Ifo Institute for Economic Research at the University of Munich

The Politician and his Banker

– How to Efficiently Grant State Aid –

Christa Hainz
Hendrik Hakenes

Ifo Working Paper No. 71

May 2009

Ifo Working Paper No. 71

The Politician and his Banker*
– How to Efficiently Grant State Aid –

Abstract

In the current recession, politicians grant state aid of yet unknown dimensions. But what is the most efficient measure for granting such aid? We use a theoretical model with firms that differ in their creditworthiness and compare different types of direct subsidies with indirectly subsidized loans. We find that, in a large parameter range, politicians prefer subsidized loans to direct subsidies, because these avoid windfall gains to entrepreneurs, and they economize on screening costs. For similar reasons, subsidized loans may increase social welfare relative to subsidies. From a welfare perspective, politicians use subsidized loans inefficiently often.

JEL Code: H25, G21, G38.
Keywords: State aid, subsidized loans, public bank, governance.

Christa Hainz
Ifo Institute for Economic Research
at the University of Munich
Poschingerstr. 5
81679 Munich, Germany
Phone: +49(0)89/9224-1237
hainz@ifo.de

Hendrik Hakenes
Leibniz University Hannover
and Max Planck Institute Bonn
Königswörther Platz 1
30167 Hannover, Germany
Phone: +49(0)511/762-5225
hakenes@fmt.uni-hannover.de

* We thank Patrick Bolton, Christoph Engel, Bruno Frey, Guido Friebel, Thomas Gall, Ela Glowicka, Martin Hellwig, Rajshri Jayaraman, Anke Kessler, Christian Koziol, Johannes Münster, Panu Poutvaara, Nadine Riedel, Lars-Hendrik Röller, Isabel Schnabel, Monika Schnitzer, Christiane Ströh, Tuomas Takkalo, Silke¨ Übelmesser and participants of the CEPR/EBRD conference "Partnership between Government and the Private Sector" in London, the German Economic Association in Munich, the CESifo Area Conference Public Sector Economics in Munich, the SFB/TR 15 conferences in Frauenwörth and Mannheim, the Annual Conference of the Research Committee Development Economics of the Verein für Socialpolitik in Göttingen, the Annual Conference of the Verein für Socialpolitik in Munich, the WZB Berlin, the Max Planck econ-workshop in Bonn, the Conference "Political Economy of International Organizations" in Ascona and the University of Munich for discussion. Financial support from the Deutsche Forschungsgemeinschaft through SFB/TR 15 Governance and the Efficiency of Economic Systems is gratefully acknowledged.

1 Introduction

All around the world, governments face the eminent task of managing a financial crisis and a recession at the same time. In order to mitigate the financial crisis, governments have already spent tremendous amounts of money on acquiring bad assets or providing new equity, or at least have incurred large amounts of contingent liabilities by giving guarantees to banks. To limit the effects of the crisis on the real economy, most governments raise public expenditure. Thus, one crucial question is how to finance these expenditures in the most efficient manner. Given the already huge burden that the rescue measures for banks put on state budgets, governments must compare the available measures of state aid with respect to their efficiency.[1]

Currently, governments around the world are discussing various measures of state aid. In the US, the big three car manufacturers asked for financial assistance at the US Senate banking committee in December 2008 and received a bridge loan. Now a presidential task force, consisting of members from different government departments, evaluates the business plans submitted by the firms to decide about future support. However, no decision about the type of measure has yet been chosen.[2] In the European Union, politicians have also demanded subsidies for the automotive industry, but nor have they specified the way in which these subsidies should be granted. Sometimes even the nationalization of firms has been considered. Some countries in the EU, for instance Germany, have implemented programs to provide guarantees to firms that have temporarily and through no fault of their own got into difficulties in the current crisis (BMWI, 2009). In the UK, the government has recapitalized banks only under the condition that they commit to further lending to small firms, a group of firms for which access to finance seems to have become particularly difficult (CESifo, 2009). This measure is taken to mitigate the credit crunch resulting from the banks' extreme reluctance to lend. Due to the credit crunch, investment projects that have positive net present values and, in normal market conditions, would be financed by private commercial banks are not undertaken.[3] Some type of state aid might mitigate this problem.

The underlying question is very general: What is the most efficient measure for a government to grant state aid? Up to now, the academic literature does not provide recommendations about which measures of state aid should be favored. Thus, this is the first paper that addresses the following set of questions. Which specific measure of granting state aid allows a government to make the most of its expenditures? How do subsidized loans fare relative to other state aid measures? In particular, can efficiency considerations justify subsidies to banks?

When answering these questions we have to take into account that, in reality, the politicians in the governments are not necessarily benevolent but may follow their own agenda. By granting specific state aid they might, for instance, want to increase

[1] By state aid we mean all measures that (in expected terms) transfer state resources.

[2] See White House Press Secretary (2009).

[3] Campello, Graham, and Harvey (2009) provide survey evidence that credit constraints currently reduce the firm's investment.

the probability of being re-elected (Boycko, Shleifer, and Vishny, 1996).[4] We capture the so-called political view in a theoretical model in which investment projects yield an externality to the politician. However, projects differ in their creditworthiness. Some are profitable enough to be financed by private banks. Others are only financed if they receive a high enough subsidy. For the politician, it pays to subsidize only those that have a relatively high probability of success. However, the politician does not have the necessary skills to assess the creditworthiness of an individual project. Only so-called credit specialists, who have access to a screening technology, can determine the creditworthiness. Furthermore, subsidization of projects requires taxation, and thus entails some distortion that reduces the politician's utility.

In our model, we discuss all the measures of state aid observed in reality.[5] First, the politician can grant *subsidized loans*. We call a bank that takes instructions from the politician, and in return receives a subsidy from the politician, a subsidized bank. Thus, in some respects, a subsidized bank is similar to a public bank. However, it is not necessarily owned by the state. Second, he can offer an *uninformed subsidy* to all firms that produce a rent. Third, the politician can grant an *informed subsidy* by employing credit specialists as consultants. Based on the resulting information, he picks out and subsidizes only those projects that need a subsidy to become profitable. Finally, the politician can create *public firms*, or nationalize existing firms.

Our analysis yields four important results on the efficiency of state aid measures. First, in the case of subsidized loans, the politician restricts competition between the subsidized bank and other private banks. If this were not the case, the subsidized bank would use subsidies to capture market shares from private banks and this would result in a cost for the politician without yielding an additional benefit. Second, the politician prefers subsidized loans to informed subsidies because this reduces the amount of screening costs he has to bear. Using a subsidized bank means that the burden of screening firms that are not the targets of the politician's intervention is born by the private banks. In a large parameter range, subsidized loans even *welfare-dominate* informed subsidies. Third, subsidized loans can dominate the uninformed subsidies. This happens if the windfall gains for the most creditworthy firms, because the politician cannot prevent them from taking the uninformed subsidy, are large relative to the screening costs of the subsidized bank. Finally, the politician uses the subsidized bank inefficiently often. The reason is that the politician does not take into account the duplication of screening costs.

Our paper is related to the literature on state aid and since we investigate subsidized loans, also to the literature on development banks or, more generally, on public banks. The papers on state aid evaluate state aid control by multilateral institutions such as the European Commission (Collie, 2000; Dewatripont and Seabright, 2006). To the best of our knowledge there are no papers that compare different measures of state aid. This is also an open point in the literature on development or public banks.

[4]This behavior is also found between states. Empirical evidence shows that the US government gives financial favors to countries that hold a rotating seat on the U. N. Security Council (Kuziemko and Werker, 2006).

[5]These measures match with the ones proposed by the European Commission (1998)

In the only theoretical paper about development banks, Armendáriz de Aghion (1999) also argues that interventions by development banks must be targeted. In fact, the development banks in Germany, Japan, France and Korea are operating in a notably successful way (United Nations, 2005). The Development Bank of Japan (DBJ) can serve as an example showing that directed lending can work. Originally, its purpose has been to finance the modernization of the Japanese economy after World War II. The management of the DBJ has been politically independent and has based its decisions on the professional judgement of its loan department.[6] As a matter of fact, the DBJ has kept the level of loan losses much lower than the private financial sector (Vittas and Cho, 1995).

The theoretical literature on public banks shows that they can foster economic development (Hakenes and Schnabel, 2006). They also have positive effects on the financial system by contributing to its stability (Allen and Gale, 2004; Andrianova, Demetriades, and Shortland, 2008). It might happen that public banks operate with a soft budget constraint because the government cannot commit to not refinancing poorly performing public banks (Kornai, 1980; Dewatripont and Maskin, 1995). Empirical evidence with respect to the efficiency of public banks is mixed. A cross-country study shows that in countries with higher government ownership of banks, both financial development and growth rates per capita are lower (La Porta, Lopez De Silanes, and Shleifer, 2002). This result could be due to soft budget constraints of public banks, but no causal links are tested in this study. At the same time, there is evidence that public banks operate as efficiently as their competitors (Altunbas, Evans, and Molyneux, 2001), which is not consistent with the hypothesis that public banks operate with a soft budget constraint. Since public banks play an important role in providing state aid and are a means by which the politician can pursue economic policy, we believe that a comparison between public and private banks neglects the fact that the objectives of public banks are different from those of private banks. Therefore, such a comparison might be misleading.

