Financial Constraints, Managerial Incentives and the Scope of the Firm∗

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Abstract

Conventional wisdom suggests that large firms have greater financial flexibility due to diversification. Bringing projects under the same top management, however, can increase the level of correlation and reduce the level of diversification, by exposing the projects to the same manager-specific shock. I challenge the conventional wisdom and show that such positive correlation enhances the firm’s ability to relax financial constraints. This is because correlation can mitigate ex-post agency problem. Thus, when credit rationing is the main concern, it is optimal to put multiple projects under the control of a big firm rather than different small firms. I also find that when credit rationing is not an issue, large firms can create value only if the likelihood of large shocks to small ones is large. These predictions are consistent with empirical observations.

Keywords: Conglomerates, Correlation, Manager-specific shocks, Financial Constraints.

JEL classification: G30, G34, L25

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1 Introduction

The advantage of conglomerates relative to stand-alone firms in relaxing financial constraints has been empirically documented, in terms of higher leverage (Berger and Ofek (1995)), greater investment scale (Hubbard and Palia (1999)), lower cost of capital (Hann et al. (2012)), and better dealing with credit crunch in the recent financial crisis (Kuppuswamy and Villalonga (2010)). The conventional wisdom, at least since Lewellen (1971), is that conglomerates have more financial leeway because diversification leads to coinsurance among projects and reduces volatility. It’s not clear, however, that conglomerates generate diversification. On the contrary, in Gabaix (2011), idiosyncratic shocks to individual projects matter in aggregate, and large firms don’t have lower volatility. This is consistent with the evidence of approximate independence of firm volatility to size in Stanley et al. (1996).

If projects within the same firm inherit some common, firm-specific shocks, then conglomerates do not generate diversification as simply bundling the cash flows of these projects. As noted in Gabaix (2011): “If Walmart doubles its number of supermarkets [...] the newly acquired supermarkets inherit the Walmart shocks.” Furthermore, as noted by Gabaix (2011) an important source of common shocks is “the firm’s chief executive officer.” Indeed, a growing empirical literature, e.g. Bertrand and Schoar (2003) and Bloom and Van Reenen (2007), underscores managerial talent as a key driver of productivity.1 This suggests that bringing several projects under the same top manager in a conglomerate could increase the correlation across these projects. One might fear such increased correlation would reduce the ability of conglomerates to relax financial constraints. The novel contribution of this paper is to show that, on the contrary, financial constraints can be relaxed by the positive correlation between the projects within a firm.

To analyze these issues, we consider a three-period model with two types of risk neutral players, managers and investors, as well as two independent and symmetric projects. The managers are penniless and protected by limited liability and the investors have deep pockets. At period 0, the investors choose the organizational structure, i.e., running the two projects in two stand-alone firms, with two different managers, or within a conglomerate, under a single manager. Both projects require the same amount of initial

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1Bertrand and Schoar (2003) find that manager fixed effects can explain a significant extent of the heterogeneity in investment, financial and organizational practices and firm performance. Bloom and Van Reenen (2007) use an innovative survey tool to score the management quality of firms in the United States, France, Germany, and the United Kingdom, and find that the management scores are strongly associated with productivity, profitability, Tobin’s Q, and survival rates.
investment from the investors. At period 1, each project can be subject to a shock, requiring additional funding. This shock is assumed to be manager-specific. For example, the negative shock can be due to cost overruns stemming from the managers’ inability to control costs. In the stand-alone case, the two projects are subject to independent shocks, corresponding to the abilities of the two different managers. In the conglomerate case, the two projects are subject to a common shock, corresponding to the ability of the single manager. Thus, conglomerates increase the correlation across projects. The manager-specific shock or ability is unknown to both parties at period 0, but is revealed publicly at period 1. For each project, after observing the shock, the investors decide whether or not to inject new funds to withstand the shock and continue the project. In addition, the investors also reorganize the firms, by spinning off the conglomerate or merging the two stand-alone firms. At period 2, any continued project is subject to moral hazard. Its manager privately chooses between exerting effort and shirking, as in Holmstrom and Tirole (1998). Credit constraints arise for the basic reason that the manager must be granted a minimum incentive rent which can reduce pledgeable income and thus make it unprofitable for the investors.

