

INCENTIVE EFFECTS OF BENEVOLENT INTERVENTION

The case of government loan guarantees

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Received October 1983, revised version received July 1984

There has been a substantial recent growth in government loan guarantees to ailing firms in the United States. This paper investigates the potential incentive effects of this practice. Using the simplest available two-period model, it is shown that when firms know that loan guarantees may be forthcoming, they may be induced to adopt riskier investments and take on more leverage. These perverse incentive effects imply that the actual loan-guarantees-related contingent liability of the government could be much larger than suspected. Our policy recommendation is that the government either abandon the practice altogether or set up a federal agency that sells loan guarantees to *all* firms at prices that depend on the riskiness of the firm's assets and its leverage.

1. Introduction

Since 1971, U.S. government guaranteed loans have tripled in amount from \$38.7 billion in 1971 to \$123.1 billion in 1981.¹ Most notable in this increase are the \$245 million in guarantees to Lockheed in 1971, the \$365.2 million in guarantees to five steel firms in 1979, and the \$700 million in guarantees to the Chrysler Corporation in 1980. The proffered explanation for issuing these guarantees is that such government support prevents the companies involved from going bankrupt and thus preserves jobs. For instance, the Commerce Department estimated that the guarantees to the steel companies saved 52 000 jobs in 1979. Loan guarantees enable the firm to raise money at credit terms more favorably than those the firm would be able to receive otherwise.

However, despite these apparent benefits, the recent size and types of guaranteed loans have caused considerable concern and controversy. One problem is that although they are sizable contingent liabilities, loan guarantees

¹The information regarding government guarantees was taken from a series of articles in both *Business Week* (30 January 1978 and 1 October 1979) and *Forbes* (29 October 1979 and 26 October 1981).

do not appear in the federal budget. Members of Congress find guarantees attractive because even Congressmen who are publicly against increased spending can appease firms in their constituencies by incurring the 'hidden' potential expenditures associated with loan guarantees. Because the loans do not appear in the budget, the actual liability that the government has incurred is difficult to measure [see Sosin (1980)].

Another problem is the recent change in the types of loan guarantees being granted by the government. The early type of loan guarantees involving the government were provided through small, actuarially sound programs. These programs provided guarantees for small loans, generally to individuals, in which the risks of the government were pooled across a large number of loans. The aggregate risk to the government was minimal because the fees that were charged covered all operating costs and any probable losses the government might incur. However, recently the nature of loan guarantees has undergone a metamorphosis. The focus has shifted from these small, actuarially sound programs to programs which guarantee the debts of large ventures. Examples of such large ventures are the guarantees to Lockheed and Conrail. Many of these large ventures have substantial uncertainty regarding future profitability and their assets commonly have limited and highly volatile disposal values. In these cases, the potential risks to the government are largely 'uncovered'.

Possibly in recognition of these problems, the Office of Management & Budgets (OMB) has been trying to impose a ceiling on the amount of loan guarantees. Another reason for recommending a ceiling is the issue of fairness; there are firms without guarantees that have to rely solely on their own ability to repay debt, which creates an asymmetric government subsidy. Since the amount of guaranteed loans outstanding is substantial, this essentially puts the government in the business of allocating credit rather than just making private borrowers more creditworthy. This problem becomes even more acute as the outstanding amount of loan guarantees increases.

Adding to the controversy surrounding loan guarantees is another potential problem that has been ignored in policy discussions of the issue as well as in the literature. Federal intervention in the economy, through loan guarantees, *may appear* nominal because the government assumes that the decision-making process of the lenders and the borrowers will not be perversely affected by the guarantees. However, since the firm can receive favorable rates on guaranteed debt, it has a motivation to raise money for new investments using more debt. Also, since most firms receiving loan guarantees are in a temporary financial bind, the firm might attempt to alleviate this problem by using the loans to choose riskier projects with higher returns. Similarly, the lenders may become more occupied with the guarantee than with their evaluation of the characteristics of the project. The purpose

of this paper is to examine these incentive effects of guaranteed loans. We analyze the potential impact of loan guarantees on the debt/equity ratios and types of projects chosen by firms that expect to be future recipients of guarantees.

The rest of the paper is organized as follows. In section 2, a model is developed in which capital structure 'matters', in the sense that the firm chooses an interior optimum with respect to its debt–equity ratio.² In this section it is assumed that no government loan guarantees are available. In section 3, government intervention is introduced through the possibility that the government *may* guarantee the debt of the firm. It is shown that as the probability that the government will guarantee the debt of the firm increases, the firm will finance projects with more debt and will eventually choose riskier projects. In essence, the government increases the risk of healthy firms by adopting the practice of granting loan guarantees to distressed firms. Thus, the model illuminates the perverse incentive effects of government loan guarantees. A point to be noted is that our model predicts that the firms which assume higher leverage and take on more risk are those that *anticipate* that there is a good chance the government will guarantee their loans if they are in financial distress. Hence, the financial controls the government may impose *subsequent* to the granting of the actual loan guarantee to the firm are irrelevant to our discussion. *Our focus is on the incentive effects*, on firms at large in the economy, *of the knowledge that firms with substantial workforces are unlikely to be allowed to go bankrupt* by the government. Section 4 concludes.

2. Basic capital structure model

2.1. *The economy*

Our objective is to use the simplest possible model that conveys the basic ideas. All agents are risk neutral. Assume that an owner–manager has the opportunity to invest in one of two mutually exclusive projects, project A or project B, which will yield cash flows over the next two periods.³ The

²Other authors with models that demonstrate the relevance of capital structure include Rubinstein (1973), Stiglitz (1972), Kraus and Litzenberger (1973), Myers (1977), Jensen and Meckling (1976), Heinkel (1982), and Lee, Thakor and Vora (1983).