We choose to model a politician that pursues his own objectives. There are several papers supporting this political view. The fact that, in election years, public banks increase their lending more than private banks suggests that politicians try to increase the probability of being re-elected (Dinç, 2005; Cole, 2009). Evidence from Pakistan shows that politically connected firms get larger loans from public banks than unconnected firms, pay lower interest rates and have higher default rates.[7] Remarkably, about 25 per cent of the loans from public banks are granted by banks that explicitly have social objectives. Interestingly, these banks are not used to favor politically connected firms (Khwaja and Mian, 2005). Moreover, after the deregulation of the French banking sector that started in 1985, bank debt declined sharply, especially for poorly performing firms which, as a consequence, were more likely to exit (Bertrand, Schoar, and Thesmar, 2007). In line with this evidence, our model argues that some entrepreneurs, although they create a rent for the politician, do not

[6]The World Bank provides recommendations for good corporate governance of state financial institutions (Scott, 2007).

[7]It thus seems that politicians exercise influence on bank employees in order to grant favors to connected firms.

receive finance from private banks but are financed by public banks. Therefore, we predict that after deregulation these poorly performing firms are no longer financed.

All these studies clearly indicate that politicians use state aid granted through public banks to pursue their own goals. These studies also point out the important role the electorate plays in monitoring politicians by showing, for instance, that the rents granted by politicians decrease if electoral participation increases (Sapienza, 2004; Khwaja and Mian, 2005; Cole, 2009). None of the studies, however, compares the costs of granting subsidies through a public bank with other means of subsidization. We fill this gap by comparing the efficiency of different means of subsidization from the political view.

The remainder of the paper is organized as follows. In section 2, we present the set-up of the model. We describe different measures to directly or indirectly subsidize projects in section 3. In section 4, we compare these measures from the politician's perspective, and from a social welfare perspective. In section 5, we discuss the results and conclude.

2 The Model

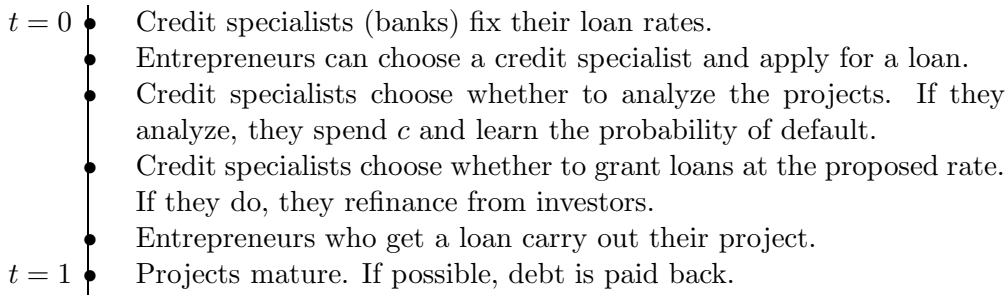
Consider an economy with three groups of agents; entrepreneurs, credit specialists, and a politician. All agents are risk neutral, and there is no discounting. Entrepreneurs want to undertake investment projects but do not have their own funds and must credit finance their projects. Since each entrepreneur has only one project, we use the expressions *project* and *entrepreneur* interchangeably.

There are three types of **entrepreneurs** of mass m_1, m_2 and m_3, with $m_1 + m_2 + m_3 = 1$. Each of them has a project that requires an investment of I and that leads to a return of Y with probability p_1, p_2 and p_3, depending on the type, stochastically independent, with $p_1 > p_2 > p_3$, otherwise it returns 0. Hence, different projects have different degrees of creditworthiness. Type 1 projects are called *excellent*; type 2 projects are called *medium*; type 3 projects are called *bad*. We will give conditions on the success probability later in this section. We assume that only entrepreneurs know their own type; the other agents do not.

A **credit specialist** carries out a credit analysis before granting a loan. He spends effort c to find out the success probability p of a project because financing without conducting a creditworthiness test yields an expected loss, i. e., $(m_1\, p_1 + m_2\, p_2 + m_3\, p_3)\, Y < (m_1 + m_2 + m_3)\, I$. The result of the credit analysis is observable only for the credit specialist who conducts it and not to anybody else. Moreover, it is noisy: with probability $1-\varepsilon$, the bank receives an informative signal, with probability $\varepsilon > 0$, it gets a random signal, distributed like the types of entrepreneurs. Hence, the signal is "excellent" with probability m_1, "medium" with probability m_2, and "bad" with probability m_3. Consequently, the probability of success of an entrepreneur with an "excellent" rating is

$$P_1 := (1 - \varepsilon)\, p_1 + \varepsilon\, (m_1\, p_1 + m_2\, p_2 + m_3\, p_3), \tag{1}$$

Figure 1: Time Structure in the Absence of Subsidies



P_2 and P_3 are defined analogously, $P_i = (1-\varepsilon)\, p_i + \varepsilon \sum_j m_j\, p_j$. Note that $P_1 < p_1$ and $P_3 > p_3$. The assumption of a noisy screening technology implies that even bad entrepreneurs apply for loans because if they receive a loan by mistake, they make positive profits. We use quotes to refer to entrepreneurs with an excellent rating ("excellent"), but who do not necessarily have excellent projects and equivalently for other types and ratings. Throughout, ε will be arbitrarily small.

There is perfect competition between a finite number of credit specialists. Different specialists make the same screening mistakes, hence their signals are perfectly correlated. This assumption implies that rejected entrepreneurs do not apply again at another bank if they know they will be rejected again; this is consistent with the evidence in Shaffer (1998). We assume that all banks can raise funds at the same costs and normalize these costs to zero.

In our model a **politician** maximizes his own utility. He gets a rent X_{pol} from successful projects.[8] The rent could be interpreted as the benefit he gets from increasing the probability of being re-elected if a project is carried out and is successful. In order to have projects realized, the politician can subsidize them. If he wants to grant subsidies, he must collect taxes. Like in Boycko, Shleifer, and Vishny (1996), d_{pol} is the disutility that the politician suffers for each unit of tax he raises. The politician wants to maximize his net utility, i. e., X_{pol} times the number of successful projects that are carried out, net of the required taxation times d_{pol}.[9]

The projects can be ranked as follows: An excellent project has a success probability p_1 high enough for the project to be financed without the help of the politician, $p_1\, Y > I + c/m_1$, taking into account the costs of screening. Both medium and bad projects have a negative net present value (NPV), $p_2\, Y < I$ and $p_3\, Y < I$. However, the probability of success of a medium project is higher than that of a bad project, $p_3 < p_2$. We assume that the politician increases his utility by subsidizing medium projects, i. e., $p_2\, X_{\text{pol}} > d_{\text{pol}}\,(I - p_2\, Y)$, but not by subsidizing bad projects, i. e., $p_3\, X_{\text{pol}} < d_{\text{pol}}\,(I - p_3\, Y)$.

[8]The politicians interests do not necessarily need to conflict with welfare. Welfare effects will be discussed in Section 4.2.

[9]The study by Khwaja and Mian (2005) shows that the social costs of lending to politically connected firms is high—the direct costs of politically connected lending are about 1.6 per cent of GDP per year. In addition, the deadweight loss from levying these transfer payments from the taxpayer are estimated to be about 0.15–0.30 per cent of annual GDP.

The timeline for the credit market game, in the absence of any subsidies, is given in Figure 1. However, in the case where the politician grants state aid, the time line is incomplete. Before the credit market game starts, the politician has to announce *what kind* of subsidy to grant, and at which *point in time*. Potentially, the politician could grant state aid before or after entrepreneurs apply at private banks for a loan. Depending on the timing, the design of the measure changes. We will present different possible solutions, finding that they are comparable to those proposed by the European Commission (1998).

3 Measures of State Aid

In this section, we discuss different types of measures that the politician may use to subsidize projects in order to get the corresponding rents. To define a point of reference, we start with the zero intervention case, the laissez faire case.

3.1 Laissez Faire

Consider the case where the politician does not influence which projects are undertaken and therefore does not need to collect taxes. Because the average NPV of a project is negative, entrepreneurs will have to be screened in equilibrium. The timing in the laissez-faire case is exactly as described in Figure 1. One institutional possibility is that credit specialists act as intermediaries between investors, from whom they collect funds at zero cost, and entrepreneurs. They will screen entrepreneurs, sorting out "medium" and "bad" ones. Hence, credit specialists endogenously act as private *bankers*. In the appendix, we prove the following lemma, furthermore deriving the necessary conditions.