At period 2, if one manager is in charge of both projects, optimally reducing the incentive rent involves a reward only when both projects are successful. This mechanism, referred to as “cross-pledging” in Tirole (2006), implies that the rent left to the manager in charge of two projects is smaller than twice the rent left to the manager in charge of a single project. Actually, the benefits of cross pledging are enhanced by correlation among projects, thus correlation between projects within a conglomerate relaxes, rather than tightens, financial constraints.

To see the rational for this result, consider the following, ultra-simplified, version of our model: The manager-specific shock can be, with equal probability, 0 or \( \infty \). In the latter case, the project must be abandoned; it would be too expensive to continue. At period 1, each project generates an expected value \( Y \) if it is continued and 0 otherwise. In addition, denote the rent given to the manager in charge of one project \( r_1 \) and the rent to the manager in charge of two projects \( r_2 \). Due to the cross-pledging effect, \( r_2 < 2r_1 \). In the conglomerate case, the two projects are subject to a common shock. Hence, both projects are continued or liquidated together with equal probability. At period 0, the expected pledgeable income for the investors is \( \frac{1}{2}(2Y - r_2) \). In the stand-alone case, the two projects are subject to two independent shocks. Thus, we have both projects continued with probability \( \frac{1}{4} \), one continued and the other liquidated with probability \( \frac{1}{2} \), and both liquidated with probability \( \frac{1}{4} \). In order to take advantage of cross-pledging, the two projects are merged at period 1 if they are continued together. As a result, at period 0, the ex-
pected pledgeable income for the investors is $\frac{1}{4}(2Y - r_2) + \frac{1}{2}(Y - r_1)$. Since $r_2 < 2r_1$, the investors obtain a larger expected income in the conglomerate case than in the stand-alone case. The driving force here is that, because of the cross-pledging effect, pledgeable income is increasing and convex in the number of viable projects. The increase in the correlation among shocks induces a mean-preserving spread in the distribution of the number of viable projects, and therefore increases income pledgeability and relaxes financial constraints.

Now, we turn to study the effect of organizational structure on total value. In our model, the total value is the sum of the investors’ pledgeable income and the managerial rent. The advantage of conglomerates have in relaxing their financial constraint does not necessarily imply that they generate more value. We show that, whether conglomerates increase or decrease value depends on the distribution of manager-specific shock, i.e., managerial talent. To our knowledge, this paper is one of the first to study the relation between optimal organizational structure and managerial characteristics.

Consider the case where the manager-specific shock is continuously distributed over $[0, \infty)$. In our previous simple case, the shock was either 0 or $\infty$, hence the project was always optimal to be liquidated when the shock was $\infty$. The only inefficiency which arises in that case was ex-ante credit rationing, i.e., the project cannot get financing at period 0. However, with a general distribution of manager-specific shock, another type of inefficiency, ex-post inefficient liquidation, may occur since at period 1 the shock can turn out to be lower than the full value of the project while greater than the pledgeable income.

Whether conglomerates create or destroy value depends on their relative abilities in mitigating both ex-ante credit rationing and ex-post inefficient liquidation. If the initial outside financing requirement is large, ex-ante credit rationing is the main concern. In this case, the projects can only be financed if they are operated in a large firm. Hence, conglomerates always dominate stand-alone firms. If the initial outside financing requirement is small, ex-ante credit rationing is not an issue. Thus, the projects can always get financing regardless of organizational structure. In this case, whether conglomerates or stand-alone firms are better in terms of total value depends on their relative advantage in alleviating ex-post inefficient liquidation.

Due to the cross-pledging effect, the continuation of one project not only depends on its own shock but also on the other’s. If the project is operated in a conglomerate firm, the shock of the other project always has the same magnitude. However, in the stand-alone case, the other shock can be small or large. If the other shock turns out to be small, the project is more likely to be continued when it is managed in a stand-alone firm than in a conglomerate firm.
firm. If the other shock turns out to be large, we obtain an opposite result. It implies that stand-alone firms are more likely to dominate conglomerates if small shocks are more likely to occur than large shocks, i.e., the ratio of high-skilled managers to low-skilled ones increases.