³The restriction to two mutually exclusive projects is primarily illustrative and may be relaxed to address issues somewhat different from those we touch upon. For example, we show later that there exists a critical probability q' such that if the firm perceives the probability of obtaining a future loan guarantee as exceeding q' , it prefers the riskier project, and if it perceives it as being less than q' , it chooses the safer project. But if the firm were allowed to invest in both projects, it is possible that both would be profitable. Thus, as the loan guarantee probability increases, the concomitant reduction in the cost of debt financing to the firm as well as an increase in the value of outside equity would imply an increase in the overall profitability of the firm's capital budget.

beginning of period 1 is denoted time 0, the end of period 1 and the beginning of period 2 are denoted time 1, and the end of period 2 is denoted time 2. It is assumed that managerial effort is capable of affecting project cash flows. [For other papers that employ this assumption, see Holmstrom (1982) and Ramakrishnan and Thakor (1982, 1984).] The manager's effort is designated by a and, for simplicity, the manager's feasible action space is restricted to $\{0, 1\}$. The owner-manager's disutility for effort is $a\zeta$, where ζ is a strictly positive, real-valued scalar. In the first period, project A has a positive cash flow of $R_A(a)$ with probability s if the owner-manager's effort level in that period is a . We assume $R_A(1)$ is greater than $R_A(0)$. Project A has a probability of $(1-s)$ of achieving a zero cash flow in the first period regardless of the effort level in that period. However, project A's cash flow in the second period is stochastically dependant on the first period's outcome. If the good state (positive cash flow) occurs in the first period, the same returns and probabilities of success are repeated in the second period. If the poor state (zero cash flow) occurs in the first period, however, the probability of success in the second period is reduced from s to r . Fig. 1 provides a summary of the two-period probabilities and returns.

Similarly, in the first period, project B has a positive payoff of $R_B(a)$ with probability p if the owner-manager's effort level in the period is a . We assume $R_B(1)$ is greater than $R_B(0)$. Also, project B has a probability of $(1-p)$ of yielding a zero cash flow in the first period regardless of the effort level chosen. And, project B's returns and probabilities of success are repeated in the second period if the good state occurs in the first period. If the first period's cash flow is zero, project B's probability of success in the second period is reduced from p to t . Fig. 2 summarizes these events pictorially. The expected payoff of project A is greater than the expected payoff of project B. This is achieved by assuming that s is greater than p and r is greater than t . But we assume $R_B(a) > R_A(a) \forall a \in \{0, 1\}$. That is, the actual payoff of project B is higher in the successful state than that of project A. Each project needs two investments in order to yield cash flows over two periods. One investment is needed at time 0 and the other investment is needed at time 1 (the end of the first period). These investments are I_0 and I_1 , respectively. The initial investment I_0 must be financed by issuing debt, outside equity, or a combination of debt and equity. The investment needed at the end of the first period is financed either internally or externally, depending on the results of the first period's outcome. If the first period cash flow is positive, I_1 is raised internally through retained earnings and is subtracted from the cash flow before the investors are given any returns. If the first period's cash flow is zero, however, I_1 must be financed by issuing additional debt and/or equity. We assume that $I_0[1+i]/s < R_A(0)$, where i is the one period riskless rate of interest. The significance of this assumption is that, even if the entire initial financing is raised with debt and project A with

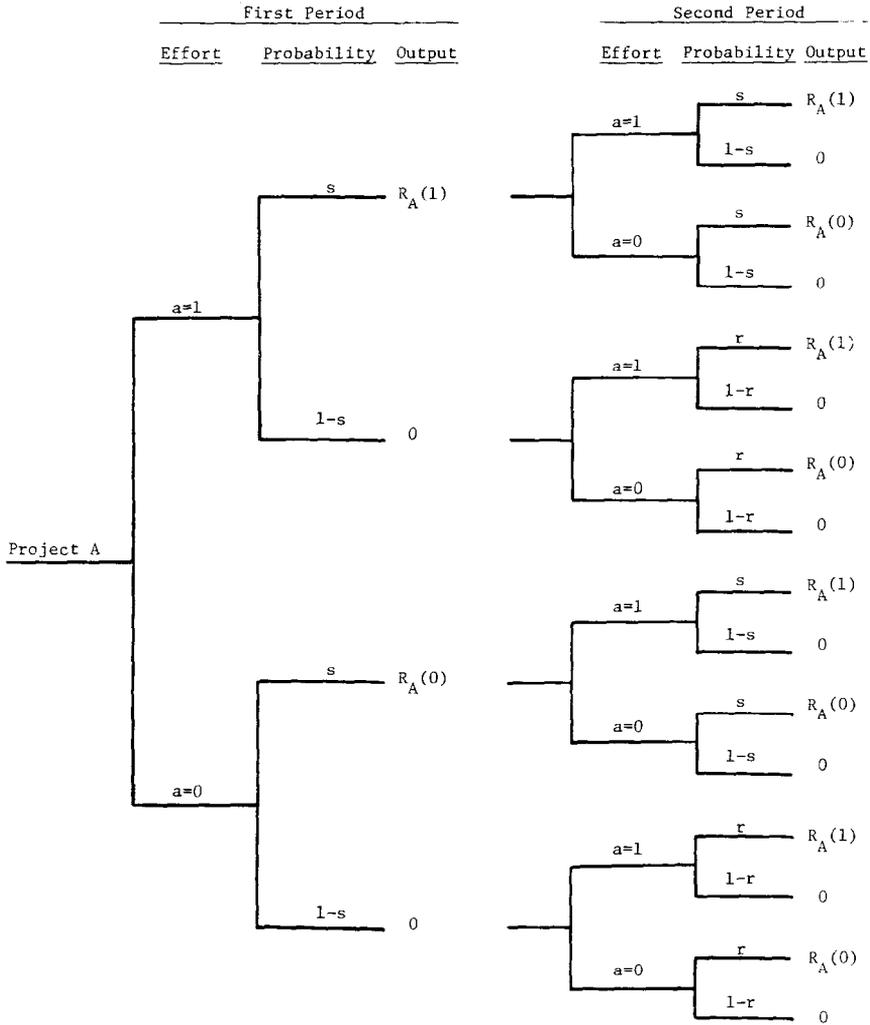


Fig. 1. Returns and probabilities for project A.

$a=0$ is chosen (which generates the lowest possible cash flow in the successful state), the firm's cash flow is sufficient to completely settle the bondholders' claims in the successful state. This makes the bondholders indifferent to the owner-manager's choice of a .