Lemma 1 (Laissez Faire) *In equilibrium, all types of entrepreneurs apply for loans at private banks. Those entrepreneurs who are rated "excellent" (type 1) get a loan at rate*

$$R_1 = \frac{I}{P_1} + \frac{c}{m_1 P_1}. \tag{2}$$

The politician's utility is

$$U_{\text{pol}}^{\text{LF}} = m_1 P_1 X_{\text{pol}}. \tag{3}$$

Proof: See the Appendix. In equilibrium, all entrepreneurs, even the bad and medium ones, apply for loans at private banks. Bad and medium entrepreneurs anticipate that banks will give them a blurred rating with probability ε, and hence give them a loan with positive probability. All entrepreneurs only apply once, because of the assumption that the screening results are perfectly correlated. If a once rejected entrepreneur applied again, he would only receive another rejection. Without

screening costs, the gross loan rate, consisting of the repayment of the principal and the markup for default risk, would be I/P_1. Note that this rate is higher than I/p_1, because the bank acknowledges that it misjudges the entrepreneur's creditworthiness with some probability. In order to break even, the bank's lending rate must cover the whole screening cost. Because a fraction m_1 of applicants is accepted, banks must add $c/(m_1 P_1)$ to the gross loan rate.

The politician's utility function (3) is determined by the utility X_{pol} he derives from each successful project. The fraction of projects that are financed is m_1, the fraction of successful projects, is $m_1 P_1$. Among the projects rated as "excellent", not only will the excellent projects be successful with probability p_1, but also some medium projects that receive a loan by mistake with probability p_2 and some bad projects with probability p_3. Of course, in the laissez faire case, no taxation is needed.

3.2 Uninformed Subsidies

One natural way of boosting the implementation of medium projects is to grant a direct subsidy. In principle, the politician could grant a subsidy to each project. Since projects generate benefits of X_{pol} for the politician but also costs in the form of a disutility d_{pol} for each additional unit of tax revenue, the politician wants to minimize the costs through taxation. To do so, he can use additional pieces of information. In our model, there are two observables that he could base his decision on. The first is whether a firm produces, which is only possible if it receives a loan from a bank. The second is whether a project is successful or not. If the politician pays out the subsidy only to firms that failed, the state aid measure is called a *guarantee*. Note that the politician cannot directly use the information generated by credit specialists because screening results are unobservable. Potentially, when the politician announces the subsidy, which happens before the credit market game starts, there are several dates at which the subsidies will be paid (see Figure 1): in t=0 before banks grant loans or before investment is undertaken, or in $t = 1$ after repayment. We look for the optimal timing and the optimal structure of subsidies.

Lemma 2 (Uninformed Subsidy) *The politician grants a limited deficit guarantee to entrepreneurs by committing to a subsidy of*

$$S^{\text{US}} = \frac{I - P_2 Y}{1 - P_2} \tag{4}$$

to all entrepreneurs that produce but are not successful at date $t = 1$. In equilibrium, all types of entrepreneurs apply for loans at private banks. Those entrepreneurs who are rated "excellent" and "medium" get a loan at rate

$$R_1 = \frac{I - (1 - P_1) S^{\text{US}}}{P_1} + \frac{c}{m_1 P_1} \quad \textit{and} \tag{5}$$

$$R_2 = \frac{I - (1 - P_2) S^{\text{US}}}{P_2} = Y, \tag{6}$$

respectively. The politician's utility is

$$U_{\text{pol}}^{\text{US}} = \sum_{i=1,\,2} \left(m_i \, P_i \, X_{\text{pol}} - d_{\text{pol}} \, m_i \, (1 - P_i) \, S^{\text{US}} \right). \tag{7}$$

Proof: See the Appendix. In equilibrium, the politician grants a subsidy that is just high enough to guarantee the implementation of "medium" projects. Not only "medium" but also "excellent" entrepreneurs take the subsidy and, as a result, "excellent" entrepreneurs receive windfall gains. For "bad" entrepreneurs, the subsidy is insufficient to allow private finance. Hence without a project, they will not get subsidies in the first place. The Lemma shows that, optimally, the politician pays his subsidy at the end of period $t = 1$.

Naturally, the politician does not want to waste tax revenues, he wants to minimize these windfall gains. He can do this by making the subsidy contingent on observable variables. If he pays a subsidy only in the case of an entrepreneur's default in which case the subsidy is in fact a guarantee, potentially partial, then the expected subsidy to an "excellent" entrepreneur is lower than that to a "medium" entrepreneur and the politician saves tax revenues.[10] Within the class of uninformed subsidies, partial guarantees waste the least tax money.

The size of the expected subsidy depends on the loan rate, which is endogenous. Projects cannot repay more than Y in the case of success. Since the resulting expected repayment is too low for the bank to recover I, the missing amount has to be covered by a guarantee. Of course, if interest rates are high, the politician must pay a higher subsidy. Interest rates are determined by price competition between banks. Relative to "medium" entrepreneurs, "excellent" entrepreneurs pay a lower interest rate because they have a lower default risk. However, "excellent" entrepreneurs must bear all screening costs, due to a selection mechanism. Assume that one of the banks demands exceptionally low loan rates from their "excellent" borrowers and commits to offering loans to "excellent" borrowers only. Then this bank would attract not only all excellent projects but also bad and medium ones. The latter groups also apply because, with lower loans rates, their expected profit increases. All firms would have to be screened. As a consequence, the costs of screening are born by "excellent" borrowers. Since "medium" entrepreneurs cannot repay more than Y, the size of the subsidy equals the (negative) NPV, $I - P_2 \, Y$, plus a markup for the default risk because it is paid only in the case of default.

For the politician's utility, note that, due to the subsidy, not only the "excellent" but also the "medium" projects are implemented. However, the subsidy is also paid to both "excellent" and "medium" entrepreneurs.

[10] In our model, there is no moral hazard problem, entrepreneurs cannot influence their success probability. In the presence of moral hazard, a deficit guarantee might no longer be the optimal form of an uninformed subsidy.

3.3 Subsidized Loans

Subsidized banks receive a subsidy from the politician, but are instructed by the politician to grant *subsidized loans*. A subsidized bank employs credit specialists who screen projects. Bankers at the subsidized bank are assumed to behave individually rational, given the constraints implemented by the politician's instructions. Whether a subsidized loan is granted depends on the screening result. There is also an additional level of intermediation, and the politician must respect incentive compatibility problems.

All instructions for the banker at the subsidized bank need to be based on variables that are observable by the politician. For example, the politician can set a loan rate floor; the subsidized bank must then grant loans at rates that are above some threshold level, or above the rate of their private competitors. However, the politician *cannot* instruct bankers to grant loans only to "medium" entrepreneurs.

The timing is as follows: Before the credit market game starts, the politician endows the subsidized bank with a certain subsidy and gives instructions to the banker. Then the credit market game starts in which the subsidized bank and the private bank announce their rates simultaneously. Firms can make their applications sequentially.

Lemma 3 (Subsidized Loans) *The politician grants a subsidy to the (subsidized) banks in the amount of*

$$S^{\mathrm{SL}} = I + c - P_2\, Y \tag{8}$$

per loan. Furthermore, he will restrict competition between the subsidized bank and the private banks, e. g., by forbidding the subsidized bank to match a private banks' loan rate. In equilibrium, all types of entrepreneurs apply for loans at private banks. Those entrepreneurs that are rated "excellent" receive an offer from a private bank. Those that are rated "medium" apply at the subsidized bank and get an offer. Equilibrium loan rates are

$$R_1 = \frac{I}{P_1} + \frac{c}{m_1\, P_1} \quad \textit{and} \quad R_2 = Y. \tag{9}$$

The politician's utility is

$$U^{\mathrm{SL}}_{\mathrm{pol}} = \sum_{i=1,\,2} \left(m_i\, P_i\, X_{\mathrm{pol}}\right) - d_{\mathrm{pol}}\, m_2\, S^{\mathrm{SL}}. \tag{10}$$

Proof: See the Appendix. All entrepreneurs apply for loans at the private banks because they offer favorable interest rates for entrepreneurs with "excellent" rating. Therefore, the loan rate is just like that in the laissez faire case. Entrepreneurs, who are rejected from a private bank because they are only "medium", apply at the subsidized bank and here they must pay the complete return Y from their project to the subsidized bank. From this return alone, the expected profit of the subsidized

bank would still be negative. Hence, the politician must compensate the banker at the subsidized bank for the expected loss per loan, $I - p_2 Y$. Furthermore, he must pay the banker, at the subsidized bank, a wage for his screening effort, $m_2 c$. Note that bad entrepreneurs do not apply at the subsidized bank.

Lemma 3 contains a timing result. Entrepreneurs *first* try to get a loan from a private bank, who offers more favorable loan rates. Even medium and bad entrepreneurs apply because of the noise within the screening technology. After learning that the screening result is "medium" (which may happen even to an excellent entrepreneur), the entrepreneur then proceeds to a subsidized bank. After learning that the screening result is "bad", the entrepreneur does not need to apply again: due to the assumptions that screening results are perfectly correlated, "bad" entrepreneurs anticipate they will be rejected again. Hence *endogenously*, entrepreneurs first try to get a loan from a private bank. This saves the subsidized bank (and thus, the politician) screening costs.

