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Liability Sharing as a Mechanism to Improve Firms' Investment and Liquidation Decisions*

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Abstract

This paper investigates the impact of *liability sharing* on the firms' investment and liquidation decisions. We look at a model involving private effort, unverifiable information, and unenforceable liquidation decisions. In this model, there exist simultaneously the two typical types of agency problems owing to limited liability associated with debt – underinvestment (lower effort) and risk seeking (delaying efficient liquidation). We show how these problems can be mitigated by the firms to form a business group and share each others' liabilities. Under certain conditions, such an alliance is an effective commitment by the member firms to provide higher level of equity investments (higher effort) and to liquidate inefficient assets (lower risk). Using data showing a high frequency of (internal) liquidation and shut-downs of the Chinese township and village enterprises (TVEs), we suggest that the practice of liability sharing among the TVEs within a community may offer an additional explanation of the spectacular performance of this sector in the past twenty years.

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Running Head: Liability Sharing and Liquidation

1 Introduction

It has been well documented that limited liability tends to create tension between a firm's equity holders and its outside creditors that distorts the firms' investment and liquidation decisions. With existing liabilities of debt, a firm's manager or equity holders may choose to underinvest in new projects with positive net present values – especially when new equity capital or junior debt must be issued to finance the new investment (e.g., Myers, 1977; Stulz, 1990; Diamond, 1991; Hart and Moore, 1995). They may also choose sub-optimal divestment decisions that reduce the firm's total value (e.g., Stein, 1989; Boot, 1992), or seek higher than socially optimal perquisite consumption and risk (e.g., Jensen and Meckling, 1976), or reduce managerial effort (see, Innes, 1990; Selender and Zou, 1994), or choose a combination of reduced effort and excessive risk (e.g., Zou, 1995; Zou and Sun, 1996). Broadly speaking, these distortions can be characterized into two types of agency problems. Namely, the one that leads to a lower expected return and the one that leads to a higher level of risk, as compared to the optimal decisions that would maximize the firm's total value. Expected returns, for example, may be influenced by lower provision of equity capital, excessive perks, or lower managerial effort. The firm's asset risk, on the other hand, may be influenced not only by undertaking high risk projects but also by delaying liquidation of inefficient risky assets (e.g., White, 1989).

Research in optimal contracting, security design, etc., that aims at minimizing such distortions has been mostly limited to the single-firm's problem. Mechanisms involving multiple firms that may also be effectively employed to ameliorate these agency problems have not been fully explored. In this paper, we investigate the role of *liability sharing* between firms that may improve the firms' investment and liquidation decisions. We look at a simple model involving private effort, unverifiable information, and unenforceable liquidation decisions. In this model, existing debt typically discourages the firm's equity holders to provide additional equity (called effort) and encourages the equity holders to delay efficient liquidation of bad assets. We then show that these problems can be mitigated when several firms form a business group and agree to share each others' liabilities. That is, under certain conditions, such an alliance can lead to higher levels of effort of the member firms as well as a higher overall frequency of voluntary and efficient liquidation of bad assets.

While it may be intuitive that liability sharing could reduce the firms' incentives for higher risk, it is somewhat surprising that sharing liabilities also has the potential to improve private efforts. The reasons may be sketched as follows.

Consider a leveraged firm whose manager acts on behalf of equity holders. Suppose the manager obtains some unverifiable signal concerning the firm's future random cash flows, and must make decisions concerning subsequent equity investment (effort) or liquidation of the firm's assets. Since the existing creditor will share some of the benefit of the firm's effort, the optimal effort level will be less than the one that maximizes the firm's total value. Also, the manager will choose to liquidate the firm's assets if and only if the signal is so bad that the present value of the firm's equity after liquidation is higher than that of continuing. Inefficiency occurs when this condition is not met, but the liquidation value of the firm's total assets exceeds the firm's total going-concern value. In this case, society would be better-off if the firm liquidates, but the firm's equity holders will prefer not to do so because continuation allows them to receive a "subsidy" from the firm's outside creditors which covers some of the expected losses.

Now assume that there are several firms facing the same type of agency problems and that they pool their liabilities in such a way that their total combined assets become the collateral for their total combined liabilities. This can be achieved by forming a business group, for example, through mergers or acquisitions, equity swaps, mutual guaranteeing of liabilities, or a commitment to a mutual guarantor (e.g. the community government of township and village enterprises in China), who will act on behalf of the combined interest of the firms' equity holders. The decision on whether to liquidate a firm is now based on whether the combined equity value of all firms after liquidating the troubled firm(s) is higher than their combined equity value of keeping the troubled firm(s) as a going concern. Suppose now that a member firm is in trouble and it would be socially more efficient to liquidate this firm. Compared to the stand-alone case, part of the benefit of liquidation that would otherwise go to outside creditors can now be retained by the rest of the firms. Whereas if the troubled firm continues with its losing business, part of the losses are borne by the business group as a whole. This reduces the benefit of expropriating outside creditors by delaying liquidation of bad assets, and therefore improves the business group's incentive to liquidate the bad firm. *Ex ante*, the total combined value of

the firms will then be enhanced in a competitive capital market.

The impact of liability sharing on the firms' private effort is more subtle. On the one hand, there may emerge the well known problem of team moral hazard (e.g., Holmström, 1982; Zou, 1992) since the consequence of a firm's effort is now further shared by the member firms. On the other hand, however, the benefits of any improved efficiency will be correctly priced in the value of the firms' debts. In other words, creditors will be willing to charge a lower interest rate to the business group than to the stand-alone firms. It is well known that the two types of our agency problems are both directly related to the interest rates on the firm's debt (e.g., Stiglitz and Weiss, 1981; Zou and Sun, 1996). Thus, lower interest rates have the potential to encourage the firms to provide higher effort. Further, we find that the firms' optimal efforts are complementary to each other under liability sharing rules, with a firm willing to increase its effort provided it expects the other member firms to increase their efforts. There is thus a tradeoff between the positive and negative effects of liability sharing concerning the firms' private efforts. We identify a large class of situations in which this positive effect dominates, which helps further increase the combined value of the firms under alliance.

Our model is also related to some other strands of literature that deserve to be mentioned. One of these concerns the ongoing debate over the benefits and costs of corporate diversification. Since liability sharing is effective only if the risks of the member firms are not perfectly correlated, our model suggests a new line of reasoning for both the formation and break-up of diversified business groups. To be more concrete, we can view the firms in our model as subsidiary firms or divisions within a conglomerate which pursue different lines of business and which operate as profit centers unless some divisions are in default. Our result then supports the view that the effect of firm diversification is a function of the market and institutional environment within which the firm operates. Diversification is likely to be more desirable when the potential conflict of interests is more severe between a firm's equity holders and creditors. In less developed economies, for instance, the lack of market intermediaries and contract enforcement mechanisms may be important reasons for sharing liabilities and diversification (e.g., Shleifer and Vishny, 1997; Khanna and Palepu, 1999; and Perotti and Gelfer, 1998). In developed economies, on the other hand, improved financial transparency, more efficient market intermediaries and more

effective contract enforcements may reduce the potential agency problems and thus allow more concentrated firms to perform better.

Another field of research to which our study is related can be found in the group-lending literature (e.g., Stiglitz, 1990; Varian, 1990; Ghatake and Guinnane, 1999). Studies on the Grameen Bank model of group lending in Bangladesh suggest that peer monitoring may be an effective way to reduce moral hazard. In that model, borrowers are individuals who form groups and share joint liability for their loans. Borrowers in the same group are assumed to have better information than outsiders about each other's ability or willingness to pay back his/her loan. The failure of one borrower to pay back a loan will cause other group members to suffer a penalty, which usually takes the form of more difficult access to future credits. There is no authority that takes care of the group's welfare as a whole, and each individual borrower chooses actions that maximize his/her own utility. As Stiglitz (1990) points out, although peer monitoring reduces the chances of bankruptcy, it comes with a cost. That is, for each individual borrower, sharing liability leads to a larger mean-preserving spread of the distribution of his or her payoff. Diagne (1998) argues that threats or social pressure may not work effectively in the practice of group lending. In contract, firms in our model share liabilities under a clearly defined governance mechanism so that threats or social pressure becomes unnecessary. Further, our model involves interim actions by firms, that is, the effort and liquidation decisions, which are crucial to determining the firms' values. The group lending concerns primarily the probability that the borrowers would honor their loans.