The problem can be summarized as follows. The owner-manager wishes to raise I_0 dollars at the beginning of the first period and I_1 dollars at the end of the first period (if feasible) to invest in the project that yields him the

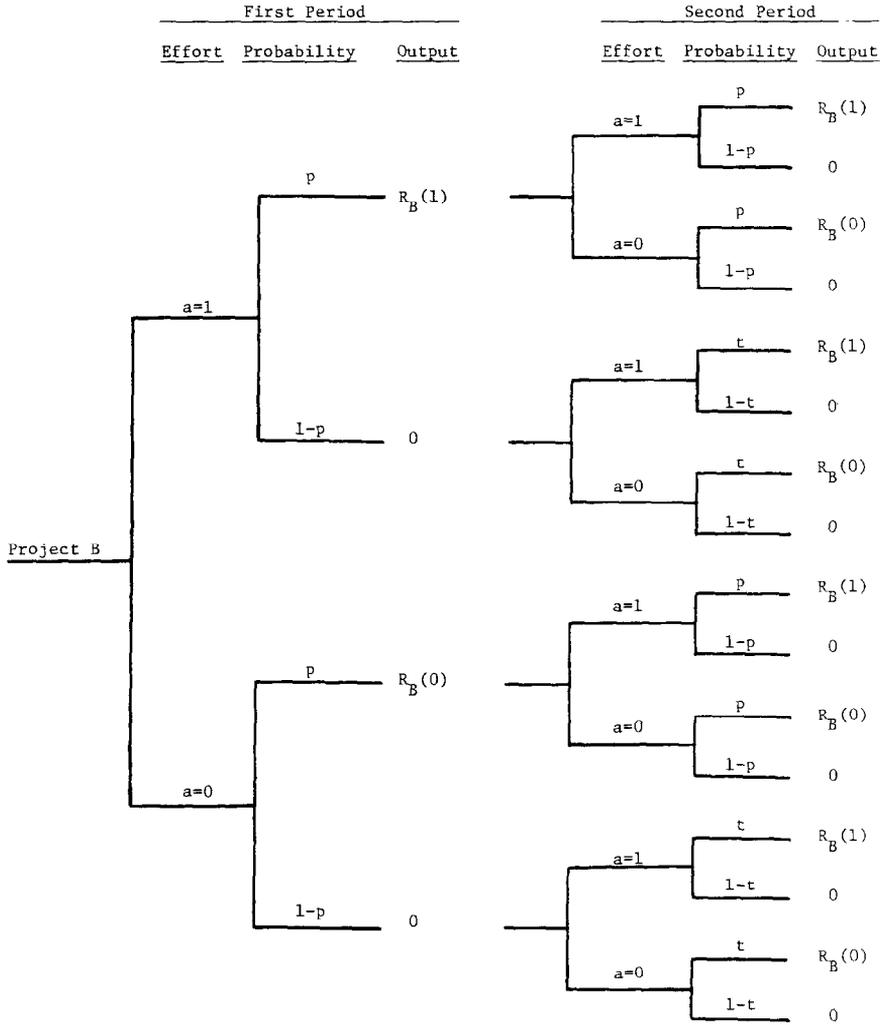


Fig. 2. Returns and probabilities for project B.

highest expected utility, subject to the constraint that all bondholders and outside shareholders in each period earn a competitive return consistent with the risk borne. In other words, in a rational-expectations equilibrium the beliefs of bondholders and shareholders about the owner-manager's choice of project and effort level are 'self-confirming'. This ensures that these financial instruments will be correctly priced [see Jensen and Meckling (1976)].

2.2. Sources of moral hazard

In this model moral hazard arises because the investors delegate decision authority to the owner–manager. In general, moral hazard exists if the agent (in this case, the owner–manager) can take an action which hurts the principal (in this case, the investors). Moral hazard in principal–agent settings is discussed extensively in Jensen and Meckling (1976), Shavell (1979), Harris and Raviv (1979), Holmstrom (1979), and Baiman and Demski (1980). In our model, moral hazard exists because the owner–manager has disutility for effort and *because neither the project choice nor his actions can be observed ex post by investors*. Specifically, the owner–manager can ‘promise’ to adopt some project and choose $a=1$, and then renege possibly on both ‘promises’, if doing so is in his best interest. The moral hazard relevant for the first period bondholders is related to the possibility of projects being switched ex post. The bondholders are indifferent to the owner–manager’s effort level because managerial effort does not affect the success probabilities of projects. It affects only the return in the successful state, and this return, for both projects, exceeds the promised payment to the bondholders, even with $a=0$. Also, the bondholders cannot completely protect themselves using debt covenants that require the owner–manager to choose a particular project, because the projects are *indistinguishable ex post* to outsiders. The moral hazard relevant for the shareholders is related to the owner–manager’s ability to switch projects and also his propensity to choose $a=0$ and produce a smaller cash flow. As mentioned earlier, the ‘agency costs’ introduced by these moral hazard problems will, in a rational expectations equilibrium, be borne completely by the owner–manager. Hence, the onus for minimizing these costs rests with the owner–manager, and he will optimize by choosing an optimal mix of debt and equity.

The assumption that project choice is unobservable ex post is important for our theory, despite the fact that investors know the returns under both projects and can, therefore, deduce — in the good state — what project was undertaken. If project choice is observable ex post, investors can negotiate contingent contracts ex ante that can completely eliminate the moral hazard relevant for bond-holders. Bond covenants would stipulate precisely the project the owner–manager should undertake, with an extreme penalty for violation. With (costless) ex post project choice observability, any deviation from the stipulated project choice can be detected and the penalty clause can be activated. With a sufficiently large penalty, the owner–manager will have no incentive to choose any project other than the stipulated project.⁴ Note

⁴If the project choice is (costlessly) observable ex post by outsiders, it is in the owner–manager’s interest to select a bond contract that includes a covenant specifying the choice of a specific project, with penalties for violation. Such a selection would dominate the existing arrangement because it would eliminate the moral hazard affecting the bondholders, the cost of which is currently borne by the owner–manager in equilibrium.

that such a mechanism is *not* feasible without ex post project choice observability. The reason is that, *even though the owner–manager’s actual project choice may be deduced, penalties for deviations from prespecified actions cannot always be enforced.* The owner–manager can falsely claim that the stipulated project was chosen and in the bad state there would be no way to *prove* otherwise; such conclusive proof (mutual verifiability) would be required to enforce contractually agreed upon penalties. Although ex post identification of project choice is possible in the good state, we assume lack of legal enforceability of bondholder penalties when the firm settles bondholders’ claims completely.

