsidies have to be paid for all successful projects (see discussion of myopic politicians provided by HONOHAN [2010]). This argument implicitly assumes that probabilities of success δ_i are sufficiently high and therefore the guarantees have to be cheaper that subsidies. Our results presented in Proposition 4 show that in the case of high project-diversity guarantees are actually cheaper even in the case of low probabilities of success.

From the point of view of a lender, the ordering of the desirability of different forms of government interventions is exactly reversed since the lender prefers the highest possible transfers from the government.

4.2 Economy with Low Diversity of Projects

The structure of maximization problems facing the lender and the approach to their solution is the same as in the analysis of government interventions in the high project-diversity economy (as presented in Section 4.1) with modifications along the lines of the analysis of the low project-diversity economy (as presented in the proof of credit contract under asymmetric information).

The solution under both types of interventions considered in this paper is:

PROPOSITION 5

$$\begin{aligned} R_1^* &= \begin{cases} y - \frac{b_2}{\delta_2} & \textit{if } \pi_2^* = 1, \\ y - \frac{b_1}{\delta_1} & \textit{if } \pi_2^* = 0, \end{cases} \\ R_2^* &= \begin{cases} y - \frac{b_2}{\delta_2} & \textit{if } \pi_2^* \neq 0, \\ \textit{any value} & \textit{if } \pi_2^* = 0, \end{cases} \\ \pi_1^* &= 1, \\ \pi_2^* &= \begin{cases} 1 & \textit{if } \delta_2 y - b_2 - \rho \geq A, \\ 0 & \textit{otherwise.} \end{cases} \end{aligned}$$

Expression A in the solution for π_2^* takes the following form for the different intervention programs:

Credit guarantees:

$$A = \frac{\theta}{1-\theta}(\frac{b_2}{\delta_2} - \frac{b_1}{\delta_1})\delta_1 - (1-\delta_2)g.$$

Interest rate subsidies:

$$A = \frac{\theta}{1-\theta}(\frac{b_2}{\delta_2} - \frac{b_1}{\delta_1})\delta_1 - \delta_2 s.$$

PROOF It follows the approach used for the proofs in the case of high project-diversity.

Using the notation for government budget cost introduced in the section dealing with high project-diversity, we obtain

$$G_g - G_s = \theta[(1-\delta_1)g - \delta_1 s] + (1-\theta)[(1-\delta_2)g - \delta_2 s].$$

Because $(1 - \delta_2)g - \delta_2 s = 0$ and $\delta_2 > \delta_1$, we conclude that in a low project-diversity case the ordering of budget costs required to remove the redlining of low-risk borrowers is $G_g > G_s$. This result is presented in the following proposition.

Proposition 6 *Assume that project-diversity is low in the sense of low differences in the specific human capital of entrepreneurs. Then, from the point of view of government budget costs, the use of subsidies is a cheaper way to achieve the realization of all projects with a positive net present value than the use of guarantees.*

The comparison of Propositions 4 and 6 shows that the budget impact ranking of subsidies and guarantees is different for low and high project-diversity cases. This is caused by different types of entrepreneurs having a less specific structure of their human capital, which may lead to their redlining in each case. In the case of low project-diversity, the redlined borrower is the Type 2 entrepreneur, who is not willing to pay a high interest rate on loans because his high general human capital provides him with good outside alternative opportunities. The government support for otherwise redlined Type 2 entrepreneurs will entail the same expected cost both for guarantees and interest rate subsidies. This means that the cost difference will be caused by providing the guarantees or subsidies to Type 1 entrepreneurs. Since the value of subsidy per borrower has to be the same for all borrowers, the difference in expected costs of subsidies is driven by the probability of their provision. This probability is lower for the Type 1 borrower than for the Type 2 borrower. Therefore the expected cost of an interest rate subsidy for a Type 1 borrower will be lower than for a Type 2 borrower. A similar argument shows that on the contrary the expected cost of the guarantee will be higher for the Type 1 entrepreneur than for the Type 2 entrepreneur.

4.3 Economic Policy Considerations

Possible recommendations on the use of different forms of government support are usually based on the assumption that the government chooses the forms of support such that governmental monetary outlays are minimized. If we admit the possibility that the political influence of lenders is strong enough to ensure that government intervention programs are biased toward providing high transfers to banks, then the situation is reversed. Under this different political economy scenario we should expect credit guarantees to be prevalent in low project-diversity case and credit subsidies to be prevalent in a high project-diversity case.