The paper is organized as follows. In the next section, we describe the model setup. In Section 3 we analyze a single firm's decisions and show the existence of the two types of agency problems in which the firm is inclined to provide lower effort and to delay liquidation of bad assets – at the expense of their creditors. In Section 4, we analyze the case where two firms pool their liabilities and form a business group, and show why liability sharing can improve efficiency and cut firms' financing costs. Numerical examples are given here to illustrates the impact of liability sharing on the firms' effort and liquidations, and on their debt and equity values. In Section 5, we apply our model to township and village enterprises (TVEs) in China and suggest that the TVEs within a community may be viewed as a diversified business group in

which firms share liabilities. Such a business group structure may have played a role to mitigate the (potentially serious) agency problems, and have significantly contributed to the superior performance of this sector of the Chinese economy. The last section concludes the paper with some additional thoughts concerning other possible applications of our results.

2 The Model

We consider a 2-period model, spanned by time t=0, 1 and 2. There are n firms, each requiring a \$1 investment (see Figures 1 and 2) at time 0. We assume that the firm's manager acts on behalf of the firm's stake holders. For simplicity, the total outputs from the firms' investments are assumed to be independently distributed and can take one of two similar, verifiable values: G (good) or B (bad), which are realized at the end (time 2).[1] At time 1, each firm receives a signal s, defined as a parameter indicating the firm's cost efficiency. Each firm will make some private effort $e \in [0, 1]$ at this stage at a cost of $C(e|s) = e^2/(2s)$ borne by the equity holders. We model e as the probability of reaching the good state G. That is, if the firm makes effort e at time 1, it's end-of-period output has probability e of being G and $1 - e$ of being B. Without loss of generality, we let $B = 0$.[2] Again for simplicity, we assume that the signal s can take only two values, good news "g" or bad news "b", with $g > b$. At time 0, it is common belief that the firm will receive $s = g$ with probability p, and $s = b$ with probability $1 - p$.

Figures 1 and 2 about here

All the firms and outside creditors are risk neutral, and we normalize the risk-free interest rate to zero. Assume further that the firms can be liquidated at time 1 for a liquidation value of L. To highlight the problem, assume that L satisfies

$$\max_e V(e|b) < L < \max_e V(e|g) \tag{1}$$

where $V(e|s) = eG - C(e|s)$ is the expected firm value at time 1, conditional on the firm's effort e and signal s. Thus the value of the firm as a going concern at time 1 is higher than its liquidation value if the signal is good, and lower than its liquidation value if the signal is bad.

3 Single-Firm Problem

We start with the case where each firm is independent and does not share governance with other firms. We assume that the firm's objective is to maximize its equity value at each stage. Such a firm is best seen as a privately owned firm; however, a state-owned firm may also fall into this category, as long as its decision makers do not care about the value of the firm's debt.

3.1 The first-best firm value

For a fully self-financed firm with sufficient internal funds, i.e., the required equity capital ($1) for investment, there would be no agency problems and the firm's equity value equals the total value of the firm. In order to justify our assumption that e represents a probability, we shall assume that $gG \leq 1$.

If the signal $s = b$, the optimal decision of the firm is to liquidate and receive the liquidation value L at time 1. If the signal $s = g$, the firm's optimal decision $e(g)$ at time 1 can be solved as

$$\max_e V(e|g) = eG - \frac{e^2}{2g} \tag{2}$$

$$\Longrightarrow \quad e^* = gG \tag{3}$$

$$\Longrightarrow \quad V(e^*|g) = \frac{gG^2}{2} \tag{4}$$

Thus, the assumption about the liquidation value of the firm made in (1) amounts to the following inequalities:

$$\frac{bG^2}{2} < L < \frac{gG^2}{2}. \tag{5}$$

Taking into account the optimal liquidation decision at time 1 on receiving signal b, the first-best value of the firm at time 0, denoted V^*, is given by

$$V^* = p\frac{gG^2}{2} + (1-p)L. \tag{6}$$

3.2 The second-best firm value

We proceed now to the analysis of the agency problems when the firm must borrow for its financing. Assume that the firm must rely entirely on debt to finance the ($1) investment at the start, as a highlighted abstract of the case with most of the firms in a transitional economy

where the access to the equity market is either nonexistent or prohibitively costly. The firm's equity value is thus equal to the net present value of the investment. In this set-up, a firm's level of debt is an exogenous variable. Let D denote the face value of the firm's debt which matures at time 2 (one dollar plus the interest rate), and assume that $L \leq D < G$. Assume that no cash flows are generated at time 1, so short-term loans or ones that require interim interest payments are not feasible.[3] Let $\pi(e|s)$ and $D(e|s)$ denote the firm's equity value and debt value at time 1 given effort e and signal s, respectively. As a going concern, the firm's optimal effort decision $e(s)$ is derived from the following program

$$\max_e \pi(e|s) = e(G-D) - \frac{e^2}{2s}$$

It follows from the first-order condition that

$$\begin{aligned} e(s) &= s(G-D) && (7)\\ D(e(s)|s) &= e(s)D = s(G-D)D && (8)\\ \pi(e(s)|s) &= \frac{s(G-D)^2}{2} > 0 && (9)\\ V(e(s)|s) &= \pi(e(s)|s) + D(e(s)|s) = \frac{s}{2}(G^2 - D^2) && (10) \end{aligned}$$

Since $e(g) = g(G-D) < gG = e^*$, the effort of the firm in the good state ($s = g$) with outside financing ($D > 0$) is lower than the first-best effort. Furthermore, upon observing $s = b$ at time 1, the firm will not choose liquidation because the equity value is positive as a going concern whereas it is zero if the firm chooses to liquidate ($\max\{L - D, 0\} = 0$).[4] Without an enforceable contract, thus, it is optimal for the firm's equity holders to continue operation regardless of any signal received at time 1. In a competitive capital market, outside creditors break even. Thus, any loss in value of the firm is borne by the firm's equity holders.

In what follows, we let the superscript 0 denote time-0 values of the firm's equity, debt, and total asset. Since the present 1 dollar of debt requires D dollars (face value) to be paid at time 2,

$$\begin{aligned} D^0 &= pe(g)D + (1-p)e(b)D \\ &= pg(G-D)D + (1-p)b(G-D)D \\ &= (G-D)D[pg + (1-p)b] = 1 && (11) \end{aligned}$$

The time-0 value of the firm's equity and total assets are thus given by, using (11),

$$\pi^0 = [pg + (1-p)b]\frac{(G-D)^2}{2} = \frac{G}{2D} - \frac{1}{2} \quad (12)$$

$$V^0 = [pg + (1-p)b]\frac{(G^2-D^2)}{2} = \frac{G}{2D} + \frac{1}{2} \quad (13)$$

The following example illustrates the problem.

Example 1: The single-firm case.

Suppose $p = 0.8$, $g = 0.2$, $b = 0.05$, $G = 5$, $L = 1$.

(A) *Without liquidation at time 1.* Solving (11) for D we get $D = 1.893\,7$. From (12) and (13), it follows that $\pi^0 = .\mathbf{820\,17}$, and $V^0 = \mathbf{1.820\,2}$. The time-1 effort decisions and the consequent values can be computed from (7) and (9), yielding $e(g) = .621\,26$, $e(b) = .155\,32$, $\pi(g) = .964\,91$ and $\pi(b) = .241\,23$. This confirms that $\pi^0 = p\pi(g) + (1-p)\pi(b) = .820\,17$. The value of debt at time-1 is given by (8), that is, $D(g) = 1.176\,5$ and $D(b) = .294\,12$. The value of debt at time-0 is thus $pD(g) + (1-p)D(b) = 1.0$, as we already know.

(B) *With liquidation at time 1.* Let us now examine using this example the potential gain of committing to liquidation when receiving the bad signal. There are several effects of such a commitment. Due to lower credit risk of the firm, the required payment at time 2, D, will be lower. To see this, note that the present 1 dollar of debt with face value D is now computed as $1 = pg(G-D)D + (1-p)L$, yielding $D = 1.382$. It follows that $\pi(g) = \frac{g(G-D)^2}{2} = 1.309$, and $\pi(b) = 0$. Thus, $\pi^0 = p\pi(g) + (1-p)\pi(b) = \mathbf{1.047\,2}$, and $V^0 = \pi^0 + 1 = \mathbf{2.047\,2}$. The effort in the good state is $e(g) = g(G-D) = .723\,6$, higher than the case without commitment to liquidation. The effort in the bad state is $e(b) = 0$ due to liquidation. The time-1 debt values are $D(g) = g(G-D)D = 1.0$ and $D(b) = L = 1.0$. Note that the benefit of commitment to liquidation goes to the firm's equity. The problem is, of course, that liquidation of bad assets is not optimal for the stand-alone firm at time 1 and thus cannot be credibly committed. This highlights the value of liability sharing as that of commitment to liquidation, as we shall show shortly.