In practice, even though actual project choices may often be observable ex post, firms usually have some leeway in influencing the return distributions of their projects through undetected asset substitutions. [See Haley and Schall (1979) and Jensen and Meckling (1976), for example.] Thus, our assumption should be taken to imply that bondholders cannot perfectly monitor and control actions that the firm could take to their detriment.

2.3. *Choice of capital structure in a competitive capital market*

Let I_d be the amount of funds raised initially by issuing debt and I_e the amount raised by issuing equity. The budget constraint is $I_0 = I_d + I_e$. The amount I_1 will have to be raised *externally* at time one only if the first period cash flow is zero.⁵ In a model such as this, the temptation for the government to intervene with a loan guarantee arises *only if the firm is compelled to declare bankruptcy (in the bad state) at time one in the absence of a guarantee.*⁶ This follows from the premise that the main rationale for a loan guarantee is the preservation of jobs. Thus, in order to create a rationale for loan guarantees (at time 1), in the next section we choose our parameter values such that it is impossible for the firm to obtain any kind of external financing at time 1 (in the absence of a guarantee) if the first period cash flow is zero. Additional debt at time 1 is not available because, without a loan guarantee, the *total* debt repayments exceed the *maximum* possible second period cash flow. And additional equity at time 1 is unavailable because either (i) total equity ownership with additional equity exceeds 100 percent (with no new debt at time one), or (ii) shareholders cannot claim a positive share of the output (even in the good state) since debt repayment exceeds the maximum possible second period cash flow.

⁵If the good state occurs at time 1, the project generates a cash flow that is sufficient to cover the refinancing required then. Because this internally generated cash flow is available, the owner–manager will avoid external financing. The reason is that external financing carries with it the cost of moral hazard, a cost that is borne by the owner–manager in equilibrium. Internal financing entails no such costs and is, therefore, less expensive.

⁶Bankruptcy and liquidation are treated as being synonymous here by virtue of the assumption that only the owner–manager has the special skills needed to manage the firm. Takeover by the creditors upon bankruptcy results in the owner–manager being ousted and the firm being liquidated.

The upshot of assuming such parameter values is that the firm will continue in the second period *only* if the good state has occurred at time 1 and I_1 can be raised internally. Hence, *the first period contract with bondholders* (who contributed to I_0) *is based on the assumption that the firm will exist for only one period.* This is because continuation of the firm in the second period occurs only if the first period bondholders' claims are *completely* settled, and in this case these bondholders do not care about the second period cash flow.

Since investors are risk neutral and the capital market is competitive, the amount, I_d , invested initially by the bondholders should equal the discounted present value of their expected payoff. Let D_j represent the face value of the debt, conditional on the bondholders assuming that project j will be chosen. Define I_d^j as the proceeds from the sale of debt in this case. The following competitive consistency equations must then be satisfied

$$I_d^A = b_1 s D_A \quad \text{or} \quad D_A = I_d^A / b_1 s, \tag{1}$$

$$I_d^B = b_1 p D_B \quad \text{or} \quad D_B = I_d^B / b_1 p, \tag{2}$$

where $b_1 \equiv 1/[1+i]$.

The risk neutral shareholders must also be given a competitive return on their investment. Thus, the shareholders' investment must equal the discounted present value of their share of the expected cash flow. Let $Z_{\bar{a}, \bar{a}}^j$ represent the fraction of the residual cash flow — after bondholders are paid off — accruing to the outside shareholders when it is assumed (ex ante) that the owner–manager will choose project j and an effort level of \bar{a} in each period. Since there are four combinations of effort levels over the two periods for *each* project, there are eight possible competitive consistency equations that must hold for any equity investment level. For a given level of debt and equity financing, the following are examples of the equity equations that must hold if project $j(j=A, B)$ is adopted and the owner–manager chooses effort equal to one in each period (note that $b_2 \equiv 1/[1+i]^2$):

$$I_e^A = b_1 s [Z_{1,1}^A] [R_A(1) - D_A - I_1] + b_2 s^2 [Z_{1,1}^A] R_A(1), \tag{3}$$

$$I_e^B = b_1 p [Z_{1,1}^B] [R_B(1) - D_B - I_1] + b_2 p^2 [Z_{1,1}^B] R_B(1). \tag{4}$$

The remaining six values of $Z_{\bar{a}, \bar{a}}^j$ are determined in a similar manner. Clearly, $[1 - Z_{\bar{a}, \bar{a}}^j]$ is the fraction of the cash flow retained by the owner–manager in each period that the firm continues.

In appendix A we provide conditions under which, without government intervention, the owner–manager will choose project A and also select $a=1$.

⁷Observe that the owner–manager enjoys successively higher levels of expected utility as q increases. Though not surprising, this reinforces the point made in footnote 3.

These conditions also ensure that the investment at time zero will be raised partly from debt and partly from equity. That is, an interior optimal capital structure is obtained without the use of taxes. This result itself is of interest, because it represents a *formal* confirmation of Jensen and Meckling's (1976) conjectures.

3. Government intervention

3.1. Firm behavior

At time 0, the owner–manager cannot be sure that the government will guarantee, at time 1, the debt of the firm if bankruptcy is imminent then without the guarantee. But at time 0, the owner–manager will be able to assign some probability q that the firm's debt will be guaranteed. This value of q will be used by the owner–manager to establish the proportions of debt and equity to employ in the outside financing raised and to decide which project will be chosen at time 0. We view the government as a (benevolent) party that weighs the costs and benefits of providing guarantees in determining the fraction of loan guarantee requests (from firms of a particular type) that it should honor. This fraction, deduced from observed government behavior over a sufficiently long time period, is then taken by each firm (of that type) as its q . Because the deduction is from observed behavior and by assumption everybody starts out with the same priors, we assume that the *same* probability q is held by the firm and the investors.