Importantly, the subsidized bank must not be allowed to compete with private banks. The reason is simple: if an entrepreneur gets a loan offer from a private bank, this implies that the help of the subsidized bank is not needed. If the subsidized bank really did undercut the private bank and gave a subsidized loan to this entrepreneur, he would just waste tax revenues. In the extreme case where the subsidized bank always undercuts private loan offers, there is a complete crowding out of private finance by the public sector, and the waste of tax revenues would be the same as with an uninformed subsidy.

How independent of the politician is the subsidized bank? It does not belong to the politician in the sense that the politician is the residual claimant. The banker at the subsidized bank himself must be the residual claimant, otherwise he would not have any incentives to screen. However, the politician must be able to give the subsidized bank instructions. He thus needs some right to punish the banker at the subsidized bank, e. g., to cut the subsidy, or to sack the banker. When comparing a subsidized bank to uninformed subsidies, we get the following result.

Proposition 1 *The politician prefers a subsidized bank to uninformed subsidies if*

$$c < \bar{c}_1 = \frac{m_1}{m_2} \frac{1 - P_1}{1 - P_2} (I - P_2 Y). \tag{11}$$

Proof: See the Appendix. In both cases, with the uninformed subsidy or with the subsidized loan, projects with an "excellent" or a "medium" rating are carried out. In neither case are projects with a "bad" rating financed. In both cases, the politician must subsidize "medium" projects, to raise their NPV to at least zero. Hence the (possibly indirect) expected subsidy to a "medium" entrepreneur is the same in both cases. However, the politician faces the following trade-off. On the one hand, with an uninformed subsidy (partial guarantee), he also grants uninformed subsidies to "excellent" entrepreneurs who take the subsidy and experience a windfall gain. On the other hand, with a subsidized loan, he must remunerate his banker at the subsidized bank for screening. Hence, the politician prefers a subsidized loan if screening costs are not too large.

3.4 Informed Subsidies

The politician may want to use the information generated by a credit specialist instead of only relying on observables. At the same time, he may also want to avoid directly interfering in the financial system.[11] In our model, we capture the informed subsidy as follows: the politician can delegate the assessment of creditworthiness to a credit specialist who informs the politician which entrepreneurs to subsidize. Given incentive compatibility, only "medium" entrepreneurs will get subsidies. The result is summarized in the following lemma.

Lemma 4 (Informed Subsidies) *A politician seeks advice from a consultant before subsidizing, if his consultant rates an entrepreneur as "medium", he grants a subsidy of*

$$S^{\mathrm{IS}} = I - P_2\, Y. \tag{12}$$

In equilibrium, entrepreneurs with "medium" or "excellent" ratings apply for loans at private banks; they receive the offers

$$R_1 = \frac{I + c}{P_1} \quad \textit{and} \quad R_2 = I + (1 - P_2)\, Y. \tag{13}$$

The politician's utility is

$$U^{\mathrm{IS}}_{\mathrm{pol}} = \sum_{i=1,\,2} m_i\, P_i\, X_{\mathrm{pol}} - d_{\mathrm{pol}}\, m_2\, S^{\mathrm{IS}} - d_{\mathrm{pol}}\, c. \tag{14}$$

Proof: See the Appendix. For entrepreneurs, it is optimal to first apply for a subsidy and then try to get a loan. The politician will grant a subsidy of exactly $I - P_2\, Y$, lifting the expected profit for a "medium" entrepreneur to exactly zero, such that "medium" projects can be financed by private banks. An entrepreneur can prove to the bank that he is "medium" by showing that he receives a subsidy. The reason is that only "medium" projects are subsidized, and the results of the credit analysis are perfectly correlated; bankers would not generate any new useful information by a further credit analysis. This implies that the private bank does not have to screen them again. Therefore, screening costs c do not enter into the interest rates for subsidized projects. For the same reason, entrepreneurs that get a "bad" rating from the consultant will not apply for a private loan. Interestingly, the interest rate for "medium" entrepreneurs depends on Y: the repayment to the bank is $Y + S^{\mathrm{IS}}$ in the case of success, and only S^{IS} under failure. An increase in Y induces the politician to reduce the subsidy, but not to the same degree. Hence, the maximum payment to the bank, $Y + S$, depends positively on Y. When comparing subsidized loans to informed subsidies, we get the following result.

[11] In practice, proposals are submitted to the program manager in a ministry and are prescreened, short-listed and evaluated by a team of experts on the basis of their scientific and economic merits. Eventually, starting with those projects with the best grades, the projects are graded and projects are financed until the budget is exhausted (Giebe, Grebe, and Wolfstetter, 2006).

Proposition 2 *The politician prefers subsidized loans to informed subsidies.*

Proof: See the Appendix. If the politician pays the subsidy through a subsidized bank, then, for the entrepreneur, getting the subsidy comes at the cost of paying a relatively high loan rate. Consequently, excellent entrepreneurs do not apply for loans at a subsidized bank in the first place. This saves screening costs for the subsidized bank, which are indirectly paid for with tax revenues from the politician. If, as an alternative, the politician pays the subsidy after screening applicants, excellent entrepreneurs have an incentive to apply for the subsidy because, in expected terms, they make a windfall gain as the credit specialist may make a mistake. Hence, all entrepreneurs apply for the subsidy, and the politician must foot the bill by paying higher screening costs.

3.5 Public Firms

Alternatively, the politician can create his own firm. However, because he does not have the ability to carry out projects, he would need to employ entrepreneurs.[12] To employ them, he needs to offer them a wage. Thus, the timing is as follows. First, the politician announces that he intends to create public firms and makes a wage offer. Next, the credit market game takes place. Then, entrepreneurs can decide whether to accept the wage offered or not.

The politician can choose to have large public firms with a continuum of entrepreneurs (such that the law of large numbers applies within a firm), or to have many small firms (such that the law of large number applies between firms). Each of these cases leads to identical allocations, hence we consider only the first case. Also, note that the politician does not need to pay the complete investment of public firms with tax revenues. He can take a loan from investors, and guarantee the repayment. That way, credit specialists (private banks) are not even needed as intermediaries between investors and public firms. Loans from public firms are perfectly safe, like a treasury bond; they do not need to be screened and can be directly traded on the capital market.

Lemma 5 (Public Firms) *In equilibrium, the politician pays zero wages to his employees. All entrepreneurs apply for loans at private banks. Entrepreneurs rated as "medium" or "bad" are rejected; they become state employees. The aggregate tax burden from the guarantee for the public firm is*

$$S^{\mathrm{PF}} = \sum_{i=2,\,3} m_i \left(I - P_i\, Y\right). \tag{15}$$

[12] In the light of the recent developments, the interpretation would be to "nationalize" a firm in distress by buying up its shares (in case of joint-stock companies), rather than giving it guarantees or capital injections.

Equilibrium loan rates for "excellent" projects are as in (2). The politician's utility is

$$U_{\text{pol}}^{\text{PF}} = \sum_{i=1,\,2,\,3} \left(m_i\, P_i\, X_{\text{pol}}\right) - d_{\text{pol}}\, S^{\text{PF}}. \tag{16}$$

Proof: See the Appendix. "Excellent" firms do not accept the offer because they receive a loan and make positive profits when conducting the project on their own. Here, the aggregate subsidy equals the aggregate (negative) net present values of "medium" and "bad" projects. The state guarantees the repayment of the loans of its firm, then competition between private banks guarantees that the value of these guarantees equals exactly the negative net present value. Because all types of projects are carried out in equilibrium, the politician's utility contains the externalities of all three types.

4 Comparison of Measures of State Aid

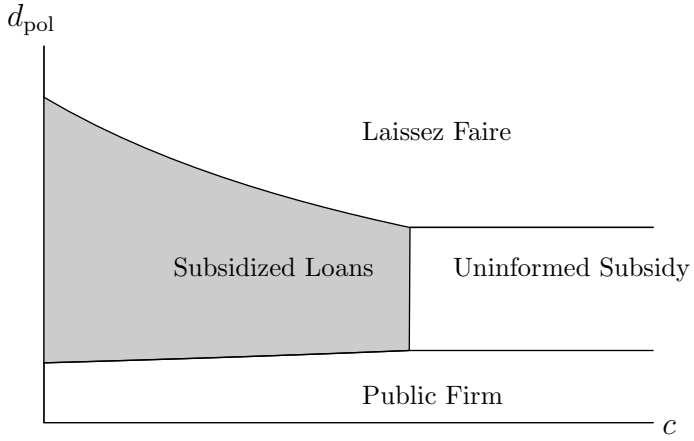
4.1 The Politician's Choice

Depending on the parameter constellations, the politician chooses the optimal state aid measure. We illustrate the politician's choice in Figure 2 for certain parameter values and plot the optimal measure for the politician.[13] Curves mark the borders between the optimal types of aid. Clearly, the measure that the politician picks depends on the parameters c and d_{pol}. As stated in the above propositions, informed subsidies are dominated by subsidized loans, and uninformed subsidies are dominated by subsidized loans if c is not too large.