(C) *The first-best value of the firm* is: $V(e^*|g) = gG^2/2 = 2.5$ at time 1 and $V^* = pV(e^*|g) + (1-p)L = \mathbf{2.2}$ at time 0. In this case, the profit of the equity holders is $\pi =$

$2.2 - 1 = \mathbf{1.2} > \mathbf{1.0472}$. Thus, even if firms can commit to liquidation upon bad signals, the agency problem is not completely resolved because of private effort. We shall come back to this example after showing the effects of liability sharing between different firms.

4 Sharing Liability

4.1 Profit sharing rules

In order to simplify the analysis we restrict attention to the case where $n = 2$.[5] Our basic assumption is that the firms can observe each other's signal realized at time 1 so that there is a potential informational advantage for the firms to merge assets in some way. Suppose the two firms form a new combined legal identity at time 0, e.g., a business group (henceforth abbreviated as BG), and the board of BG is able to observe the signals of both firms and will act to maximize the total equity value of the two firms.[6] Within the BG, assume that the firms will enjoy their own profits unless the other firm defaults, in which case the surviving firm will take over the failing firm's liability as well as its liquidation value. In other words, the two firms will operate exactly as though they were independent firms, except that at time 1 the BG headquarters have the right to decide which firm or firms shall be liquidated.

In what follows, we let the over-bar indicate the parameters that pertain to the BG case, e.g., $\overline{\pi}$ for BG's equity (per firm) and $\overline{e}$ for effort of the firm under BG. In particular, let $\overline{D}$ denote the face value of each firm's debt, and assume that $G > 2\overline{D}$ so that the BG is solvent as long as one of the firms produces the high output. We shall continue to focus on the case that $L \leq \overline{D}$, i.e., that liquidation is equivalent to bankruptcy if each firm is regarded as a single legal identity. Within the BG, thus, liquidation of one firm can be seen as an *internal bankruptcy* of this firm on the BG as a whole.

Our model set-up is in line with most of those in the incomplete contracting literature, in which information is typically assumed to be observable but not contractible (see, e.g., Grossman and Hart, 1986; Hart and Moore, 1988; and Hart, 1988, 1995). Many examples have been constructed to justify such an assumption. In our model, it can be imagined that information concerning a firm's probability assessment of its future cash flows may be similarly assessed by

other firms operating in a close community, but may be difficult to verify in court.[7] Alternatively, we can view the BG (i.e., the new identity) as borrowing on behalf of each firm and becoming the loan guarantor of every member firm, backed by the combined assets of both firms. In return, the firms commit to a governance structure in which the BG has the full power to liquidate or reorganize any member firm in contingencies where at least one firm receives a bad signal. For instance, if firm 1 defaults, firm 2 is responsible for the payment of both firms' debt at maturity. The BG defaults only if the total asset value of both member firms falls short of their total debt value at time 2. This alternative model set-up may be more representative of the information and governance structures of the TVEs in China (see Section 5).

4.2 The BG case without liquidation

Before we start the analysis, let $S = (s_1, s_2)$ denote a state of nature (joint signal at time 1) that can take one of four values: gg, gb, bg, and bb. The probabilities that S will reach these states are p^2, $p(1-p)$, $(1-p)p$, and $(1-p)^2$, respectively. Let $\overline{\pi}_i(\overline{e}_1, \overline{e}_2|S)$, $D(\overline{e}_1, \overline{e}_2|S)$, and $V(\overline{e}_1, \overline{e}_2|S)$ denote, respectively, the i-th firm's time-1 equity value, the combined debt value, and the combined total value of the two firms. These are the functions of effort pair $(\overline{e}_1, \overline{e}_2)$ and signal S. With both firms as going concerns, the firm i's equilibrium optimal effort decision $\overline{e}_i(S)$ is derived from the following programs

$$\begin{aligned}
\max_{\overline{e}_1} \overline{\pi}_1(\overline{e}_1, \overline{e}_2|s_1, s_2) &= \overline{e}_1\overline{e}_2(G - \overline{D}) + \overline{e}_1(1 - \overline{e}_2)(G - 2\overline{D}) - \frac{\overline{e}_1^2}{2s_1} \\
\max_{\overline{e}_2} \overline{\pi}_2(\overline{e}_1, \overline{e}_2|s_1, s_2) &= \overline{e}_1\overline{e}_2(G - \overline{D}) + \overline{e}_2(1 - \overline{e}_1)(G - 2\overline{D}) - \frac{\overline{e}_2^2}{2s_2}
\end{aligned}$$

It follows from the first-order conditions that

$$\overline{e}_1(s_1, s_2) = s_1(G - 2\overline{D} + \overline{e}_2(s_1, s_2)\overline{D}) \tag{14}$$

$$\overline{e}_2(s_1, s_2) = s_2(G - 2\overline{D} + \overline{e}_1(s_1, s_2)\overline{D}) \tag{15}$$

From Figure 3 we can see that the two firms' effort choices are complementary to each other in that if firm 1 increase (decrease) the effort, firm 2 will also increase (decrease) effort.

Figure 3 about here.

Solving for the effort pair, we obtain

$$\overline{e}_1(s_1,s_2) = s_1(G-2\overline{D})\frac{(1+s_2\overline{D})}{1-s_1s_2\overline{D}^2} \tag{16}$$

$$\overline{e}_2(s_1,s_2) = s_2(G-2\overline{D})\frac{(1+s_1\overline{D})}{1-s_1s_2\overline{D}^2} \tag{17}$$

Substituting (16) and (17) into $\overline{\pi}_i$ yields

$$\begin{aligned}
\overline{\pi}_1(\overline{e}_1,\overline{e}_2|s_1,s_2) &= \overline{e}_1[(G-\overline{D})-(1-\overline{e}_2)\overline{D})]-\frac{\overline{e}_1^2}{2s_1} \\
&= \frac{s_1}{2}[\frac{(G-2\overline{D})(1+s_2\overline{D})}{1-s_1s_2\overline{D}^2}]^2 \\
\overline{\pi}_2(\overline{e}_1,\overline{e}_2|s_1,s_2) &= \overline{e}_2[(G-\overline{D})-(1-\overline{e}_1)\overline{D})]-\frac{\overline{e}_2^2}{2s_2} \\
&= \frac{s_2}{2}[\frac{(G-2\overline{D})(1+s_1\overline{D})}{1-s_1s_2\overline{D}^2}]^2
\end{aligned} \tag{18}$$

Owing to symmetry, we can focus on firm 1 only and omit the subscript. Thus, letting $\overline{e}(s_1s_2)$ and $\overline{\pi}(s_1s_2)$ denote the firm-1's equilibrium effort and equity value, we obtain Table 1.

Table 1 about here.

From Table 1 it is easy to see that $\overline{e}(gg) > \overline{e}(gb) > \overline{e}(bg) > \overline{e}(bb)$ and, equivalently, that $\overline{\pi}(gg) > \overline{\pi}(gb) > \overline{\pi}(bg) > \overline{\pi}(bb)$. The time-1 value of the BG and its total value of debt are given by

$$V(\overline{e}_1,\overline{e}_2|s_1,s_2) = (\overline{e}_1+\overline{e}_2)G-\frac{\overline{e}_1^2}{2s_1}-\frac{\overline{e}_2^2}{2s_2} \tag{19}$$

$$= (\overline{e}_1+\overline{e}_2-\overline{e}_1\overline{e}_2) \tag{20}$$

$$D(\overline{e}_1,\overline{e}_2|s_1,s_2) = (\overline{e}_1+\overline{e}_2)G-\frac{\overline{e}_1^2}{s_1}-\frac{\overline{e}_2^2}{s_2} \tag{21}$$

$$= (\overline{e}_1\overline{e}_2+\overline{e}_1(1-\overline{e}_2)+\overline{e}_2(1-\overline{e}_1))2\overline{D} \tag{22}$$

$$= (\overline{e}_1+\overline{e}_2-\overline{e}_1\overline{e}_2)2\overline{D} \tag{23}$$

The value of combined debt at time 0 is thus

$$2\overline{D}^0 = [p^2(2\overline{e}_1-\overline{e}_1^2)+2p(1-p)(\overline{e}_1+\overline{e}_2-\overline{e}_1\overline{e}_2)+(1-p)^2(2\overline{e}_2-\overline{e}_2^2)]2\overline{D} = 2$$