There is a critical value of q which determines the project and financing mix the owner–manager chooses. This value of q is labeled q' , with $0 < q' < 1$. If q is zero, investors price their investments in the same manner as in the competitive equilibrium 'single period' model. That is, the owner–manager still chooses project A with an interior financing mix.

If q is greater than zero but less than q' , investors believe that there is a chance that the firm will receive a guarantee at time 1. This has two effects. First, it directly lowers the cost of debt financing. Second, the availability of a loan guarantee at time 1 means that bond refinancing can take place then at the riskless rate. (If the guarantee is not actually available, there will be no continuation at time 1.) This reduces the firm's expected repayment obligation, and since first period bondholders and shareholders price their securities taking this into account, the values of the firm's equity and debt are both enhanced. The optimal interior solution is still project A. But the amount of debt financing increases. Note that *conditional* on the loan guarantee being available, there is *no* uncertainty about whether the firm will continue for two periods.

If q is greater than q' , the first period investors have a very high expectation that the firm will receive a loan guarantee. In this case, the rates

on debt financing are lowest and the expected utility of the owner–manager is greatest with the riskier project, namely project B. The result is even more debt financing. Therefore, q' is the value of q at which the owner–manager switches projects. Each case is evaluated in more detail in the next two subsections.

3.2. Probability q is between zero and q'

When $q \in (0, q']$, all investors determine the required rates of return on their investments assuming the firm will last for two periods with probability $s + [1 - s]q$ if it selects project A and probability $p + [1 - p]q$ if it selects project B. The rational pricing of debt implies that the following competitive consistency equations are satisfied:

$$I_d^A = b_1 s D_A + b_2 \{1 + i\} [1 - s] q D_A, \tag{5}$$

$$I_d^B = b_1 p D_B + b_2 \{1 + i\} [1 - p] q D_B. \tag{6}$$

The second term in each of these equations is the expected payoff to the bondholders if the firm continues in the second period. The probability that the firm will continue, conditional on its first period cash flow being zero, is q and this appears in both equations. It is assumed that if the first period cash flow is zero and the government intervenes, the firm's debt will be renewed for an additional period at the riskless rate. This makes sense because the firm continues only if there is a loan guarantee, and the bondholders' payoff in this case is riskless. Rewriting eqs. (5) and (6) yields:

$$D_A = I_d^A / [b_1 \{s + (1 - s)q\}], \tag{7}$$

$$D_B = I_d^B / [b_1 \{p + [1 - p]q\}]. \tag{8}$$

It is now apparent why continuation of the firm in the second period is feasible. As q increases in (7) and (8), the face value of debt, D_A , required to bring in a desired level of debt financing, I_d^A , declines. Thus, the firm's debt repayment obligation is reduced. This reduction implies that, if the first period output is zero, and bondholders are asked to renew the debt contract for an additional period, the firm's repayment obligation at the end of the second period will not exceed the second period cash flow. Now if the first period cash flow is zero, the additional investment, I_1 , must be raised externally at the beginning of the second period. This additional investment can be financed with more debt, I_{dd} , and/or with additional equity, I_{ee} , with $I_1 = I_{dd} + I_{ee}$. Let D_{jj} represent the face value of the additional debt incurred by the firm at time 1 with project j having been adopted at time 0. This debt

must be repaid at time 2. Let I_{dd}^j be the receipts from the sale of this debt. The following competitive consistency equations must then be satisfied:

$$I_{dd}^A = b_1 D_{AA}, \quad (9)$$

$$I_{dd}^B = b_1 D_{BB}. \quad (10)$$

If moral hazard considerations could be abstracted from in an economy characterized by universal risk neutrality, the owner–manager would find outside equity and debt equally desirable. At time 1, if the firm receives a loan guarantee, its debt becomes riskless and thus, as far as the bondholders are concerned, there is no moral hazard. But this loan guarantee does not eliminate the owner–manager’s propensity to choose $a=0$ for the second period. Consequently, equity-related moral hazard still persists. The price of external equity will reflect this. The owner–manager will, therefore, find it in his best interest to use only debt for the incremental financing required at time one. Thus, $I_{ec}^j = 0, \forall j$. Assuming, for illustrative purposes, that project A has been chosen and that the owner–manager takes $a=1$ in the first period, $a=1$ in the second period if the first period cash flow is positive, and $a=0$ in the second period if the first period cash flow is zero, the competitive consistency conditions for the pricing of the equity purchases at *time zero* are

$$\begin{aligned} I_e^A = & [Z_{1,1,0}^A][b_1 s \{R_A(1) - D_A - I_1\} + b_2 s^2 R_A(1) \\ & + b_2(1-s)r\{R_A(0) - (1+i)D_A - D_{AA}\}q], \end{aligned} \quad (11)$$

$$\begin{aligned} I_e^B = & [Z_{1,1,0}^B][b_1 p \{R_B(1) - D_B - I_1\} + b_2 p^2 R_B(1) \\ & + b_2(1-p)t\{R_B(0) - (1+i)D_B - D_{BB}\}q]. \end{aligned} \quad (12)$$

As in the basic model, the shareholders’ and the bondholders’ beliefs about the owner–manager’s choice of project and effort levels are self-confirming. Therefore, the owner–manager will choose project A when q is between zero and q' and the solution will include part debt and part equity financing at time 0 and (if necessary) all debt financing at time 1. Our analysis in appendix B reveals that the owner–manager continues to choose project A with the first period effort equal to 1 and the second period effort also equal to 1, conditional on the good state occurring in the first period. But if the bad state is encountered and the first period cash flow is zero, it is impossible to motivate the owner–manager to opt for $a=1$ in the second period. The reason is that, due to the intertemporal correlation between project cash flows, the probability of second period success is lowered so much by first period failure that the incremental private gain to the owner–manager—

given his effort disutility function — from choosing $a=1$ as opposed to $a=0$ is insufficient. Thus, if the first period cash flow is zero, the owner–manager chooses $a=0$ in the second period.

3.3. Probability q is greater than q'

Suppose the owner–manager believes that the probability is very high that the government will provide a loan guarantee at time 1 if the first period cash flow is zero. Debt financing then becomes even more attractive to the owner–manager because the yield on debt falls sharply as creditors perceive lower risk. As q approaches 1, the face value of debt for project B approaches the face value of debt for project A for any fixed level of receipts, I_d . In this case, the owner–manager is able to increase his expected utility by choosing the riskier project because it leads to a potentially higher cash flow without inviting an increase in the cost of debt. Therefore, q' is the value of q at which the owner–manager's expected utility from choosing project B exceeds the expected utility from choosing project A. For all values of q greater than q' , project B is selected with progressively higher debt financing levels at time 0.