For relatively high d_{pol}, the costs of intervention are so high that the politician prefers not to interfere at all (laissez faire). For very low d_{pol}, the politician prefers to have all projects financed and hence uses public firms to carry out projects. That way, he benefits from the rent X_{pol} from "medium" projects, avoiding the screening costs c, but has to accept that "bad" projects are also carried out. For medium d_{pol} and not too large c, the politician will choose subsidized loans. In this range, the politician prefers subsidized loans to public firms because his costs of taxation d_{pol} are relatively high. This disadvantage is high enough to compensate the politician for giving up the rent of "bad" projects, which are not undertaken with subsidized loans. The politician prefers subsidized loans to laissez faire because the costs of raising taxes are low enough to justify the realization of "medium" projects, which would not be undertaken in the laissez faire case. For medium d_{pol} and larger c, the politician will choose an uninformed subsidy. In this range, his utility is higher if he grants subsidies to "excellent" entrepreneurs but economizes on bearing the screening costs of the subsidized bank.

[13] For the plot, we fix parameters at $I = 1.0$, $Y = 1.3$, $p_1 = 0.9$, $p_2 = 0.7$, $p_3 = 0.5$, $m_1 = 1/2$, $m_2 = m_3 = 1/4$, ε small (we take the limiting case of $\varepsilon \to 0$), and $X_{\text{pol}} = 0.2$.

Figure 2: The Politician's Choice of Subsidization Measures



Now suppose that, for some reason, subsidized banks and subsidized loans are not an option. In Figure 3, we show how the politician's choice changes. In the light gray region, the politician opts for an informed subsidy, which was dominated by the subsidized loan before. The regions in which the politician chooses laissez faire, uninformed subsidies, or public firms have increased.

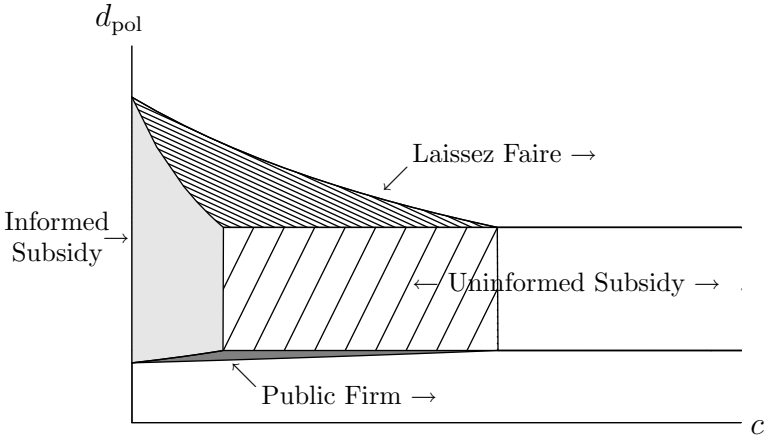
This exercise also allows us to study the argument, made by Shleifer and Vishny (1994), that a politician reduces the number of interventions if the costs of an intervention increase. Our analysis comes to a different result. In the white regions, the politician's behavior is not affected by whether or not he has access to subsidized loans. For low d_{pol} in the dark gray region, the politician implements public firms. This means that now a mass of $m_2 + m_3$ entrepreneurs enjoy being a public firm, and the degree of state intervention increases. For medium d_{pol} in the lightly shaded region, the politician switches to an informed or uninformed subsidy and the mass of subsidized entrepreneurs remains unchanged, but the cost of subsidization increases. Only for relatively high d_{pol} in the strongly shaded region, do we have the same result as Shleifer and Vishny; instead of using subsidized loans for indirect subsidization, the politician chooses laissez faire. Hence, how the degree of state intervention changes if subsidized loans are no longer available depends crucially on the alternative options of the politician, on the characteristics of the project (X_{pol}, c, m, p and ε), and on the politician's costs of increasing taxes (d_{pol}).

4.2 Social Welfare

In this section, we compute social welfare for the five different measures of state aid. In our current set-up of the model, projects lead to an externality on the politician (the rent X_{pol}), but not on the public. Additionally, let us assume that the implementation of a project also influences social welfare, leading to a social externality of X_{soc}.[14] For $X_{\text{soc}} > 0$, not only the politician but also the public benefits

[14]Without loss of generality, let us assume that the externality to the politician is also already contained in X_{soc}; otherwise, the aggregate social externality from a successful project would add

Figure 3: Subsidization Measures in the Absence of Subsidized Loans



from a successful project. For $X_{\text{soc}} < 0$, the project even has a negative effect on public welfare and medium projects should never be undertaken.[15] Furthermore, we must take into account that taxation leads to a social distortion that is proportional to the tax, d_{soc}. Note that, even for $X_{\text{pol}} = X_{\text{soc}}$ and $d_{\text{pol}} = d_{\text{soc}}$, the politician does not always pick the welfare-optimal subsidization measure. Social welfare takes into account profits and losses of third parties (e. g., private banks or entrepreneurs), but the politician's utility function does not.

Aggregate welfare from a social perspective consists of the NPV of projects including the social externality, weighted by the mass of types financed, net of the costs of taxation, and the costs of screening.

Lemma 6 (Social Welfare) *Depending on the measure of subsidization, social welfare is*

$$
\begin{aligned}
W_{\text{soc}}^{\text{LF}} &= m_1 \left(P_1 \left(Y + X_{\text{soc}} \right) - I \right) - c, \\
W_{\text{soc}}^{\text{US}} &= \sum_{i=1,\,2} \left(m_i \left(P_i \left(Y + X_{\text{soc}} \right) - I \right) - d_{\text{soc}}\, m_i \left(1 - P_i \right) S^{\text{US}} \right) - c, \\
W_{\text{soc}}^{\text{SL}} &= \sum_{i=1,\,2} m_i \left(P_i \left(Y + X_{\text{soc}} \right) - I \right) - d_{\text{soc}}\, m_2\, S^{\text{SL}} - \left(1 + m_2 \right) c, \\
W_{\text{soc}}^{\text{IS}} &= \sum_{i=1,\,2} m_i \left(P_i \left(Y + X_{\text{soc}} \right) - I \right) - d_{\text{soc}}\, m_2\, S^{\text{IS}} - \left(1 + m_1 + d_{\text{soc}} \right) c, \quad \textit{and} \\
W_{\text{soc}}^{\text{PF}} &= \sum_{i=1,\,2,\,3} m_i \left(P_i \left(Y + X_{\text{soc}} \right) - I \right) - d_{\text{soc}}\, S^{\text{PF}} - c.
\end{aligned}
$$

Proof: See the Appendix. If X_{soc} is not too small, subsidized loans can even welfare-dominate the laissez faire regime. However, if X_{soc} is small, zero or even negative,

up to $X_{\text{soc}} + X_{\text{pol}}$.

[15] If the negative externality is large, even the impact of an excellent project on social welfare can be negative. However, the measures we study here cannot be used to avoid excellent projects being undertaken in this case.

then laissez faire is the optimal policy. This is obvious from comparing the welfare of the different regimes. For rather small d_{soc}, positive X_{soc} and large c, it can be optimal to have public firms even from a social perspective. The public wants the externality, taxation is not very costly, and screening (even by subsidized banks) is prohibitively costly. Comparing the different measures, we derive the following proposition.

Proposition 3 *Subsidized loans welfare-dominate uninformed subsidies iff*

$$c < \bar{c}_2 = \frac{d_{\text{soc}}}{1 + d_{\text{soc}}} \frac{m_1}{m_2} \frac{1 - P_1}{1 - P_2} (I - P_2 Y); \tag{17}$$

and they welfare-dominate informed subsidies iff

$$d_{\text{soc}} > \frac{m_2 - m_1}{1 + m_2}. \tag{18}$$

Proof: See the Appendix. If there are more excellent than medium projects in the economy ($m_1 > m_2$), then condition (18) is satisfied for all $d_{\text{soc}} \geq 0$. As with a politician who maximizes his own utility, subsidized loans can welfare dominate both informed and uninformed subsidies. In comparison to the uninformed subsidy, subsidized loans avoid the windfall gains to "excellent" entrepreneurs. Thereby, the deadweight loss of taxation decreases. However, the total screening costs with subsidized loans are higher because entrepreneurs rated as "medium" apply twice (at the private bank and after the rating at the subsidized bank). As long as screening costs are not too high, the subsidized bank is the more efficient measure for granting state aid also from a social welfare perspective.

Next, we compare informed subsidies and subsidized loans in terms of social welfare. We find that on the one hand the screening costs for "excellent" projects are duplicated under the informed subsidy, and the costs of screening all entrepreneurs must be financed by tax revenues. On the other hand, with subsidized loans the screening costs of "medium" entrepreneurs are duplicated, but only the costs of screening "medium" entrepreneurs through the subsidized bank are financed by taxes. Thus, for high enough m_1, social welfare is higher with subsidized loans. The higher the costs of taxation, the lower the threshold value of m_1 where the subsidized loans become the more favorable alternative.

Given the result of Proposition 3 we want to know whether the politician chooses to use a subsidized loans when it is the best choice from the point of view of social welfare. We can prove the following result.