4.3 The BG case with liquidation

Now we consider the possible liquidation decisions of the BG at time 1. First, we note that the BG will never liquidate both firms at time 1 provided the liquidation value is lower than the face value of debt ($L \leq 2\overline{D}$), as we have assumed. Next, if a firm is liquidated at time 1 its decision maker has no longer a role in the decision of the remaining firm's effort. Thus we only need to look at any firm, say firm-1's effort decision given that the other firm is liquidated. Let $\overline{\pi}(\overline{e}|s,L)$ and $\overline{D}(\overline{e}|s,L)$ denote, respectively, the BG's equity value and debt value given liquidation of the second firm at time 1. These are the functions of the firm-1's effort $\overline{e}$ and signal s. Solving for the optimal effort of the remaining firm $\overline{e}(s,L)$ and the consequent equity and debt values from the program

$$\max_{\overline{e}} \overline{\pi}(\overline{e}|s,L) = \overline{e}(G - 2\overline{D} + L) - \frac{\overline{e}^2}{2s}$$

we obtain

$$\begin{aligned}
\overline{e}(s,L) &= s(G - 2\overline{D} + L) && (24)\\
\overline{\pi}(\overline{e}(s,L)|s,L) &= \frac{s(G - 2\overline{D} + L)^2}{2} && (25)\\
\overline{D}(\overline{e}(s,L)|s,L) &= \overline{e}2\overline{D} + (1-\overline{e})L && (26)\\
&= s(G - 2\overline{D} + L)(2\overline{D} - L) + L && (27)\\
V(\overline{e}(s,L)|s,L) &= \overline{\pi}(\overline{e}(s,L)|s,L) + \overline{D}(\overline{e}(s,L)|s,L) && (28)\\
&= \frac{s(G - 2\overline{D} + L)^2}{2} + s(G - 2\overline{D} + L)(2\overline{D} - L) + L && (29)\\
&= \frac{1}{2}s\left(G - 2\overline{D} + L\right)[G + 2\overline{D} - L] + L && (30)\\
&= \frac{1}{2}s[G^2 - (2\overline{D} - L)^2] + L && (31)
\end{aligned}$$

We next show that there exist plausible situations in which the BG will find it optimal to liquidate bad firms.

Proposition 1 *Suppose that $\overline{D}$ is given. Then, at time 1 the BG will not liquidate any firm in state $S = gg$ if and only if*

$$1 + \frac{L}{(G - 2\overline{D})} < \frac{\sqrt{2}}{1 - g\overline{D}} \qquad (32)$$

Similarly, in state $S = bb$ the BG will liquidate (randomly) one bad firm if and only if

$$\frac{\sqrt{2}}{1 - b\overline{D}} < 1 + \frac{L}{(G - 2\overline{D})} \tag{33}$$

Proof: First, suppose at time 1 the state of nature is $S = gg$. Then the BG will choose to let both firms go on if and only if keeping both firms as going concern the BG's combined equity value $2\overline{\pi}(gg) > \overline{\pi}(g, L)$, that is, $g(G - 2\overline{D})^2/(1 - g\overline{D})^2 > g(G - 2\overline{D} + L)^2/2$. This is equivalent to the inequality in (32). Similarly, if the signals are $S = bb$, the BG will choose to liquidate one firm if and only if $2\overline{\pi}(bb) < \overline{\pi}(b, L)$, that is, $b(G - 2\overline{D})^2/(1 - b\overline{D})^2 < b(G - 2\overline{D} + L)^2/2$. This is equivalent to the inequality in (33). Q.E.D.

Proposition 2 *Suppose that $\overline{D}$ is given, and that the liquidation value satisfies the following inequalities:*

$$\frac{A(g, b, \overline{D})}{\sqrt{g}} < (1 + \frac{L}{G - 2\overline{D}}) < \frac{A(g, b, \overline{D})}{\sqrt{b}} \tag{34}$$

where

$$A(g, b, \overline{D}) = \sqrt{g[\frac{(1 + b\overline{D})}{1 - gb\overline{D}^2}]^2 + b[\frac{(1 + g\overline{D})}{1 - gb\overline{D}^2}]^2}.$$

Then, the BG will liquidate the bad firm if $S = gb$ or bg.

Proof: It is straightforward to verify that (34) implies $\overline{\pi}(g, L) > \overline{\pi}(gb) + \overline{\pi}(bg) > \overline{\pi}(b, L)$. Q.E.D.

The conditions in Propositions 1 and 2 define four possible ranges of $L/(G - 2\overline{D})$ concerning the BG's liquidation decisions (see Figure 4). The magnitude of $L/(G - 2\overline{D})$ measures the attractiveness of liquidating the bad firm relative to keeping the bad firm and risking its ruin. The higher is this measure, the more likely that the BG will choose to liquidate the bad firm. Summarizing, we have:

- In range I, liquidation will not occur in any state.
- In range II, liquidation occurs in states gb and bg but not in state bb.
- In range III, liquidation occurs in all the three states involving a bad firm, namely in states gb, bg, and bb.

- In range IV, the BG will choose to liquidate one firm in all the states including the best state gg. This last range suggests that the liquidation value is so high that it becomes optimal even for the equity holders to reduce the risk of losing it.

Figure 4 about here.

4.4 Comparing equity values of BG with single firms

So far we have shown that it is optimal for the BG to liquidate the bad firm at time 1 in some plausible situations. These results are derived assuming that the BG is formed. We now investigate the rationale for the firms to form the BG and share liabilities. Before we start, it is important to realize that liability sharing under BG makes the firms' combined debt less risky for the outside creditors. Even neglecting the subsequent impact on the firms' effort and liquidation decisions, the face value (or equivalently the interest rate) that outside creditor charges on the firms' debt will be lower due to lowered credit risk. From Figure 5 we can see that in both the gb and the bg states the BG can pay back its combined debt in full, whereas in the independent case one firm will default on its loan. Carrying this observation further, the lower face value of debt will induce higher effort and a higher incentive for BG to liquidate the bad asset. These effects in turn will further reduce the credit risk and lower the face value of the BG's debt. In equilibrium, we should expect a higher value of BG as a whole – at least for some liquidation values that fall in the ranges of II or III in Figure 4. We first identify a strong condition under which forming the BG is optimal for the firms even if there is no improvement on liquidation.

Figure 5 about here.

Proposition 3 *Assume that the following inequality holds.*

$$\frac{(G-2\overline{D})}{1-b\overline{D}} > G-D \tag{35}$$

Then under BG without interim liquidations, $\overline{e}(gg) > \overline{e}(gb) > e(g)$, *and* $\overline{e}(bg) > \overline{e}(bb) > e(b)$. *That is, the effort levels are improved under BG in all the possible states. Consequently, the equity value of the firms are improved. That is,* $\overline{\pi}(gg) > \overline{\pi}(gb) > \overline{\pi}(g)$, *and* $\overline{\pi}(bg) > \overline{\pi}(bb) > \overline{\pi}(b)$.

Proof: We only need to show that $\overline{e}(gb) > e(g)$ and $\overline{e}(bb) > e(b)$. Consulting Table 1, we have

$$\frac{\overline{e}(gb)}{g} = \frac{(G-2\overline{D})(1+b\overline{D})}{1-gb\overline{D}^2} > \frac{(G-2\overline{D})}{1-b\overline{D}} > G-D = \frac{e(g)}{g} \tag{36}$$

$$\frac{\overline{e}(bb)}{b} = \frac{(G-2\overline{D})}{1-b\overline{D}} > G-D = \frac{e(b)}{b} \tag{37}$$

The rest of the proof follows straightforwardly. Q.E.D.

It is now easy to establish a similar result for the BG with possible interim liquidations.

Proposition 4 *Under the conditions in Propositions 1, 2 and 3,* $\overline{e}(g,L) > \overline{e}(gb) > e(g)$, *and* $\overline{e}(b,L) > \overline{e}(bb) > e(b)$, $\overline{\pi}(g,L) > \overline{\pi}(gb) > \overline{\pi}(g)$, *and* $\overline{\pi}(b,L) > \overline{\pi}(bb) > \overline{\pi}(b)$. *That is, the effort levels and equity values are further improved under BG in all the possible states.*

Proof: Straightforward. Q.E.D.

Proposition 5 *Under BG, there exist values of* G, p, L, g, *and* b *such that some conditions in Propositions 1 and 2 hold and subsequently the firms will voluntarily form into a BG at time* 0 *and share liabilities, i.e.,* $\pi^0 < \overline{\pi}^0$.

Proof: It suffices to prove this statement of existence with a numerical example.

Example 2: The BG case with liquidation.

We choose the same data as in Example 1 so that the solutions can be compared with the stand-alone case of the firms. Thus, suppose $p = 0.8$, $g = 0.2$, $b = 0.05$, $G = 5$, $L = 1$.