Hence, the probability that a loan guarantee from the government may be forthcoming has a potential impact on the risk profile of the firm's investments as well as its capital structure.

3.4. Numerical illustration

We now illustrate the main points of this section with a numerical example. Let

$$s=0.75, \quad p=0.60, \quad r=0.18, \quad t=0.10,$$

$$i=0.05, \quad \zeta=3, \quad I_0=40, \quad I_1=15,$$

$$R_A(1)=70, \quad R_A(0)=62, \quad R_B(1)=86, \quad R_B(0)=76.$$

The critical value for q is $q'=0.68$. Now consider three cases: q is 0, q is 0.50, and q is 1. When q is 0, the owner–manager will not continue in the second period if the first period cash flow is zero. The optimal solution is project A with $a=1$ in period 1 and $a=1$ in period 2 if the firm continues in that period. The owner–manager's expected utility is 30.102 and the optimal interior level of debt financing can take any value between 6 and 29.

When q is 0.50 (which is between zero and q'), the firm continues for a second period if its first period cash flow is positive or its first period cash flow is zero and a loan guarantee is actually available. The owner–manager

still chooses project A with $a=1$ in period 1, $a=1$ in period 2 following the good state at time 1, and $a=0$ in period 2 following the bad state (and a loan guarantee) at time 1. The owner–manager’s expected utility is 34.7945 and the optimal level of debt financing is 32 in the first period. If the first period cash flow is zero, the additional debt financing used in the second period is 15.

Finally, when q is 1 (which is strictly greater than q'), debt becomes riskless and D_A is equal to D_B . In this case, the owner–manager switches to project B with the same effort levels as with q less than q' . The owner–manager’s expected utility is 40.74 and the optimal level of debt financing is 40 in the first period. If the first period cash flow is zero, additional second period debt financing is 15. Note that since the owner–manager has switched projects, the probability of project failure is greater in *each* period. This has two significant implications. First, because the probability of first period failure goes up, the likelihood that the government will be asked to provide a loan guarantee at time 1 also increases. This means that the government’s willingness to accommodate some loan guarantee requests may have *the inadvertent effect of stochastically increasing the number of requests for loan guarantees in the future*. Second, since the probability of second period failure also goes up, the likelihood that the government will actually have to ‘deliver’ on its guarantees (by settling the claims of the firm’s creditors) also increases. This is another way in which the government unwittingly increases its contingent liability.

4. Concluding remarks

The basic appeal of a free market system is that competitive behavior by all market participants leads to an efficient allocation of resources. This resource allocation is Pareto optimal and hence cannot be improved upon by (benevolent) government intervention. From time to time, however, the government deems it necessary to intervene in some manner. Because informational and other imperfections hamper perfect competition, such governmental initiative is often well advised. Examples are some antitrust actions and certain regulations in the food and drugs industries. But whether the issuance of loan guarantees is advisable, is debatable. Now that Chrysler seems to have recovered, many will argue that rescuing it was a good idea and some may press for increased government involvement in loan guarantees. That, however, is ‘twenty-twenty hindsight’ and can hardly be used as the basis for assessing the social desirability of government loan guarantees. We are *not* suggesting that the bailing out of a financial distressed firm is always *ex post inefficient*. There will, of course, be many instances in which a rescued firm will ‘tighten its belt’ and do very well after having received a guarantee. Thus, jobs will be saved and a decline in competition within the

industry avoided. Such economic benefits will lead to gains on the political front for those in government. These are the obvious benefits of loan guarantees. But there are also costs. These costs are related to the incentive effects of loan guarantees and have been the subject of our research.

Our analysis paves the way for a few policy prescriptions. Our most significant suggestion is that the government take the unpredictability out of its loan guarantee program. It should either completely eschew loan guarantees or, if that is considered unacceptable, it should make guarantees available to *all* firms. This could be achieved by setting up a federal agency akin to the FDIC. This agency could make loan (guarantee) insurance available to any firm for a price (premium). The insurance premium would be sensitive to the firm's asset risk and financial leverage. Consequently, a pricing mechanism could be used to combat the potentially perverse effects of loan guarantees.

Appendix A: Analysis of the case in which the firm exists for only one period if the first period cash flow is zero (i.e. $q=0$)

There are eight possible contracts for each level of financing that can be offered to the bondholders and the shareholders. In this case there is no loan guarantee and q is zero. These contracts are:

Contract	Outside shareholders' fractional ownership	Face value of debt
1	$Z_{1,1}^A$	D_A
2	$Z_{1,0}^A$	D_A
3	$Z_{0,1}^A$	D_A
4	$Z_{0,0}^A$	D_A
5	$Z_{1,1}^B$	D_B
6	$Z_{1,0}^B$	D_B
7	$Z_{0,1}^B$	D_B
8	$Z_{0,0}^B$	D_B

There are two types of constraints that must be met for a contract to be optimal. First, the contract must be incentive compatible. This means that the contract should be such that the owner-manager has no incentive to switch projects or effort levels after the contract is negotiated. The second type of constraint guarantees that the owner-manager's expected utility from the chosen contract, at the optimal interior financing mix, is greater than the expected utility from any other feasible contract. In this appendix, constraints

are listed that insure that the owner–manager finds it optimal to choose project A with effort level $\mathbf{a}=1$ in each period that the firm continues. Let $\mathbf{a}^*=(1, 1)$ denote the owner–manager’s effort vector when he chooses $\mathbf{a}=1$ in both periods. Also, let $\mathbf{a}^0=(0, 0)$ denote the effort vector when the owner–manager chooses $\mathbf{a}=0$ in both periods. Other effort combinations are defined analogously.

The following incentive compatibility constraints are needed to insure that, *subsequent* to having negotiated contract 1 with the outside financiers by promising to invest in project A and choose \mathbf{a}^* , the owner–manager will indeed opt for project A with \mathbf{a}^* .