The predictions of our theory are consistent with the dramatic reversal in the assessment of conglomerates, which is positive during the 1960s and 1970s and then became negative in the 1980s and 1990s.\(^2\) Bhide (1990) argues that due to technological, economic and regulatory changes during 1970s and 1980s, information asymmetries became less of an issue in corporate financing. Hence, credit constraints were more of a concern during the 1960s and 1970s. Our theory implies that in this context, conglomerates would create value. Credit constraint, however, became less of an issue in the 1980s and 1990s. Furthermore, it is likely that, during this period, the increased the competition in the managerial labor market (Murphy and Zabojnik (2004)) and the improvement in CEO education (Palia (2000)) reduced the proportion of low ability managers. In this context, our model predicts that conglomerates were less likely to be efficient.

This paper contributes to the literature on the relation between financing constraints and organizational structure. One segment of literature is based on the tradeoff theory of capital structure (Lewellen (1971), Higgins (1971), Scott (1977), Sarig (1985), Leland (2007), and Banal-Estanol et al. (2011)). The other segment is the internal capital market literature, based on agency conflicts (Gertner et al. (1994), Stein (1997), Scharfstein and Stein (2000), Rajan et al. (2000), and Inderst and Muller (2003)). The present paper also underscores agency conflicts, but by taking account of manager-specific shocks, we obtain the new finding that correlation can help conglomerates relax financial constraints.

This paper is also associated with the studies on the relation between managerial characteristics and organizational structure. Van den Steen (2005) shows that a manager with strong beliefs about the right course of action will attract, through sorting in the labor market, employees with similar beliefs. Dessein (2012) provides a formal theory of the firm in which managerial direction and bureaucratic decision-making play a key role. The key difference in the present paper is that rather than focusing on managerial vision or direction, we focus on manager specific ability and cost overrun shocks.

This paper also complements the literature on managers’ span of control (Calvo and Wellisz (1978) and Rosen (1982)). Rajan and Wulf (2006)

document the increase of managers’ span of control in past decades. They attribute the change of managers’ span of control to three possible factors: the development of information technology, the improvement in corporate governance and the increased competition in product markets. This paper complements this literature by arguing that financial constraints are another important driver of managers’ span of control.

This paper contributes to the literature regarding how firms deal with liquidity shocks. During the recent financial crisis, lack of liquidity has been regarded as one of the main factors contributing to the propagation of the initial shock (Brunnermeier and Pedersen (2009)). Holmstrom and Tirole (1998) analyze it by focusing on whether private assets provide sufficient liquidity and discussing the role of government in supplying additional liquidity. The manager-specific shocks in our model can be interpreted as liquidity shocks. With this interpretation in mind, our analysis sheds light on how firms should be structured to withstand liquidity shocks.

The remainder of the paper is organized as follows. Section 2 introduces the model. Section 3 studies different organizational structures in the case without moral hazard. Section 4 analyzes the case with moral hazard. Section 5 discusses the robustness of the results. Section 6 presents the empirical implications and the conclusion is in Section 7. All formal proofs are in the appendix.

2 The Model

There are two types of players, investors and managers, as well as two independent and symmetric projects, A and B. Both types of players are risk neutral. The investors have deep pockets, but do not have the necessary skills to operate any project. In contrast, the managers are penniless and protected by limited liability. They are able to manage the projects while having different management abilities.

We consider a three period model, t = 0, 1, 2. The timeline is summarized as in Figure 1. At period 0, the two projects can be managed in two stand-alone firms or in one conglomerate firm. In the stand-alone case, the two projects are operated by two different managers. In the conglomerate case, the two projects are operated by the same manager. Each project requires an initial investment $I$.