We find by trial and error that the liquidation value falls in range II of Figure 4. The value of $\overline{D}$ can be computed from the formula of the value of BG's debt at time 0, that is,

$$2 = p^2 D(gg) + 2p(1-p)D(g,L) + (1-p)^2 D(bb) \tag{38}$$

in which $D(gg)$ and $D(bb)$ are given in Table 1 and $D(g,L)$ is presented in (27). It follows from (38) that $\overline{D} = 1.1543$. Comparing with $D = 1.8937$ for the stand-alone firm, this is a dramatic interest saving for the firms under BG. To verify that we are indeed looking at an example with $L/(G-2\overline{D})$ in the range II of Figure 4, we have

$1+\frac{L}{(G-2\overline{D})}=1.371\,6<\frac{\sqrt{2}}{1-b\overline{D}}=1.500\,8<\frac{\sqrt{2}}{1-g\overline{D}}=1.838\,7$

$A(g,b,\overline{D})=.554\,66$ and $\frac{A(g,b,\overline{D})}{\sqrt{g}}=1.240\,3<(1+\frac{L}{G-2\overline{D}})=1.371\,6<\frac{A(g,b,\overline{D})}{\sqrt{b}}=2.480\,5.$

Given that $\overline{D}=1.154\,3$, we can compute the effort, equity, and total value of the firms under GB from (24), (25), and Table 1. These are given as follows.

$\overline{e}(g,L)=.738\,28$, $\overline{e}(gg)=.699\,85$, $\overline{e}(bb)=.142\,81$, $\overline{e}(gb)=.577\,04$, $\overline{e}(bg)=.167\,87$;

$\overline{\pi}(\overline{e}(g,L)|g,L)=1.362\,6$, $\overline{\pi}(\overline{e}(b,L)|b,L)=.340\,66$;

$\overline{\pi}(gg)=1.224\,4$, $\overline{\pi}(bb)=.203\,95$, $\overline{\pi}(gb)=.832\,44$, $\overline{\pi}(bg)=.281\,82$.

Confirming the results of the previous propositions, we have

$\overline{e}(g,L)>\overline{e}(gg)>e(g)$, $2\overline{\pi}(gg)>\overline{\pi}(\overline{e}(g,L)|g,L)>\overline{\pi}(gb)+\overline{\pi}(bg)$ and

$\overline{\pi}(\overline{e}(b,L)|b,L)<2\overline{\pi}(bb)$.

Finally, we get the time-0 value of the BG's equity and total value as compared to the stand-alone case:

$2\overline{\pi}^0=[p^2 2\overline{\pi}(gg)+2p(1-p)\overline{\pi}(g,L)+(1-p)^2\overline{\pi}(bb)]=2.019\,6.$

$\overline{\pi}^0=\mathbf{1.009\,8}>\pi^0=\mathbf{0.820\,2}.$

$\overline{V}^0=\mathbf{2.009\,8}>V^0=\mathbf{1.820\,2}.$

5 An Application to Chinese TVEs[8]

As in most transitional economies, debt has been and still is the major source of financing for firms in China. In 1996, for instance, only 22.4 billion yuan, or 0.8 percent of the total capital investment, were raised in the Chinese stock market (*Statistical Yearbook of China*, 1998, pp.67, 672). Unless sponsored by the government, such as the traditional state-owned enterprises (SOEs), firms generally have to borrow at high interest rates which plausibly incorporate the creditors' concern about the agency problems that stem from capital market imperfections. Some firms, even with high profitable potentials may, and for good reasons (Stiglitz and Weiss, 1981), end up facing credit rationing. Against such a backdrop, those firms which can obtain loans, and secure better interest rates and terms of conditions have a clear advantage over their competitors. From an evolutionary viewpoint, one may conjecture that competition for loans (and better conditions on the loans) would lead to innovation in mechanisms that can

better tackle the above agency problems. The fact that TVEs have not only survived, but also thrived, under the adverse capital market conditions suggests that these firms may have found mechanisms that are more efficient and more compatible to the current state of Chinese economy. In 1996 and 1997, the average debt/asset ratio of TVEs was over 61 percent, indicating that the TVE sector is highly leveraged (*Yearbook of China's Township and Village Enterprises*, 1997, p.270; 1998, pp.204, 208). In our view, the ownership and governance structure evolved within the TVE sector in China is a judicious response to the above-mentioned debt-related agency problems, which, to some extent, may have accounted for the spectacular economic performance of this sector.

A township or village with a collection of TVEs under its control might be seen as some kind of an informal conglomerate, which runs diversified businesses. Having the important coordinating role in the TVEs' development processes, the community government has demonstrated a preference for creating diversified, small-scale TVEs at the start, and then helping its TVEs to expand in scale and scope, and even grow out of the community (Sun, 1997). Casual observation suggests that TVEs in a community normally operate as though they are private firms. But if a firm falls into financial difficulty, or it looks like it will, the community government has the full right to intervene. The community may demand liquidation of the firm's assets, initiate a merger, or arrange acquisition of the troubled firm by another (healthier) firm. In this sense, the TVEs in a community share each other's credit risks, while remaining independent of each other in normal times. TVEs in a community usually share much information among themselves, due to family and kinship ties, historical partnerships, locational proximity, and so on. The member firms also enjoy the benefits of the community in other ways, such as access to bank credit, bureaucratic support, information flows within the government hierarchy, distribution of key materials through official channels, and other proxies for market intermediaries.[9]

Applying our theory to the case of TVEs, we predict that the TVEs under the umbrella of a community would be more efficient in making investment and liquidation decisions. In particular, as compared with state-owned and private firms, the TVE governance structure as we sketched above should encourage more frequent voluntary liquidations of inefficient assets. Since timely liquidation reduces the expected losses from inefficient continuation, the firms under

a community governance structure should be able to reduce their borrowing costs and be more efficient.

Available data suggest that the TVE sector does experience a high frequency of enterprise liquidation and shut-downs (see Table 2). For example, in years of austerity (such as 1989 and 1990), over 10 percent of the TVEs were liquidated or taken over by other TVEs; in contrast, only fewer than 1.8 percent of state-owned enterprises (SOEs) were merged or taken over (Sun, 1997, p.18) during the same period. The private sector stands in between, with a less than 8 percent liquidation rate including merger and bankruptcy filings.[10] It is rare to see a TVE filing for bankruptcy, which further suggests that a problematic TVE is more likely to be liquidated internally within the TVE group before it gets into more serious financial difficulty. In fact, TVE liquidations and take-overs are typically seen as the internal affairs of the community (Wong *et al.*, 1995; Byrd and Lin, 1990).[11]

Table 2 about here

It is worth remarking that our theory is probably less applicable to the SOEs. Although SOEs may also be seen as firms or divisions under a common central or local government, there are two major distinctions between the two governance structures – that is, between a government at county and above levels that runs a group of SOEs and a government at township and village levels that runs a group of TVEs. First, the former government not only runs the SOEs, but also controls the state banks or local branches of the state banks. As a result, creditors are part of the group and thus cannot effectively exercise their rights to get their money back. This is the well known problem of the soft-budget constraint. In deed, even the decisions about granting loans and interest rates are subject to internal control and negotiations. Whereas for the township and village governments, the creditors are outsiders and the TVEs can face rather hard economic and legal pressure to repay their loans. Conceivably, market considerations such as credit risk, loan conditions, and interest rates, etc., and mechanisms that help improve credibility become more meaningful for the TVEs than for the SOEs. Second, a SOE manager is not just an entrepreneur, but also a bureaucrat whose interests, understandably, may differ significantly from maximizing the equity value of the firm as we have assumed in the

model. The appointments of the SOE managers, for example, have been tightly controlled by the Party committees at different levels with significant political considerations (e.g., Perotti, *et al.* 1999). And the supervisory government or the manager of a SOE must assume social security responsibility for the firm's employees and their families even if the firm is liquidated. In other words, efficient liquidation will be hard to be implemented with a SOE owing to non-market concerns. Although the recent financial centralization in China might be able to remove some power of the local governments over bank loans, the bureaucratic hierarchy of personnel appointments largely remains intact. We might conjecture, however, that liability sharing could also work for some SOEs in suitable situations provided that these firms and their creditors are more profit oriented and their financial obligations can be legally enforced.

6 Concluding Discussion

In this paper we have investigated possible impacts of liability sharing on firms' investment and voluntary liquidation decisions. While much has been written on the agency problems resulting from asymmetric information, moral hazard, and limited liability between a firm's insiders and outsiders, mechanisms involving several firms' decisions that are capable of ameliorating the agency costs of debt have not been well explored. This paper contributes to our understanding of liability sharing in this respect.

Due to the existence of firm's non-contractible information and private actions, liability of debt tends to encourage the firm's equity holders to provide less than optimal effort and to delay liquidation of inefficient assets – despite further erosion of the firm's total value. The main finding in this paper is that when independent firms face these agency problems, forming a diversified business group and share liabilities may help the firms to increase their combined values. We show that under certain plausible conditions (see Figure 4 and Propositions 4 and 5), liability sharing can encourage member firms to provide higher efforts and the business group to be more willing to liquidate inefficient firms. Here, effort is not confined to management input alone, but also refers to possible injection of equity capital in any form, such as the use of internal funds, reduction of dividends, bonuses or wages, or issuance of new shares or junior debts.