Proposition 4 *The politician uses subsidized loans inefficiently often.*

Proof: See the Appendix. The explanation for the discrepancy is that the politician does not take into account screening costs and, in particular, the duplication of screening costs. For him screening costs only matter if they have to be covered by

the subsidy. When comparing the threshold values where the politician switches from using subsidized loans to using uninformed subsidies to the threshold value where social welfare changes, we can show that the threshold value is higher for the politician. The reason is that the politician does not take into account that the screening costs for "medium" entrepreneurs arise twice because he does not care about the costs of private banks. Moreover, the politician always prefers the subsidized loans to informed subsidies. However, as shown in Proposition 3, there exist parameter ranges where informed subsidies are more efficient from a welfare perspective.[16]

This section has made four points. *First*, and almost trivially so, laissez faire is the first best alternative if the social externality of projects is negative, $X_{\text{soc}} \leq 0$. *Second*, subsidized loans can be welfare-optimal if $X_{\text{soc}} > 0$. *Third*, in a large parameter range, subsidized loans welfare-dominate both the informed and the uninformed subsidies (Proposition 3). *Finally*, politicians use subsidized loans inefficiently often (Proposition 4).[17]

5 Conclusion

Different measures of state aid have been discussed and used during the recent financial crisis. The above model helps compare their efficiency, both from a politician's point of view and from a welfare perspective. Take, for instance, the case of car manufacturers. Different firms differ in their future prospects, and hence in their creditworthiness. Firms that manage to keep their production alive yield a benefit for both politicians and society. They keep their workers employed and generate demand on input markets. Consequently, if firms are on the verge of closing down their production, some intervention may be appropriate. However, the rescue plans come at the cost of raising additional taxes or reducing other public expenditures. Therefore, the politician needs to grant state aid in the most efficient manner. Neither does he want to give tax money to healthy firms, nor does he want to waste money on hopeless firms. Hence, our model environment fits exactly.

The analysis shows that, from the politician's perspective, there is no *dominant* institutional design. Depending on circumstances, a different measure of state aid will be optimal. Even nationalizing a firm can be adequate, but only if distortions from taxation are very low (see Figure 2).[18] Doing nothing can be optimal if distortions from taxation are extremely high. In between, there is a range where the state should intervene, making use of some type of subsidization. In the paper,

[16]Note that the result of Proposition 4 is independent of the size of d_{pol} relative to d_{soc}.

[17]However, it is also conceivable that the public prefers laissez faire (because X_{soc} is small), and the politician switches from subsidized loans to laissez faire if subsidized loans are banned (hence he is in the densely shaded region of Figure 3).

[18]If globalization renders taxation more expensive, this leads to less state-owned firms or more privatization. The idea is that through globalization some factors of production become more mobile, and it becomes more difficult to tax them. As a result, immobile factors have to bear a higher tax burden and, thereby, the deadweight loss of taxation increases (European Economic Advisory Group, 2007).

we have shown that uninformed subsidies through partial guarantees are optimal if information costs are relatively high. If they are lower, subsidizing banks is optimal, because for the politician, covering the screening costs of the subsidized bank is cheaper than granting a windfall gain to excellent firms. In both of these cases, the preferred institution comprises elements of both markets and of the state. In the case of partial guarantees, the state grants the guarantees; prices and allocation are then organized by the banking market. In the case of subsidized banks, we have argued that the state should subsidize some (not all) banks, and prohibit these banks from competing with other unsubsidized banks. That way, market forces organize a targeting of the subsidies. Bad firms do not get loans at all. Medium firms get loans at rather unfavorable but still subsidized rates and can invest. Excellent firms take loans at more favorable rates; reflecting their high solvency, from private, unsubsidized banks. Finally, with respect to social welfare, our analysis has shown that optimal institutional designs are similar to the politicians' preferred choices, but politicians subsidize banks inefficiently often.

A Appendix

Proof of Lemma 1. Because banks make mistakes with positive probability, and a loan application is not costly to entrepreneurs, all types of entrepreneurs will apply for loans. Of all these applicants, a fraction m_1 is excellent, hence the bank's refinancing costs are $m_1 I$. The entrepreneurs who get the loan are of mixed quality, their probability of success is P_1 as defined in (1). The expected profit for the bank is hence

$$\Pi = m_1 P_1 R_1 - m_1 I - c.$$

Due to the assumption of perfect competition, the expected profit from a loan must be zero. Solving for R_1 yields (2).

Under what conditions does a banker reject entrepreneurs with a "medium" rating? When the screening costs are already sunk, the expected profit from a "medium" entrepreneur is $\Pi = m_2 P_2 R_2 - m_2 I$. The banker can demand a loan rate of at most $R_2 = Y$. A sufficient condition that bankers reject entrepreneurs with a "medium" rating is thus $P_2 Y < I$. For small ε, this inequality becomes $p_2 Y < I$; medium projects must have a negative NPV. The expected return from entrepreneurs with a "bad" rating is even lower, they will also be rejected under the above condition. In order to have intermediated finance, the return from a screened loan must exceed that from an unscreened loan, $\Pi \geq \bar{p} Y = [m_1 p_1 + m_2 p_2 + m_3 p_3] Y$. This term is assumed to be negative, hence finance is always intermediated.

The politician derives utility X_{pol} from all successful projects. Projects that get finance (mass m_1) are successful with probability P_1, hence the politician's utility is given by (3). For small ε, the politician's utility is approximately $m_1 p_1 X_{\text{pol}}$. ■

Proof of Lemma 2. We show that the politician cannot improve upon the subsidy described in the lemma. The necessary subsidy depends on the loan rates for different entrepreneurs, so we have to determine these rates first.

Step 1: Determine loan rates. Note that banks must make their interest rate offers contingent on the rating of the entrepreneur. Since a bank offered the same loan rate for all classes of entrepreneurs, this rate would have to be relatively high, hence especially entrepreneurs with "excellent" ratings would rather go to banks with attractive loan offers for "excellent" entrepreneurs. A bank that grants loans to entrepreneurs with "excellent" and "medium" ratings at rates R_1 and R_2 makes a profit of

$$\Pi_{1,2} = \sum_{i=1,2} \Big(m_i \left(P_i \, R_i + (1 - P_i) \, S^{\mathrm{US}} - I \right) \Big) - c.$$

However, the interest rates for "excellent" projects R_1 cannot be arbitrarily high. For too high a R_1, banks that specialize on "excellent" projects could emerge and attract excellent projects with a lower R_1. Because banks err with positive probability, medium and bad projects would also try to get a loan from these banks. Hence, the expected profit of such a bank out of equilibrium would be

$$\Pi_1 = m_1 \left(P_1 \, R_1 + (1 - P_1) \, S^{\mathrm{US}} - I \right) - \, c.$$

If both $\Pi_{1,2} = 0$ and $\Pi_1 = 0$, then the interest rates constitute an equilibrium; no bank can improve profits by adjusting its loan rates, and

$$R_1 = \frac{I - (1 - P_1) \, S^{\mathrm{US}}}{P_1} + \frac{c}{m_1 \, P_1},$$
$$R_2 = \frac{I - (1 - P_2) \, S^{\mathrm{US}}}{P_2}.$$

The politician must grant the "medium" entrepreneur a subsidy high enough to make the application for a loan worthwhile. On the other hand, he wants to choose S^{US} just high enough to raise the creditworthiness of "medium" entrepreneurs so that they get access to private finance. This yields $R_2 \geq Y$, and in the limit $R_2 \to Y$. Solving the three equations $\Pi_{1,2} = 0$, $\Pi_1 = 0$, and $R_2 = Y$ for R_1, R_2 and S^{US}, we get (4), (5) and (6).

Step 2: Derive the optimal kind of subsidy. With a subsidy as in (4), both "medium" and "excellent" entrepreneurs will produce. With a subsidy *lower* than in (4), "medium" entrepreneurs could not produce, because the loan rate demanded by banks would exceed the highest repayment possible, Y. As a consequence, production decisions would be the same as without any subsidies. With a subsidy slightly *higher* than (4), "medium" and "excellent" entrepreneurs would produce, but tax revenues would be wasted because the same production decisions could be achieved with a lower subsidy. With an even higher subsidy (for instance an unlimited deficit guarantee that covers the total repayment), even "bad" entrepreneurs would get access to loans.

If the politician granted a subsidy unconditional on success, then the expected amount of subsidy paid to "excellent" projects would be the same as that paid to "medium" projects. In the case of a partial deficit guarantee, the expected subsidy paid to "excellent" projects is lower because their probability of success is higher and that way the politician can economize on tax revenues. If the politician granted a subsidy unconditional on production, then *all* entrepreneurs would take the subsidy as a windfall gain. Even "bad" entrepreneurs would take a subsidy although they cannot produce because they do not get access to private loans. This wastes tax revenues and creates a disutility to the politician. Summarizing, we find that, given the politician uses a subsidy to influence production decisions, the method of lemma 2 is the most efficient way of using tax revenues.