Project A with \mathbf{a}^* is preferred to project A with \mathbf{a}^0 , which implies that

$$\begin{aligned} & \{1 - Z_{1,1}^A\} b_1 s [R_A(1) - R_A(0)] + b_2 s^2 \{1 - Z_{1,1}^A\} [R_A(1) - R_A(0)] \\ & \geq [b_1 + s b_2] \zeta. \end{aligned} \tag{A1}$$

Since project A with \mathbf{a}^* is preferred to project A with $\mathbf{a}=(1, 0)$, we have

$$\{1 - Z_{1,1}^A\} s [R_A(1) - R_A(0)] \geq \zeta. \tag{A2}$$

Since project A with \mathbf{a}^* is preferred to project A with $\mathbf{a}=(0, 1)$,

$$\{1 - Z_{1,1}^A\} s [R_A(1) - R_A(0)] \geq \zeta. \tag{A3}$$

The preference for project A with \mathbf{a}^* over project B with \mathbf{a}^* implies

$$\begin{aligned} & \{1 - Z_{1,1}^A\} \{b_1 [s R_A(1) - p R_B(1)] + b_2 [s^2 R_A(1) - p^2 R_B(1)]\} \\ & \geq \{1 - Z_{1,1}^A\} b_1 \{s - p\} \{D_A + I_1\} + b_2 \{s - p\} \zeta. \end{aligned} \tag{A4}$$

The preference for project A with \mathbf{a}^* over project B with \mathbf{a}^0 implies

$$\begin{aligned} & \{1 - Z_{1,1}^A\} [b_1 \{s R_A(1) - p R_B(0)\} + b_2 \{s^2 R_A(1) - p^2 R_B(0)\}] \\ & \geq \{1 - Z_{1,1}^A\} b_1 [s - p] [D_A + I_1] + [b_1 + s b_2] \zeta. \end{aligned} \tag{A5}$$

The preference for project A with \mathbf{a}^* over project B with $\mathbf{a}=(1, 0)$ implies

$$\begin{aligned} & \{1 - Z_{1,1}^A\} [b_1 \{s R_A(1) - p R_B(1)\} + b_2 \{s^2 R_A(1) - p^2 R_B(0)\}] \\ & \geq \{1 - Z_{1,1}^A\} b_1 [s - p] [D_A + I_1] + s b_2 \zeta. \end{aligned} \tag{A6}$$

Finally, the preference for project A with \mathbf{a}^* over project B with $\mathbf{a}=(0, 1)$ implies

$$\begin{aligned} & \{1 - Z_{1,1}^A\} [b_1 \{sR_A(1) - pR_B(0)\} + b_2 \{s^2R_A(1) - p^2R_B(1)\}] \\ & \geq \{1 - Z_{1,1}^A\} b_1 [s - p] [D_A + I_1] + b_1 \zeta + b_2 [s - p] \zeta. \end{aligned} \tag{A7}$$

Constraint (A1) is derived as follows. Suppose the owner–manager decides to pick project A with \mathbf{a}^* and expects to finance the project with I_d dollars of debt financing and with I_e dollars of equity financing. Then, the face value of debt is determined as follows from (1):

$$D_A = I_d / [b_1 s].$$

And the outside shareholders’ fractional share of ownership is determined as follows from (3):

$$Z_{1,1}^A = I_e / [b_1 s \{R_A(1) - D_A - I_1\} + b_2 s^2 R_A(1)].$$

Having obtained these amounts, the owner–manager will not choose project A with \mathbf{a}^0 if his expected utility from choosing \mathbf{a}^* is greater than his expected utility from choosing \mathbf{a}^0 . Thus, we must have:

$$\begin{aligned} & b_1 [\{1 - Z_{1,1}^A\} s \{R_A(1) - D_A - I_1\} - \zeta] + b_2 [\{1 - Z_{1,1}^A\} s^2 R_A(1) - s \zeta] \\ & \geq b_1 [\{1 - Z_{1,1}^A\} s \{R_A(0) - D_A - I_1\}] + b_2 [\{1 - Z_{1,1}^A\} s^2 R_A(0)], \end{aligned}$$

which reduces to constraint (A1). The same procedure is followed in the derivation of the other incentive compatibility constraints. For an interior capital structure to be optimal with the selection of project A and effort vector \mathbf{a}^* , it must be true that $\exists Z_{1,1}^A \in (0, 1), D_A > 0$ such that

$$\begin{aligned} & b_1 [\{1 - Z_{1,1}^A\} s \{R_A(1) - D_A - I_1\} - \zeta] + b_2 [\{1 - Z_{1,1}^A\} s^2 R_A(1) - s \zeta] \\ & \geq \max b_1 [\{1 - Z_{a_1, a_2}^j\} \theta_j \{R_j(a_1) - D_j - I_1\} - a_1 \zeta] \\ & \quad + b_2 [\{1 - Z_{a_1, a_2}^j\} \theta_j^2 R_j(a_2) - a_2 \theta_j \zeta] \\ & Z_{a_1, a_2}^j \in [0, 1], \\ & D_j \in [0, \infty), \\ & a_t \in \{0, 1\}; \quad t = 1, 2, \end{aligned} \tag{A8}$$

where a_t is the effort chosen in period t , j indexes the choice of project ($j=A, B$) and

$$\theta_j = \begin{cases} s & \text{if } j=A, \\ p & \text{if } j=B. \end{cases}$$

Satisfaction of (A8) not only guarantees the optimality of an *interior* capital structure, but also ensures that the owner–manager will prefer the ‘negotiation’ of contract 1 to every other contract. In other words, constraints (A1)–(A8) ensure that the expected utility of the owner–manager is the highest when he offers the outside financiers contract 1, chooses an interior capital structure, and actually implements contract 1 by investing in Project A and choosing a^* as the effort vector.