Channeling the government funds through commercial lending instead of the direct provision of subsidies to firms is often considered to be a generally accepted practice. The firm owners may prefer to receive lump-sum payments in a form of direct government subsidies, but they realize that tying government support with commercial loans may actually bring more funds available for the firm. Additionally the entrepreneurs realize that the provision of indirect support through credit guarantees and subsidies to commercially extended credit is easier to accept by the general public and for policymakers rather than asking for direct support from public funds.

The danger of government support channeled through the lender with market power could be that the lender may adjust the terms of lending such that all benefits would accrue to him and the borrower would not be better off after the intervention. Our model shows that this situation will not happen with credit guarantees and interest rate subsidies. Since all the borrowers will be strictly better off, this type of intervention is universally acceptable for politicians, voters and civil servants. The widespread acceptance of this type of support also means that it would be difficult to remove unless a different form of support is offered to replace it. As an example of successful downsizing we would mention the importance of commercial credit guarantees and interest rates subsidies provided to farmers in the Czech Republic since 1994 by the Supporting and Guarantee Agricultural and Forestry Fund. This very successful program was responsible for a significant part of Czech government expenditures on agriculture policy in the second half of the 1990s, but its funding significantly diminished with the gradual incorporation of the Common Agricultural Policy (CAP) of the EU. Czech farmers and agricultural policymakers were willing to sacrifice public funding for commercial credit support in return for higher payments from the EU and Czech public funds in the framework of the CAP.

Additional discussion of Czech credit market, policies, problems and their analytical solutions is provided by JAKUBIK [2007b,a], KNOT AND VYCHODIL [2005], KOLECEK [2008], LIZAL [2002], RICHTER [2006b,a], SEIDLER [2008], GERSL AND HLAVACEK [2007], GERSL [2008], HANOUSEK AND ROLAND [2002], HLAVACEK AND HLAVACEK [2006b,a], and CECHURA [2006].

5 Conclusions

This paper presents a policy-relevant model of government interventions in credit markets. It proves that both considered instruments (government credit guarantees and interest rate subsidies) have nonambiguous positive effects on social efficiency. Both enable the government to ensure that all socially efficient projects will be undertaken. The principal difference between these two instruments is in their budgetary implications, which are quite different for the economies with high and low project-diversity. The expected size of the monetary transfer from government to lenders is lower for credit guarantees in high-project diversity case. It is lower for interest rate subsidies in low project-diversity scenario.

This means that as long as the participation cost of low-risk entrepreneurs are sufficiently close to the participation cost of high-risk entrepreneurs, the budget-cost-minimizing government should prefer guarantees over interest rate subsidies as an intervention instrument for the elimination of credit rationing in a targeted credit market segment. Our results show that a relaxation of the usually-maintained modeling assumption of uniform participation costs for all borrowers does not eliminate the theoretical argument for the desirability of government support. However, it has an effect on the choice of the most cost-efficient form of this support in the case that the difference in participation costs is sufficiently high.

Government intervention is always favorable both for redlined and financed types of entrepreneurs in our model. The entrepreneur, who would be credit rationed in the absence of government support, would be able to run his project, and the other type of entrepreneur will receive better contract conditions than would be the case in the absence of government intervention. A low-risk type of borrower is made better off by government intervention in the high project-diversity case since the induced pooling means that a low-risk borrower gets to keep a positive surplus as compared to only breaking even under a separating equilibrium. The same is true for a high-risk borrower in the low project-diversity case.

As our model shows, public support of the commercial credit provision is beneficial for all borrowers and lenders. This may explain the widespread use of these programs and their favorable treatment by policymakers, financiers and businessmen. The lenders not only appreciate the possibility to extend the guaranteed credit, but they also benefit from the positive effect of government guarantees on their regulatory capital (Teply [2007]).

The credit guarantees and subsidies provided by government to all applicants, who passed the credit screening process by the commercial bank, are potentially very strong policy instruments. Our model shows that they are also efficient instruments, as long as the forms of credit support are chosen in the right way. The policy relevance of our model is obvious from the fact that the model is based on the basic features of a number of successful credit support programs all over the world. The introduction of the credit support program is especially beneficial in the time of the credit crunch at the sectoral level, as has happened in agriculture and other restructured industries in many transition economies in the 1990s, or on an economy-wide level, which was the case in Japan during 1998–2001.