Finally, let us derive the politician's utility from implementing a direct, uninformed subsidy. Both medium and excellent projects are carried out and take the subsidy. An aggregate tax of $\left(m_2\left(1-P_2\right)+m_1\left(1-P_1\right)\right)S^{\mathrm{US}}$ must be levied to finance the subsidy. Hence, the politician's utility is given by (7). ■

Proof of Lemma 3. *Step 1: Determine loan rates.* In equilibrium, private banks will grant loans only to "excellent" projects, hence they will offer the most favorable loan rates. As a consequence, bad entrepreneurs will apply at a private bank. If they are rejected because they are "bad", they know that they will never get a loan (because the screening technologies of all banks are identical) so they will not apply again. "Medium" entrepreneurs will first apply at a private bank as well, to have the chance to benefit from the favorable loan rates if they are rated as "excellent." After being rejected, they apply at a subsidized bank, which finances "medium" projects, since the expected loss it makes with each "medium" project is compensated by a subsidy from the politician. Given the subsidy in (8), the subsidized banks demand $R_2 = Y$ and we are exactly in the limiting case where medium entrepreneurs only just participate.

"Excellent" entrepreneurs always apply for a loan at the private bank (the one with the lowest rate). There is perfect competition between private banks for "excellent" projects and this drives down their expected profit to zero. Thus, the private bank's expected profit is $\Pi_1 = m_1\left(P_1\,R_1 - I\right) - c$. Now $\Pi_1 = 0$ implies (9).

Step 2: Derive optimal subsidy. The maximum loan rate that a subsidized bank can demand is $R_2 = Y$. In this case, the subsidized bank's profit function is given by

$$\Pi^{\mathrm{SL}} = m_2\left(P_2\,Y + S^{\mathrm{SL}} - I\right) - m_2\,c. \tag{19}$$

This term must be non-negative, otherwise the subsidized banker's participation constraint would be violated. Choosing S^{SL} as in (8), we find that the participation constraint just holds, and the subsidized banker's expected profits are zero.

The subsidy must not be higher than necessary to satisfy the subsidized bankers' participation and incentive compatibility constraints, otherwise tax revenues would be wasted.

Step 3: Restriction in competition is necessary. An important feature of the subsidized bank is that competition with private banks must be restricted, for example, by not allowing subsidized banks to offer the same loan rates as private banks. If there were unrestricted competition, the subsidized bank could give loans to "excellent" entrepreneurs and still collect the subsidy. This would allow them to make positive profits. Consequently, subsidized banks would grant loans to all "excellent" and "medium" entrepreneurs. The aggregate subsidy to the subsidized bank would then be higher than with direct subsidization of entrepreneurs, as in Section 3.2.

The politician derives utility from both "excellent" and "medium" projects. In equilibrium, only "medium" entrepreneurs get the indirect subsidy through the subsidized bank. Hence, the politician's utility is given by (10). ■

Proof of Proposition 1. Compare the politician's utilities under the two subsidization measures, $U_{\text{pol}}^{\text{SL}}$ and $U_{\text{pol}}^{\text{US}}$. Straightforward algebraic manipulation shows that $U_{\text{pol}}^{\text{SL}} > U_{\text{pol}}^{\text{US}}$ as long as (11) holds. ■

Proof of Lemma 4. *Step 1: Determine the loan rates.* The politician grants a subsidy to entrepreneurs rated as "medium". They can use the subsidy to signal their rating. The profit of a private bank from a subsidized entrepreneur is

$$\Pi_2 = m_2 \left(P_2 \, R_2 + (1 - P_2) \, S^{\text{IS}} - I \right),$$

Under perfect competition, the loan rate will be

$$R_2 = \frac{I - (1 - P_2) \, S^{\text{IS}}}{P_2}.$$

Now, after entrepreneurs have received a subsidy and a loan, only entrepreneurs rated as "excellent" by the credit specialist will apply for loans at private banks. Entrepreneurs who were rated as "bad" will not apply because they know for sure that they will not receive a loan. As a consequence, the profit function from a non-subsidized loan is

$$\Pi_1^{\text{Bank}} = m_1 \left(P_1 \, R_1 - I \right) - m_1 \, c,$$

hence, in market equilibrium the interest rate is R_1 as in (9).

Step 2: Derive optimal subsidy. In order to analyze the size of the subsidy, we need to find out which entrepreneurs are screened by whom. All entrepreneurs will apply for the subsidy, because they do not want to risk being rejected by the bank and then lose the chance to get the subsidy. As a result, the aggregate screening cost of the consultants is at least c. It is also possible to find a contract that needs no more than c: Employ one consultant and let him screen all entrepreneurs, employ another consultant and let him control a random fraction η, pay the first consultant only if the second finds no mistakes, and let η converge to zero. Based on the first consultant's report, the politician grants subsidies only to "medium" entrepreneurs. Now private banks can observe the subsidy, and hence can give loans, without

further screening, to these subsidized entrepreneurs, if the subsidy is sufficiently high. The politician can again set the subsidy such that the medium entrepreneurs' participation constraint binds. Setting $R_2 = Y + S^{\mathrm{IS}}$, we get $S^{\mathrm{IS}} = I - P_2\,Y$.

The public consultants cannot be the owners of private banks, but must be independent agents. The politician cannot allow his public consultant to give loans to entrepreneurs who get a subsidy: The public consultant would have, in terms of information, a competitive advantage on the loan market compared to other private banks. Therefore, he could always offer a lower loan rate than the private bank and make sure that he can grant the loan. Anticipating this, the public consultant could tell the politician to subsidize even if an entrepreneur is already "excellent." The public consultant could profit indirectly because of his competitive advantage. As a consequence, both "excellent" and "medium" entrepreneurs would get the subsidy, and the consultant's advice would be worthless. Moreover, if the public consultant gave the loan himself, the institutional setting might be indistinguishably close to a subsidized bank.

Now the politician's utility comprises of the following components. Projects are carried out by "medium" and "excellent" entrepreneurs. The subsidy is paid only to "medium" entrepreneurs. Furthermore, the politician must pay a wage of c per screened loan to his advisors (credit specialists). Consequently, the aggregate utility is (14). ■

Proof of Proposition 2. We only need to compare $U_{\mathrm{pol}}^{\mathrm{SL}}$ from (10) with $U_{\mathrm{pol}}^{\mathrm{IS}}$ from (14). Using straightforward algebra, we find that $U_{\mathrm{pol}}^{\mathrm{SL}}$ always exceeds $U_{\mathrm{pol}}^{\mathrm{IS}}$ because $c\,d_{\mathrm{pol}} > m_2\,c\,d_{\mathrm{pol}}$ for any strictly positive c and d_{pol}. ■

Proof of Lemma 5. All entrepreneurs apply at the bank, but "medium" and "bad" entrepreneurs will be rejected. They apply to the politician to become a public employee. When making wage offers, the politician needs to take into account the outside option that different types of entrepreneurs have. Entrepreneurs rated as "medium" have expected profits of zero, if they do not sell their project, because they cannot get loans from private banks. Consequently, the politician does not need to offer more than an infinitesimal wage to employ entrepreneurs rated as "medium." In the limiting case, he can pay zero wages. However, at any weakly positive wage, entrepreneurs rated as "bad" will apply as well. Only entrepreneurs rated as "excellent" will choose to remain independent at a zero wage. However, the politician does not aim to employ entrepreneurs rated as "excellent" in the first place, since their projects are carried out without government intervention, because they are sure to be financed by private banks.

Although the politician does not need to pay for the projects, public firms do not come free of cost. The politician needs to be liable for the debt of public firms, otherwise investors would not grant loans. Because investors can observe that the government guarantees the repayment, they do not need to screen public firms. They get the same repayment in the case of success or failure, independent of the quality

of the entrepreneurs within the firm. Therefore, they do not need a compensation for risk, and every public firm has a loan rate of $r = 1$.

Hence, the politician's expected payment for such bailouts is $(m_3\,(1-p_3)+m_2\,(1-p_2))\,I$. However, the politician does not need to finance these payments completely from taxes. He can use the revenues from the successful public firms, which amount to $(m_3\,p_3+m_2\,p_2)\,(Y-I)$. Only the difference between the expected revenues and the expected bailouts must be levied by taxation,

$$S^{\mathrm{PF}} = \sum_{i=2,\,3} m_i\,(1-p_i)\,I - m_i\,p_i\,(Y-I),$$

which is equal to (15). Because entrepreneurs can still get a public job after a rejection from a private bank, all entrepreneurs apply for loans, just like in the laissez faire case. As a consequence, screening out "bad" and "medium" entrepreneurs is just as costly for private banks, and the equilibrium loan rate is $R_1 = (I + c/m_1)/P_1$ like in (2). ■

Proof of Proposition 3. Comparing social welfare under different measures,

$$W_{\mathrm{soc}}^{\mathrm{SL}} - W_{\mathrm{soc}}^{\mathrm{US}} = \frac{d_{\mathrm{soc}}\,m_1\,(1-P_1)\,(I-P_2\,Y) - c\,m_2\,(1-P_2)\,(d_{\mathrm{soc}}+1)}{1-P_2},$$

which is positive if (17) holds. Along the same line,

$$W_{\mathrm{soc}}^{\mathrm{SL}} - W_{\mathrm{soc}}^{\mathrm{IS}} = c\,(m_1 + d_{\mathrm{soc}} - d_{\mathrm{soc}}\,m_2 - m_2),$$

which is positive if (18) holds. ■

Proof of Proposition 4. Comparing the threshold values in Proposition 1 and Proposition 3 shows that $\bar{c}_2/\bar{c}_1 = d_{\mathrm{soc}}/(1+d_{\mathrm{soc}})$, hence $\bar{c}_1 > \bar{c}_2$. ■

References

Allen, F., and D. Gale (2004): "Financial Intermediaries and Markets," *Econometrica*, 72(4), 1023–1061.