Appendix B: Analysis of the case in which the probability of a government loan guarantee is between zero and q'

There are eight possible contracts for each combination of financing that can be offered to the bondholders and the shareholders. These contracts are ($Z_{n,k,m}^j$ is the share of ownership of outside shareholders when the owner–manager promises to adopt project j and take $a=n$ in the first period, $a=k$ in the second period given a positive first period cash flow, and $a=m$ in the second period given zero cash flow in the first period):

Contract	Shareholder's percentage	Face value of debt
1	$Z_{1,1,0}^A$	D_A
2	$Z_{1,0,0}^A$	D_A
3	$Z_{0,1,0}^A$	D_A
4	$Z_{0,0,0}^A$	D_A
5	$Z_{1,1,0}^B$	D_B
6	$Z_{1,0,0}^B$	D_B
7	$Z_{0,1,0}^B$	D_B
8	$Z_{0,0,0}^B$	D_B

Developed in this section are the incentive compatibility constraints that guarantee that the owner–manager will implement the terms of contract 1 *subsequent* to having negotiated it. Implementation of contract 1 implies that the owner–manager will choose project A with effort equal to 1 in the first period, 1 in the second period given a positive first period cash flow, and 0 in the second period given zero cash flow in the first period.

For notational convenience define \mathbf{a}^f as the vector of effort choices corresponding to contract f . Thus, $\mathbf{a}^1 \equiv (1, 1, 0)$, $\mathbf{a}^2 \equiv (1, 0, 0)$ and so on. Now the preference for project A with \mathbf{a}^1 over project A with either \mathbf{a}^2 or \mathbf{a}^3 implies that

$$s[1 - Z_{1,1,0}^A][R_A(1) - R_A(0)] \geq \zeta \tag{B1}$$

The preference for project A with \mathbf{a}^1 over project A with \mathbf{a}^4 implies that

$$[1 - Z_{1,1,0}^A][b_1s + b_2s^2][R_A(1) - R_A(0)] \geq [b_1 + sb_2]\zeta. \tag{B2}$$

The preference for project A with \mathbf{a}^1 over project B with \mathbf{a}^5 implies that

$$\begin{aligned} & [1 - Z_{1,1,0}^A]b_1[sR_A(1) - pR_B(1)] + b_2[1 - Z_{1,1,0}^A][s^2R_A(1) - p^2R_B(1)] \\ & + b_2[1 - Z_{1,1,0}^A]q[\{1 - s\}rR_A(0) - \{1 - p\}tR_B(0)] \\ & \geq b_1[1 - Z_{1,1,0}^A][\{s - p\}\{D_A + I_1\}] + b_2[s - p]\zeta \\ & + b_2[1 - Z_{1,1,0}^A]q[\{r[1 - s] - t[1 - p]\}\{[1 + i]D_A + D_{AA}\}]. \end{aligned} \tag{B3}$$

The preference for project A with \mathbf{a}^1 over project B with \mathbf{a}^6 implies that

$$\begin{aligned} & [1 - Z_{1,1,0}^A]b_1[sR_A(1) - pR_B(1)] + b_2[1 - Z_{1,1,0}^A][s^2R_A(1) - p^2R_B(0)] \\ & + b_2[1 - Z_{1,1,0}^A]q[\{1 - s\}rR_A(0) - \{1 - p\}tR_B(0)] \\ & \geq b_1[1 - Z_{1,1,0}^A][s - p][D_A + I_1] + b_2s\zeta \\ & + b_2[1 - Z_{1,1,0}^A]q[\{r[1 - s] - t[1 - p]\}\{[1 + i]D_A + D_{AA}\}]. \end{aligned} \tag{B4}$$

The preference for project A with \mathbf{a}^1 over project B with \mathbf{a}^7 implies that

$$\begin{aligned} & [1 - Z_{1,1,0}^A]b_1[sR_A(1) - pR_B(0)] + b_2[1 - Z_{1,1,0}^A][s^2R_A(1) - p^2R_B(1)] \\ & + b_2[1 - Z_{1,1,0}^A]q[\{1 - s\}rR_A(0) - \{1 - p\}tR_B(0)] \\ & \geq b_1[1 - Z_{1,1,0}^A][s - p][D_A + I_1] + b_1\zeta + b_2[s - p]\zeta \\ & + b_2[1 - Z_{1,1,0}^A]q[\{r[1 - s] - t[1 - p]\}\{[1 + i]D_A + D_{AA}\}]. \end{aligned} \tag{B5}$$

And finally, the preference for project A with \mathbf{a}^1 over project B with \mathbf{a}^8

implies that

$$\begin{aligned}
 & [1 - Z_{1,1,0}^A]b_1[sR_A(1) - pR_B(0)] + b_2[1 - Z_{1,1,0}^A][s^2R_A(1) - p^2R_B(0)] \\
 & + b_2[1 - Z_{1,1,0}^A]q[\{1-s\}rR_A(0) - \{1-p\}tR_B(0)] \\
 & \geq b_1[1 - Z_{1,1,0}^A][s-p][D_A + I_1] + b_2s\zeta + b_1\zeta \\
 & + b_2[1 - Z_{1,1,0}^A]q[\{r[1-s] - t[1-p]\}\{[1+i]D_A + D_{AA}\}]. \quad (B6)
 \end{aligned}$$

Two more conditions must be satisfied. The first is that there should be an interior optimal capital structure, and the second is that the owner-manager should prefer ex ante to negotiate contract 1 rather than any other contract. For both conditions to be satisfied, it must be true that $\exists Z_{1,1,0}^A \in (0, 1), D_A > 0, D_{AA} > 0$ such that

$$\begin{aligned}
 & [1 - Z_{1,1,0}^A]\{b_1s[R_A(1) - D_A - I_1] + b_2s^2R_A(1)\} \\
 & + [1 - Z_{1,1,0}^A]b_2r[1-s]q[R_A(0) - D_A\{1+i\} - D_{AA}] - b_1\zeta - b_2\zeta s \\
 & \geq \max_{i,j} EU(Z_a^j i, D_j), \\
 & Z_a^j i \in [0, 1], \\
 & D_j \in [0, \infty), \quad (B7)
 \end{aligned}$$

where $Z_a^j i$ is the fractional share of ownership of the outside shareholders if the owner-manager negotiates contract i and promises to invest in project j , D_j is the face value of debt issued at time zero, and $EU(\cdot, \cdot)$ is the owner-manager's expected utility.

If q is greater than q' , contract 5 is optimal and a different set of incentive compatibility conditions are needed. For the sake of brevity, these details are not provided here.

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