The public support of commercially granted credit does not exhibit the squeeze-out effect on commercial loans which may be caused by the direct governmental provision of soft loans. Nevertheless, there are still two contradictory effects of this type of public intervention. The positive effect is the alleviating of the credit crunch and enabling banks to finance potentially profitable business projects that would not be financed otherwise. The negative effect could be connected with adverse selection and moral hazard problems associated with subsidized lending, which we did not consider in this paper. There could be adverse selection where companies with low profitability and socially inefficient projects would use the public support program. Or there could be a significant moral hazard on the side of banks that would not exercise the due screening of loan applicants and would not provide proper monitoring of the approved loans. The experience of both transition economies with sectoral credit support programs analyzed by JANDA [2008a] and the Japanese economy-wide program open to all small and medium-sized enterprises (SME) which was analyzed by FUKANUMA, NEMOTO, AND WATANABE [2006], UESUGI, SAKAI, AND YAMASHIRO [2006], and UESUGI [2008] show that the positive effects prevailed and credit support programs had a positive impact on the economy.

Appendix

A.1 Proof of Proposition 1

First, we consider the case of high project-diversity. From (IC2) we get

$$\begin{aligned}
\pi_2[\delta_2(y - R_2) - b_2] &\geq \pi_1[\delta_2(y - R_1) - b_2] \\
&> \frac{\delta_1}{\delta_2}\pi_1[\delta_2(y - R_1) - b_2] \\
&= \pi_1[\delta_1(y - R_1) - \frac{\delta_1}{\delta_2}b_2] \\
&> \pi_1[\delta_1(y - R_1) - b_1],
\end{aligned}$$

where the last inequality is due to the high project-diversity condition $\delta_2/\delta_1 > b_2/b_1$. The strict inequalities change to equalities for $\pi_1 = 0$. This means that as long as (IR1) is satisfied, the (IR2) is satisfied, too. Since (IR2) is slack for all positive π_1, we obtain $\pi_2 > 0$ in this case. Because zero probabilities of granting credit to both types of borrowers would lead to a no-lending situation, we further consider the situation when at least one of π_1 and π_2 is positive.

In the following Lagrangian for the Problem 1 we assume that the (IC1) is satisfied. Once we solve for the optimal interest rates and probabilities of providing credit we show that these values satisfy (IC1). Under this assumption the Lagrangian is:

$$\begin{aligned} L &= \theta\pi_1[\delta_1 R_1 - \rho] + (1-\theta)\pi_2[\delta_2 R_2 - \rho] + \lambda\pi_1[\delta_1(y - R_1) - b_1] + \\ &\quad \mu\{\pi_2[\delta_2(y - R_2) - b_2] - \pi_1[\delta_2(y - R_1) - b_2]\} + \tau_1\pi_1 + \tau_2(1-\pi_1) + \tau_3\pi_2 + \tau_4(1-\pi_2). \end{aligned}$$

The Kuhn-Tucker conditions for this problem are given by FOC:

$$\begin{aligned} \frac{\partial L}{\partial R_1} &= \theta\pi_1\delta_1 - \lambda\pi_1\delta_1 + \mu\pi_1\delta_2 = 0, \\ \frac{\partial L}{\partial R_2} &= (1-\theta)\pi_2\delta_2 - \mu\pi_2\delta_2 = 0, \\ \frac{\partial L}{\partial \pi_1} &= \theta(\delta_1 R_1 - \rho) + \lambda[\delta_1(y - R_1) - b_1] - \mu[\delta_2(y - R_1) - b_2] + \tau_1 - \tau_2 = 0, \\ \frac{\partial L}{\partial \pi_2} &= (1-\theta)(\delta_2 R_2 - \rho) + \mu[\delta_2(y - R_2) - b_2] + \tau_3 - \tau_4 = 0, \end{aligned}$$

and by (IC2), (IR1), $0 \le \pi_1 \le 1, 0 \le \pi_2 \le 1$, complementary slackness conditions, and the non-negativity of multipliers.

Suppose that (IR1) is not binding. Complementary slackness then implies $\partial L/\partial R_1 = \pi_1(\theta\delta_1 + \mu\delta_2) = 0 \Rightarrow \pi_1 = 0$. This leads to a contradiction with (IR1) not binding. Therefore (IR1) has to bind. This means that $\pi_1^* = 0$ or $R_1^* = y - b_1/\delta_1$. Since $\pi_2 > 0$ for all $\pi_1 > 0$, the positive value of the multiplier $\mu = 1 - \theta$ which we obtain from $\partial L/\partial R_2 = 0$ shows that (IC2) is also binding.