Our finding is not only of theoretical interest, but may have the potential for reform policies in developing or transitional economies. In these economies, outside debts are a major source of financing for firms owing to the underdeveloped capital markets. Combined with a lack of market intermediaries and contract enforcement mechanisms, the agency problems dealt with in this paper could be much more prevalent in these economies. We apply our theory to the analysis of township-village enterprises in China, and find supporting evidence of the high liquidation frequency of the TVEs. The outstanding economic performance of the TVE sector is also consistent with our prediction that liability sharing can motivate higher efforts and improve investment/disinvestment efficiency. In addition, our result may also explain some of the risk-diversification activities of large conglomerates in less developed economies and suggests a way to restructure debt-plagued SOEs in the transition economies. For instance, instead of privatizing each individual SOE separately, some of these firms might first be grouped together under a holding company, whose role would be similar to our business group. Three conditions for this kind of bundling to be successful are that (a) the holding company has a better access to information about the member firms than the state or provincial government, and is able to act in the interests of the combined equity values of the group; (b) the holding company has the right to liquidate inefficient firms and must honor the repayment obligations of the combined liabilities of the member firms unless the whole group goes bankrupt; and (c) firms in the holding company are allowed to operate as though they are private firms provided all member firms are solvent. As we have shown, such business alliance can be justified and has a good chance to become more efficient.

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Notes

1. The analytical results of this paper will remain as long as firms' outputs are not perfectly correlated, although introducing correlations would dramatically complicate the analysis.

2. This is because what matters in our context is the difference between G and B, i.e., the risky part of the firm. Our analysis will not change if we add any constant number to G and B, and to the liquidation value L (see below).

3. If we introduce cash flows at time 1 which are uncorrelated with the firm's signals, our analysis will essentially remain the same, because these cash flows do not have any informational content for outside creditors. Short- or long-term loans become important for outside creditors in controlling credit risk only if interim cash flows are informative. We do not pursue this extension in this paper.

4. Note that with our risk-free interest rate normalized to zero, the value of L (respectively D) at time 1 is the same as its value at time 2. Similarly, there is no discounting of the firm's expected equity value, because all players are risk neutral, so the firm's equity value at time 1 is the same as its expected equity value at time 2.

5. For the case with more firms we expect similar results, although conditions that lead to these results may be more complicated. We do not expect to find any additional insights that would warrant such an extension.

6. This may be justified, for instance, by assuming that the firms can commit to some internal disclosure regulations that are not available to the outside creditors and that fully reveal their signal at time 1 to the board of BG. Also, we shall assume that there is no private interest of the BG board that is in conflict with the BG's combined equity holders. This is consistent with our model in which the CEO or board of the BG does not take any private action nor have any personal interest that may distort their goal of maximizing the BG's equity value.

7. Some of the group-lending literature also invokes such similar assumptions as that group members share information or that they can monitor each other better than outsiders; see, e.g., Stiglitz (1990) and Varian (1990). It is also worth noting that our optimal solution within a BG is a simple

example supporting Maskin and Tirole's (1997) observation that the verifiability problem alone need not undermine the optimality of contracting at time 0.

8. For the general features of TVEs and the famous TVE miracle, see, Che and Qian, 1998; Perotti et al., 1999, among others.

9. See Lin (1995) for a well documented example of the community TVE groups, Daqiuzhuang village.

10. The decrease in the number of the Chinese rural private firms in 1989 and 1990 may be largely due to shut-downs and bankruptcies. In 1994 and 1995, the same sector again experienced a decrease in numbers of firms. But this time mergers of household enterprises into joint-stock and joint-household partnerships may have been dominant, because of the simultaneous increase of employment (e.g., 25.2 percent in 1995) in the private sector (*Yearbook of China's Township and Village Enterprises*, 1996, pp. 4-5).

11. Of course, a higher liquidation rate can be the consequence of other factors as well. For instance, the firm's size and degree of leverage. But the TVEs are not distinctively different in these factors from the SOEs. According to the 1995 National Industrial Census, for instance, the debt/asset ratio of industrial SOEs was 65.8 percent, whereas that of all TVEs (including those in commerce) was 62.8 percent (People's Daily, 25 July 1998; TVE Yearbook, 1996, pp. 100-101). In terms of firm size, although TVEs tend to be much smaller than large and medium-sized SOEs, there exist numerous small SOEs under the control of county and city governments (Sun, 1999). These suggest that the factors such as size and leverage are not likely to have a strong explanation power for the higher liquidation rate of TVEs over SOEs. One important difference between the SOEs and the TVEs lies in their budget constraint. The SOEs enjoy a soft budget constraint that makes them prone for higher risk (Zou and Sun, 1996); whereas the budget constraint for a group of TVEs in a single community is likely to be hard (Perotti, et al., 1999), supporting our conjecture that liability sharing is effective among the TVEs within a community.

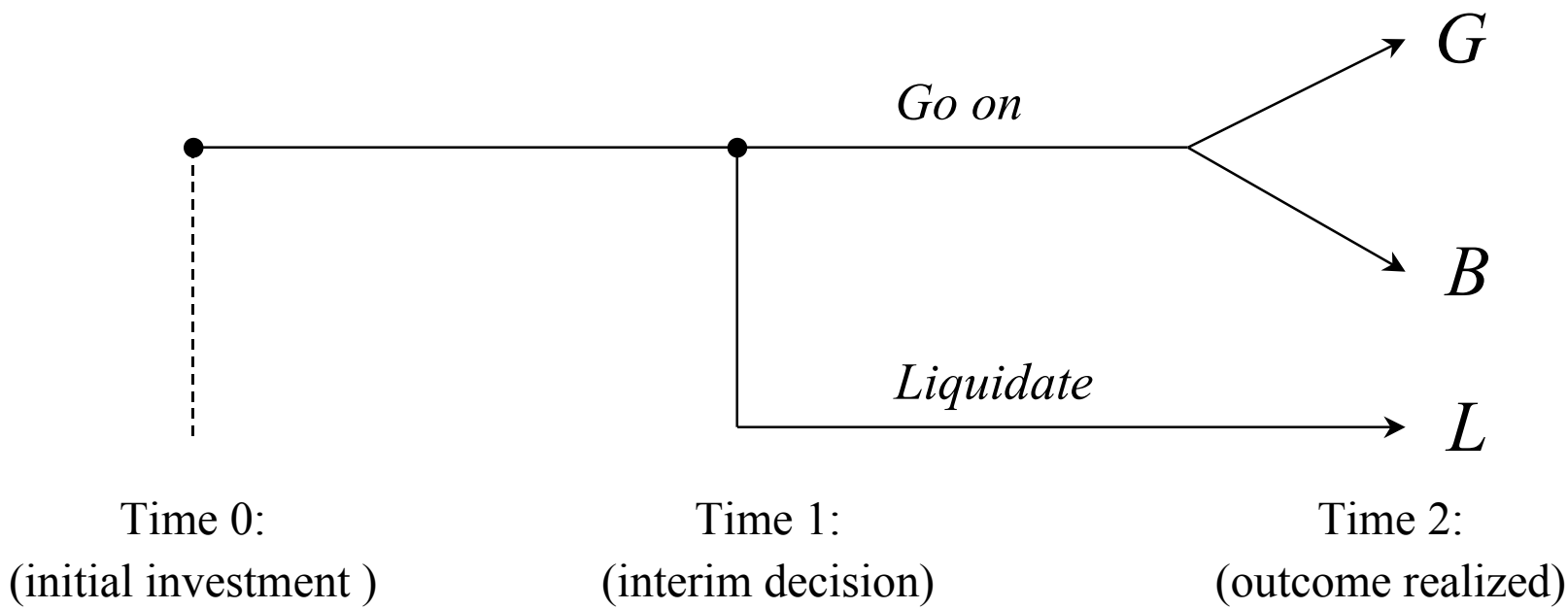

Figure 1. Model Setup (firm actions)

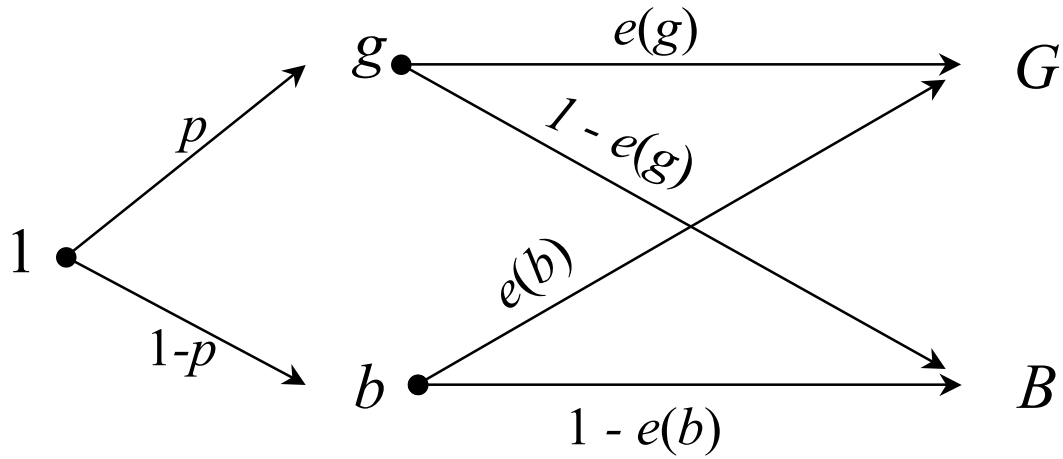

Figure 2. Model Setup (information structure)