Altunbas, Y., L. Evans, and P. Molyneux (2001): "Bank Ownership and Efficiency," *Journal of Money, Credit and Banking*, 33(4), 926–954.

Andrianova, S., P. Demetriades, and A. Shortland (2008): "Government Ownership of Banks, Institutions, and Financial Development," *Journal of Development Economics*, 85(1-2), 218–252.

Armendáriz de Aghion, B. (1999): "Development Banking," *Journal of Development Economics*, 58(1), 83–100.

Bertrand, M., A. Schoar, and D. Thesmar (2007): "Banking Deregulation and Industry Structure: Evidence from the 1985 French Banking Act," *Journal of Finance*, 62(2), 597–628.

BMWI (2009): "Loan and Guarantee Program of the German Federal Government," http://www.bmwi.de/BMWi/Navigation/Presse/pressemitteilungen,did=292138.htm.

Boycko, M., A. Shleifer, and R. W. Vishny (1996): "A Theory of Privatisation," *Economic Journal*, 106(435), 309–319.

Campello, M., J. R. Graham, and C. R. Harvey (2009): "The Real Effects of Financial Constraints: Evidence from the Financial Crisis," SSRN.

CESifo (2009): "Rescue Packages," http://www.cesifo-group.de/portal/page/portal/DICE_Content/BUSINESS_AND_FINANCIAL_MARKETS/FINANCIAL_MARKETS/Banking/RP-recap-I.pdf.

Cole, S. A. (2009): "Fixing Market Failures or Fixing Elections? Agricultural Credit in India," *American Economic Journal: Applied Economics*, 1(1), 219–250.

Collie, D. R. (2000): "State Aid in the European Union: The Prohibition of Subsidies in an Integrated Market," *International Journal of Industrial Organization*, 18(6), 867–884.

Dewatripont, M., and E. Maskin (1995): "Credit and Efficiency in Centralized and Decentralized Economies," *Review of Economic Studies*, 62(4), 541–555.

Dewatripont, M., and P. Seabright (2006): "'Wasteful' Public Spending and State Aid Control," *Journal of European Economic Association*, 4(2-3), 513–522.

Dinç, I. S. (2005): "Politicians and Banks – Political Influences on Government-Owned Banks in Emerging Markets," *Journal of Financial Economics*, 77(2), 453–479.

European Commission (1998): "Sixth Survey on State Aid in the European Union in the Manufacturing and Certain Other Sectors," Discussion paper, Brussels.

European Economic Advisory Group (2007): *EEAG Report on the European Economy*. CESifo Group, Munich.

Giebe, T., T. Grebe, and E. Wolfstetter (2006): "How to Allocate R&D (and Other) Subsidies: An Experimentally Tested Policy Recommendation," *Research Policy*, 35(9), 1261–1272.

Hakenes, H., and I. Schnabel (2006): "The Threat of Capital Drain – A Rationale for Public Banks?," MPI Preprint 2006/11, Max Planck Institute for Research on Collective Goods.

Khwaja, A. I., and A. Mian (2005): "Do Lenders Favor Politically Connected Firms? Rent Provision in an Emerging Financial Market," *Quarterly Journal of Economics*, 120(4), 1371–1411.

Kornai, J. (1980): *Economics of Shortage*. North Holland Press, Amsterdam.

Kuziemko, I., and E. Werker (2006): "How Much Is a Seat on the Security Council Worth? Foreign Aid and Bribery at the United Nations," *Quarterly Journal of Economics*, 114(5), 905–930.

La Porta, R., F. Lopez De Silanes, and A. Shleifer (2002): "Ownership Of Banks," *Journal of Finance*, 57(1), 265–302.

Sapienza, P. (2004): "The Effects of Government Ownership on Bank Lending," *Journal of Financial Economics*, 72(2), 357–384.

Scott, D. H. (2007): "Strengthening the Governance and Performance of State-Owned Financial Institutions," Discussion paper, World Bank Policy Research Working Paper No. 4321, World Bank, Washington D. C.

Shaffer, S. (1998): "The Winner's Curse in Banking," *Journal of Financial Intermedation*, 7(4), 359–392.

Shleifer, A., and R. W. Vishny (1994): "Politicians and Firms," *Quarterly Journal of Economics*, 109(4), 995–1025.

United Nations (2005): "Rethinking the Role of National Development Banks," Discussion paper, Ad Hoc Expert Grout Meeting "Rethinking the Role of National Development Banks", New York, 1-2 December 2005.

Vittas, D., and Y. J. Cho (1995): "Credit Policies. Lessons from East Asia," Discussion paper, World Bank Policy Research Working Paper No. 1458, World Bank, Washington D. C.

White House Press Secretary (2009): "Geithner, Summers Convene Official Designees to Presidential Task Force on the Auto Industry," http://www.whitehouse.gov/the_press_office/Geithner-Summers-Convene-Official-Designees-to-Presidential-Task-Force-on-the-Auto-Industry/.

Ifo Working Papers

No. 70 Röhn, O., S. Orazbayev and A. Sarinzhipov, An Institutional Risk Analysis of the Kazakh Economy, May 2009.

No. 69 Ziegler, C., Testing Predicitive Ability of Business Cycle Indicators, March 2009.

No. 68 Schütz, G., Does the Quality of Pre-primary Education Pay Off in Secondary School? An International Comparison Using PISA 2003, March 2009.

No. 67 Seiler, C., Prediction Qualities of the Ifo Indicators on a Temporal Disaggregated German GDP, February 2009.

No. 66 Buettner, T. and A. Ebertz, Spatial Implications of Minimum Wages, February 2009.

No. 65 Henzel, S. and J. Mayr, The Virtues of VAR Forecast Pooling – A DSGE Model Based Monte Carlo Study, January 2009.

No. 64 Czernich, N., Downstream Market structure and the Incentive for Innovation in Telecommunication Infrastructure, December 2008.

No. 63 Ebertz, A., The Capitalization of Public Services and Amenities into Land Prices – Empirical Evidence from German Communities, December 2008.

No. 62 Wamser, G., The Impact of Thin-Capitalization Rules on External Debt Usage – A Propensity Score Matching Approach, October 2008.

No. 61 Carstensen, K., J. Hagen, O. Hossfeld and A.S. Neaves, Money Demand Stability and Inflation Prediction in the Four Largest EMU Countries, August 2008.

No. 60 Lahiri, K. and X. Sheng, Measuring Forecast Uncertainty by Disagreement: The Missing Link, August 2008.

No. 59 Overesch, M. and G. Wamser, Who Cares about Corporate Taxation? Asymmetric Tax Effects on Outbound FDI, April 2008.

No. 58 Eicher, T.S: and T. Strobel, Germany's Continued Productivity Slump: An Industry Analysis, March 2008.

No. 57 Robinzonov, N. and K. Wohlrabe, Freedom of Choice in Macroeconomic Forecasting: An Illustration with German Industrial Production and Linear Models, March 2008.

No. 56 Grundig, B., Why is the share of women willing to work in East Germany larger than in West Germany? A logit model of extensive labour supply decision, February 2008.

No. 55 Henzel, S., Learning Trend Inflation – Can Signal Extraction Explain Survey Forecasts?, February 2008.

No. 54 Sinn, H.-W., Das grüne Paradoxon: Warum man das Angebot bei der Klimapolitik nicht vergessen darf, Januar 2008.

No. 53 Schwerdt, G. and J. Turunen, Changes in Human Capital: Implications for Productivity Growth in the Euro Area, December 2007.

No. 52 Berlemann, M. und G. Vogt, Kurzfristige Wachstumseffekte von Naturkatastrophen – Eine empirische Analyse der Flutkatastrophe vom August 2002 in Sachsen, November 2007.

No. 51 Huck, S. and G.K. Lünser, Group Reputations – An Experimental Foray, November 2007.

No. 50 Meier, V. and G. Schütz, The Economics of Tracking and Non-Tracking, October 2007.

No. 49 Buettner, T. and A. Ebertz, Quality of Life in the Regions – Results for German Counties, September 2007.

No. 48 Mayr, J. and D. Ulbricht, VAR Model Averaging for Multi-Step Forecasting, August 2007.

No. 47 Becker, S.O. and K. Wohlrabe, Micro Data at the Ifo Institute for Economic Research – The "Ifo Business Survey", Usage and Access, August 2007.

No. 46 Hülsewig, O., J. Mayr and S. Sorbe, Assessing the Forecast Properties of the CESifo World Economic Climate Indicator: Evidence for the Euro Area, May 2007.

No. 45 Buettner, T., Reform der Gemeindefinanzen, April 2007.