After substituting $\mu = 1 - \theta$ into $\partial L/\partial \pi_2$ we obtain

$$\frac{\partial L}{\partial \pi_2} = (1-\theta)(\delta_2 y - \rho - b_2) + \tau_3 - \tau_4 = 0.$$

Since $\delta_2 y - \rho - b_2 > 0$ by our Assumption 1 of positive net present value, τ_4 has to be positive. Therefore by complementary slackness $\pi_2^* = 1$.

Since $\pi_2^* = 1$, the binding constraint (IC2) implies that

$$R_2^* = y - \frac{b_2}{\delta_2} + \pi_1(\frac{b_2}{\delta_2} - \frac{b_1}{\delta_1}).$$

Assume $\pi_1 > 0$. Then $\partial L/\partial R_1 = 0$ implies that $\lambda = [\theta\delta_1 + (1-\theta)\delta_2]/\delta_1$. After substitutions for R_1, λ, μ into $\partial L/\partial \pi_1$ we obtain

$$\frac{\partial L}{\partial \pi_1} = \theta(\delta_1 y - b_1 - \rho) + (1-\theta)\delta_2(\frac{b_2}{\delta_2} - \frac{b_1}{\delta_1}) - \tau_2 = 0.$$

As long as

$$\delta_1 y - b_1 - \rho \geq \frac{1-\theta}{\theta}\delta_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2})$$

we obtain $\pi_1^* = 1$ as an optimal solution.

To check that the solution satisfies (IC1), we first substitute the values of R_i^* for $\pi_i^* = 1$ into (IC1). This simplifies as $0 \geq 0$, which means that (IC1) will be satisfied. Then we substitute the values of R_i^* for $\pi_1^* = 0$, $\pi_2^* = 1$ into (IC1). In that case, (IC1) simplifies as $b_1/\delta_1 \geq b_2/\delta_2$, which is by definition always true in the high project-diversity case.

By this we proved the high project-diversity part of Proposition 1. Now we finish the proof with the case of low project-diversity. Firstly we get from (IC1)

$$\begin{aligned}
\pi_1[\delta_1(y - R_1) - b_1] &\geq \pi_2[\delta_1(y - R_2) - b_1] \\
&\geq \pi_2[\delta_1(y - R_2) - b_2\frac{\delta_1}{\delta_2}] \\
&> \delta_1\pi_2[\delta_2(y - R_2) - b_2,
\end{aligned}$$

where the inequality in the second line follows from the definition of low project-diversity. As long as $\pi_2[\delta_2(y - R_2) - b_2] \geq 0$, we obtain that $\delta_1\pi_2[\delta_2(y - R_2) - b_2] \geq 0$ and (IR1) is satisfied as a non-binding restriction for all positive π_2, which leads to $\pi_1 > 0$.

Going through the same steps as in the high project-diversity case, we find that:

$$\begin{aligned}
\pi_1^* &= 1, \\
R_2^* &= y - \frac{b_2}{\delta_2} \qquad \text{if } \pi_2^* > 0, \\
R_1^* &= y - \frac{b_1}{\delta_1} + \pi_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2}).
\end{aligned}$$

Similarly to the high project-diversity case we obtain

$$\pi_2^* = \begin{cases} 1 & \text{if } \delta_2 y - b_2 - \rho \geq \frac{\theta}{1-\theta}\delta_1(\frac{b_2}{\delta_2} - \frac{b_1}{\delta_1}), \\ 0 & \text{otherwise.} \end{cases}$$

Q.E.D.