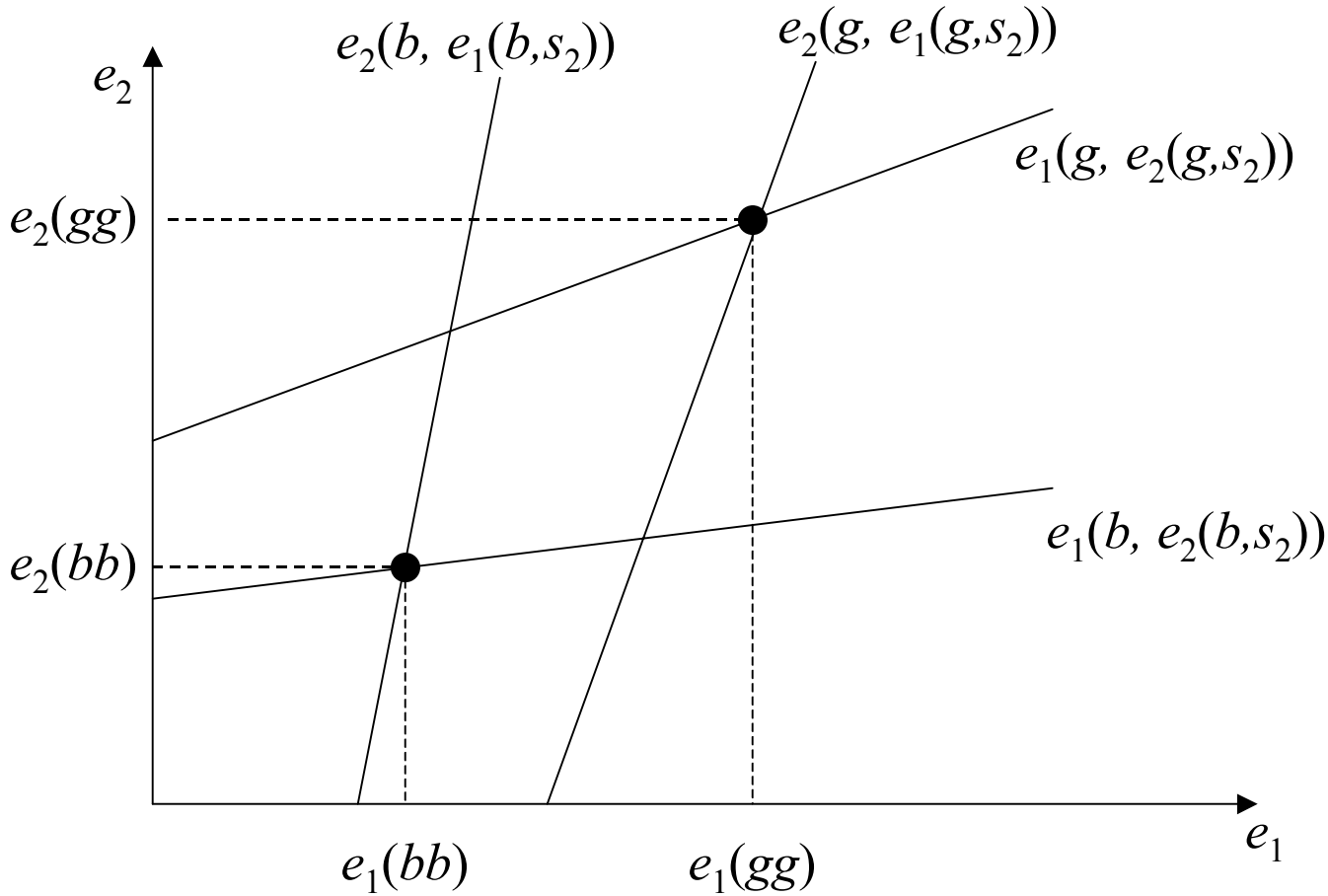

Figure 3. Effort Choices of the Two Firms

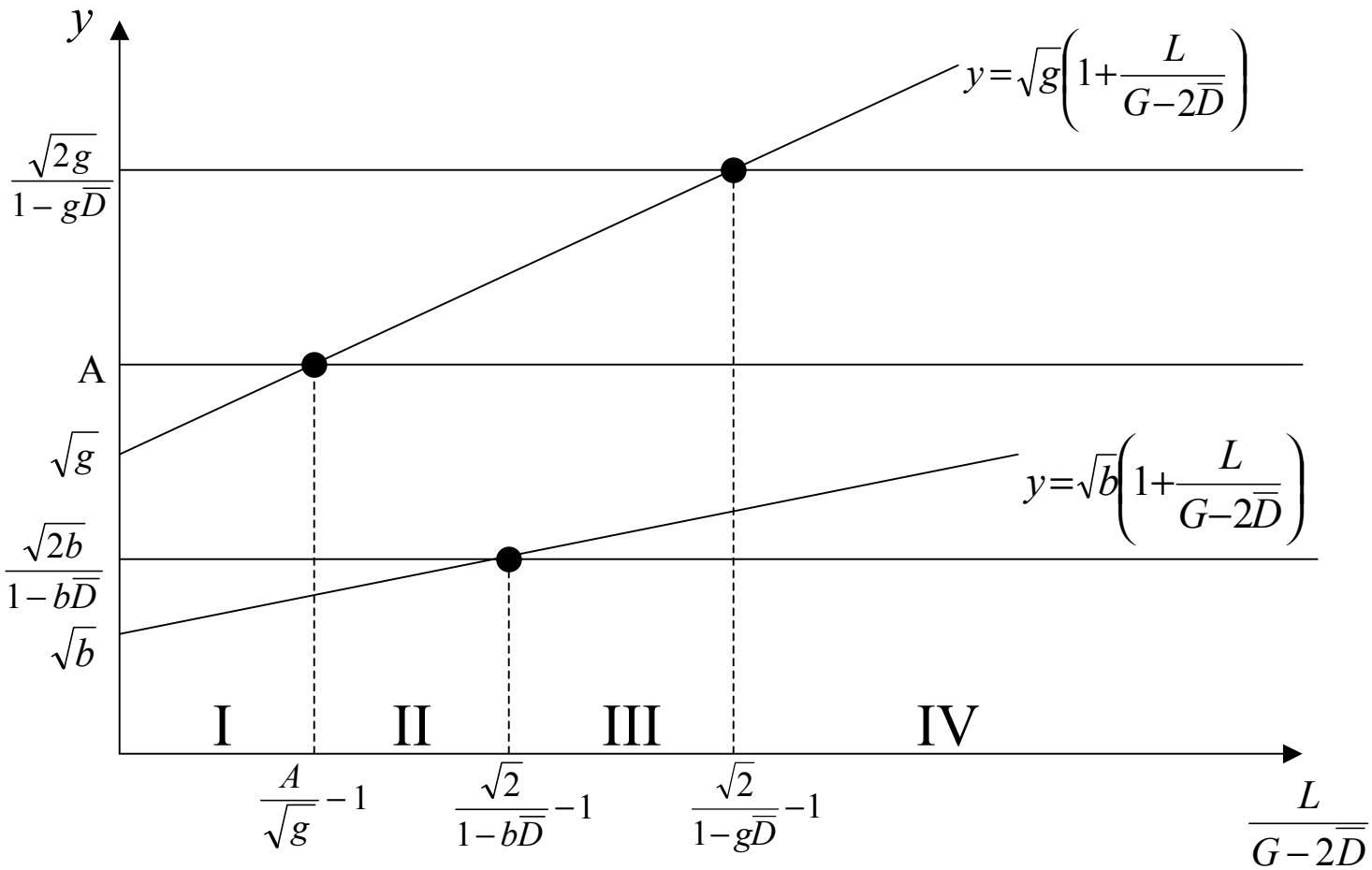

Figure 4. Ranges Relevant to the Business Group's Liquidation Decisions

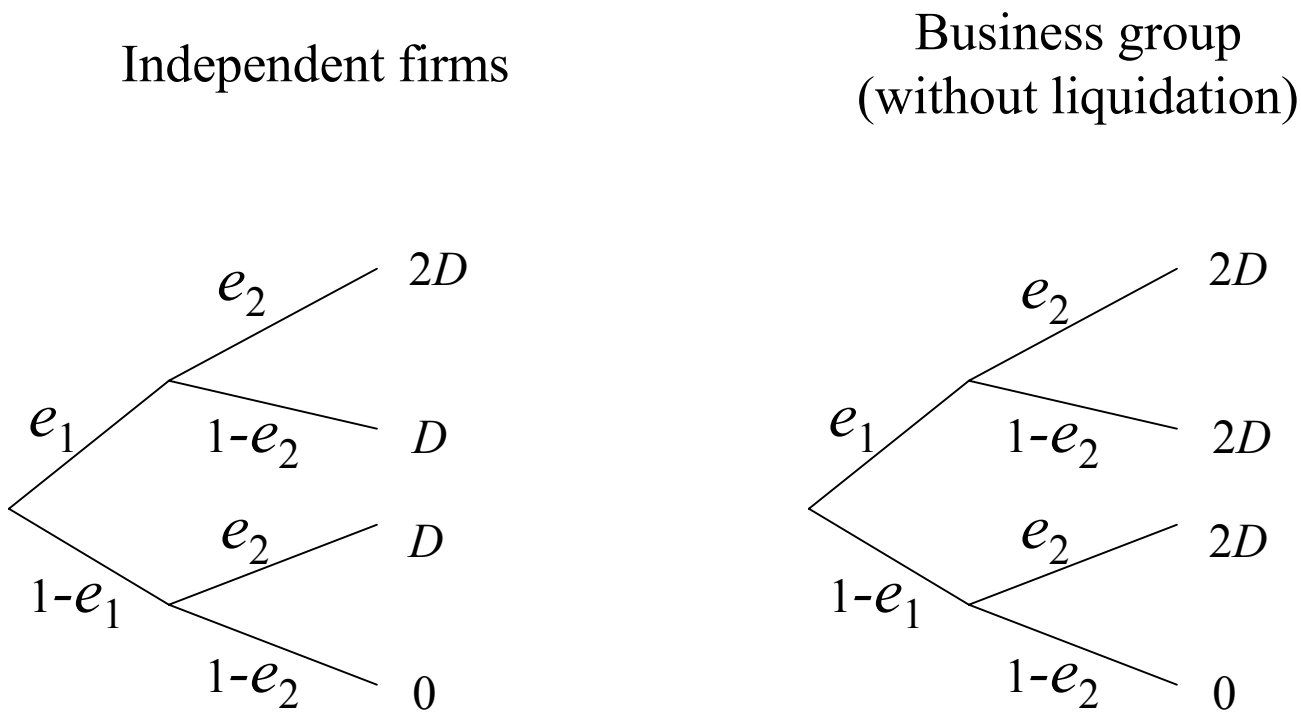

Figure 5. Liability Sharing in Business Group Reduces Credit Risk of Combined Debt

Table 1: Firm's Time-1 Effort Choice, Equity and Debt Values under the Alliance and without Liquidation

S	Prob.	$\bar{e}(S)$	$\bar{p}(S)$	$D(S)$
gg	p^2	$\bar{e}(gg) = g\left[\frac{G-2\bar{D}}{1-g\bar{D}}\right]$	$\bar{p}(gg) = \frac{g}{2}\left[\frac{G-2\bar{D}}{1-g\bar{D}}\right]^2 = \frac{\bar{e}(gg)^2}{2g}$	$D(gg) = 2\bar{D}\left(2\bar{e}(gg) - \bar{e}(gg)^2\right)$
gb	*p(1-p)*	$\bar{e}(gb) = g\left[\frac{(G-2\bar{D})(1+b\bar{D})}{1-gb\bar{D}^2}\right]$	$\bar{p}(gb) = \frac{g}{2}\left[\frac{(G-2\bar{D})(1+b\bar{D})}{1-gb\bar{D}^2}\right]^2 = \frac{\bar{e}(gb)^2}{2g}$	$D(gb) = 2\bar{D}\left(\bar{e}(gb) + \bar{e}(bg) - \bar{e}(gb)\bar{e}(bg)\right)$
bg	*(1-p)p*	$\bar{e}(bg) = b\left[\frac{(G-2\bar{D})(1+g\bar{D})}{1-gb\bar{D}^2}\right]$	$\bar{p}(bg) = \frac{b}{2}\left[\frac{(G-2\bar{D})(1+g\bar{D})}{1-gb\bar{D}^2}\right]^2 = \frac{\bar{e}(bg)^2}{2b}$	$D(bg) = 2\bar{D}\left(\bar{e}(bg) + \bar{e}(gb) - \bar{e}(bg)\bar{e}(gb)\right)$
bb	$(1-p)^2$	$\bar{e}(bb) = b\left[\frac{G-2\bar{D}}{1-b\bar{D}}\right]$	$\bar{p}(bb) = \frac{b}{2}\left[\frac{G-2\bar{D}}{1-b\bar{D}}\right]^2 = \frac{\bar{e}(bb)^2}{2b}$	$D(bb) = 2\bar{D}\left(2\bar{e}(bb) - \bar{e}(bb)^2\right)$

Table 2. The Liquidation Frequency of Rural Firms in China, by Type of Ownership (in years when data are available)

	1989		1990		1994		1995		1996	
	Number (1,000)	Share (%)	Number (1,000)	Share (%)	Number (1,000)	Share (%)	Number (1,000)	Share (%)	Number (1,000)	Share (%)
Total of rural firms	18,686.3	100.00	18,504.0	100.00	24,945.0	100.00	22,027.0	100.00	23,360.0	100.00
Closed or liquidated	1,600.0[a]	8.56	1,400.0[a]	7.56	n.a.		3,042.0	13.80	n.a.	
Township/Village firms	**1,535.7**	**100.00**	**1,453.9**	**100.00**	**1,651.0**	**100.00**	**1,620.0**	**100.00**	**1,550.0**	**100.00**
Closed	**160.0[b]**	**10.40**	**150.0[b]**	**10.30**	**39.3[c]**	**2.40**	**61.8[c]**	**3.81**	**46.7**	**3.01**