A.2 Proof of Proposition 2

We follow the strategy used in the case without an intervention. In the same way as in the non-intervention situation we eliminate (IR2), assume the satisfaction of (IC1) and form the Lagrangian:

$$\begin{aligned}
L &= \theta\pi_1[\delta_1 R_1 + (1-\delta_1)g - \rho] + (1-\theta)\pi_2[\delta_2 R_2 + (1-\delta_2)g - \rho] - \\
&\quad \mu\{\pi_1[\delta_2(y - R_1) - b_2] - \pi_2[\delta_2(y - R_2) - b_2]\} + \lambda\pi_1[\delta_1(y - R_1) - b_1] + \\
&\quad \tau_1\pi_1 + \tau_2(1-\pi_1) + \tau_3\pi_2 + \tau_4(1-\pi_2).
\end{aligned}$$

Kuhn-Tucker conditions are FOC:

$$\begin{aligned}
\frac{\partial L}{\partial R_1} &= \theta\pi_1\delta_1 + \mu\pi_1\delta_2 - \lambda\pi_1\delta_1 = 0, \\
\frac{\partial L}{\partial R_2} &= (1-\theta)\pi_2\delta_2 - \mu\pi_2\delta_2 = 0, \\
\frac{\partial L}{\partial \pi_1} &= \theta[\delta_1 R_1 + (1-\delta_1)g - \rho] - \mu[\delta_2(y - R_1) - b_2] + \lambda[\delta_1(y - R_1) - b_1] + \tau_1 - \tau_2 = 0, \\
\frac{\partial L}{\partial \pi_2} &= (1-\theta)[\delta_2 R_2 + (1-\delta_2)g - \rho] + \mu[\delta_2(y - R_2) - b_2] + \tau_3 - \tau_4 = 0,
\end{aligned}$$

and (IC2), (IR1), $0 \leq \pi_1 \leq 1, 0 \leq \pi_2 \leq 1$, complementary slackness conditions, and the non-negativity of multipliers.

Similarly, like in the case without intervention, multipliers λ and μ are again found to be positive, the optimal values of R_i^* are the same as in the case without intervention and we obtain $\pi_2^* = 1$. After substitutions for R_1, λ, μ into $\partial L/\partial\pi_1$ we obtain

$$\begin{aligned}
\frac{\partial L}{\partial \pi_1} &= \theta(\delta_1 y - b_1 - \rho + (1-\delta_1)g) + (1-\theta)\delta_2(\frac{b_2}{\delta_2} - \frac{b_1}{\delta_1}) + \tau_1 - \tau_2 = 0 \\
&\Rightarrow \quad \pi_1^* = \begin{cases} 1 & \text{if } \delta_1 y - b_1 - \rho \geq \frac{1-\theta}{\theta}\delta_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2}) - (1-\delta_1)g, \\ 0 & \text{otherwise.} \end{cases}
\end{aligned}$$

The rest of the solution, checking our assumption about (IC1), is identical to the case without intervention.

Q.E.D.

A.3 Proof of Proposition 3

Using the same approach as in the situation without intervention we form the Lagrangian

$$\begin{aligned}
L &= \theta\pi_1[\delta_1(R_1 + s) - \rho] + (1-\theta)\pi_2[\delta_2(R_2 + s) - \rho] - \\
&\quad \mu\{\pi_1[\delta_2(y - R_1) - b_2] - \pi_2[\delta_2(y - R_2) - b_2]\} + \lambda\pi_1[\delta_1(y - R_1) - b_1] + \\
&\quad \tau_1\pi_1 + \tau_2(1-\pi_1) + \tau_3\pi_2 + \tau_4(1-\pi_2).
\end{aligned}$$

Since the structure of the optimization problem is identical to the case of credit guarantees intervention, the only difference in the Kuhn-Tucker conditions for these two problems is in

$$\begin{aligned}
\frac{\partial L}{\partial \pi_1} &= \theta[\delta_1(R_1 + s) - \rho] - \mu[\delta_2(y - R_1) - b_2] + \lambda[\delta_1(y - R_1) - b_1] + \tau_1 - \tau_2 = 0, \\
\frac{\partial L}{\partial \pi_2} &= (1-\theta)[\delta_2(R_2 + s) - \rho] + \mu[\delta_2(y - R_2) - b_2] + \tau_3 - \tau_4 = 0.
\end{aligned}$$

Following the same strategy of proof as in the credit guarantees case we therefore obtain

$$\frac{\partial L}{\partial \pi_1} = 0 \quad \Rightarrow \quad \pi_1^* = \begin{cases} 1 & \text{if } \delta_1 y - b_1 - \rho \geq \frac{1-\theta}{\theta}\delta_2(\frac{b_1}{\delta_1} - \frac{b_2}{\delta_2}) - \delta_1 s, \\ 0 & \text{otherwise.} \end{cases}$$

Q.E.D.

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Univerzita Karlova v Praze, Fakulta sociálních věd
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E-mail : ies@fsv.cuni.cz http://ies.fsv.cuni.cz