Liquidated	**n.a.**		**n.a.**		**82.6**	**5.00[c]**	**81.0**	**5.00[c]**	**77.5**	**5.00[c]**
Filed for bankruptcy[d]	**0.0**	**0.00**	**0.0**	**0.00**	**0.0**	**0.00**	**0.0**	**0.00**	**0.0**	**0.00**
Joint/Household firms	17,150.6	100.00	17,050.1	100.00	23,310.0	100.00	20,410.0	100.00	21,810.0	100.00
Closed, merged, Taken over, or bankrupt	1,440.0	8.40	1,270.0	7.44	n.a.		2,900.0[e]	14.21	n.a.	

Sources: *Yearbook of China's Township and Village Enterprises* (hereafter, *TVE Yearbook*) (1990, pp. 4, 6, 20; 1995, p. 5; 1996, pp. 5, 9, 99-109, 1997, pp. 3, 121-122); *Statistical Yearbook of China* (1991, p. 377; 1996, p. 387).

Notes: [a] According to the *TVE Yearbook* (1990, p. 4), in the first half of 1989, 800,000 rural non-agricultural enterprises were closed or taken over and merged. Many official reports (see, *ibid*, 1990, p. 6) indicate that about 3 million rural non-agricultural firms were closed or liquidated in 1989 and 1990. Based on these two figures it is safe to say that 1,600,000 were closed or liquidated in 1989 and 1,400,000 in 1990.

[b] Our central concern is the liquidation frequency of those TVEs owned by a township and village community, which is presented in the panel 2. According to the *TVE Yearbook* (1990, p. 4), 80,000 TVEs owned by the community were closed during the first half year of 1989. Following (a) we assume that the same pace was maintained in the second half-year of 1989 and the year 1990.

[c] According to the *TVE Yearbook* (1995, p. 5; 1996, pp. 3-9, 1997, p. 3), 39,257, 61,800, and 46,700 TVEs owned by the community were closed in 1994, 1995 and 1996, respectively. At the same time, a large number of community TVEs were sold, taken over, leased, or merged in the process of property right reform. By conservative estimate, we put the proportion of these types of liquidation at 5 percent of the total.

[d] There was even no word of "bankruptcy" appearing in the all issues of *TVE Yearbook*, indicating that bankruptcy by court was not relevant to community TVEs.

[e] According to the *TVE Yearbook* (1996, pp. 4-5), 2.9 million household and jointly privately owned rural non-agricultural enterprises were merged, and to a lesser extent taken over, closed, or went bankrupt in 1995 (cf. Note 10).