Once the manager starts overseeing the firm, things may go wrong. At period 1, each project encounters a shock, which can be a cost overrun or a shortfall in cash flows to finance operating expenses. The shock is manager specific. Its magnitude depends on the manager’s skill, which is unknown to
all parties at period 0 but revealed to the public at period 1. The manager-specific shock for each project $\rho$ is distributed according to a c.d.f $F(\cdot)$ over $[0, +\infty)$ (with a p.d.f $f(\cdot)$). If the two projects are initially managed in two stand-alone firms, the shocks of the two projects are independent. If the two projects are managed in one conglomerate firm, the shocks are perfectly correlated.

To continue the project and reap the final cash-flow, additional investment $\rho$ must be injected to cover the shock. Otherwise, the project is liquidated, the additional expense $\rho$ is avoided, but the final cash-flow will be lost. After observing the two shocks, the investors need to determine which project to continue and which to liquidate. In addition, conglomerates have ex-post split options and stand-alone firms have ex-post merger options. In other words, the investors should make the reorganizational decision, i.e., decide whether to merge the two stand-alone firms or spin off the conglomerate firm.

At period 2, any continued project is subject to moral hazard in that its manager privately chooses between effort and shirking à la Holmstrom and Tirole (1998). If the manager exerts effort, the probability of success is $P$; if he shirks, this probability is lowered to $P - \Delta$ but he enjoys a non-transferable private benefit $B$.

The project matures at period 2, delivering a revenue $R$ if it succeeds and no revenue if it fails.

Our model departs from Holmstrom and Tirole (1998) in three crucial aspects. First, the liquidity shock in our model is manager-specific rather than project-specific. This is very crucial in the sense that the correlation of shocks differs according to whether the two projects are separately or jointly managed at the initial stage. One interpretation for manager-specific

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shocks is that different managers are more or less prone to mistakes. Highly skilled managers make judicious choices, while less skilled managers can err.\(^5\) Second, in Holmstrom and Tirole (1998), the managers are assumed to have all the bargaining power. In contrast, we assume that the investors have all the bargaining power. With this assumption, our contracting problem is simplified. In addition, there is no role for hedging policies that firms can apply to deal with shocks, such as credit lines or liquidity hoarding. Hence, we can concentrate our study on organizational structure.\(^6\)

3 Equilibrium without Moral Hazard

In this section, we consider a benchmark case where managers’ effort is observable and contractable.

3.1 Stand-alone Firms

In the stand-alone case, one manager is in charge of one project. At period 1, the shocks of the two projects, \(\rho_A\) and \(\rho_B\), are independent because of the combination of the characteristics of the two managers. After observing \(\rho_A\) and \(\rho_B\), the investors need to decide whether to merge the two stand-alone firms. In the case without moral hazard, ex-post mergers have no impact on the income that can be pledged to the investors, and thereby the investors are indifferent. In addition, the investors also need to determine which project to continue and which to liquidate, by comparing the continuation benefit with the cost of withstanding the shock. At period 1, the continuation value for each project is always \(PR\) and the cost to withstand the cost overrun is \(\rho_i\), where \(i = A, B\). If \(\rho_i \leq PR\), the investor will provide liquidity to continue project \(i\). Otherwise, it will be liquidated. Thus, the expected value of each project is

\[
F(\text{PR})PR - \int_0^{\text{PR}} \rho f(\rho) d\rho - I, \tag{1}
\]

where \(F(\text{PR})\) is the expected continuation probability and \(\int_0^{\text{PR}} \rho f(\rho) d\rho\) is the expected liquidity injection to cover the shock. This expected value can

\(^5\)The literature, e.g., Bertrand and Schoar (2003), Adams et al. (2005), Malmendier and Tate (2005), Bloom and Van Reenen (2007) and Kaplan et al. (2012), argue that CEO abilities significantly influence firm performance.

\(^6\)See the details for why there is no role of liquidity hoarding or credit lines in the discussion section.
be simplified as $\int_0^{PR} F(\rho) d\rho - I.\footnote{If the manager-specific shock is distributed according to another c.d.f. $G(\cdot)$, which is second-order stochastically dominated by $F(\cdot)$, we obtain $\int_0^{PR} G(\rho) d\rho \geq \int_0^{PR} F(\rho) d\rho$. It indicates that the value of the project increases with the risk of managerial talent. It is because the problem faced by each investor is actually a real option problem and the value of option is an increasing function of the risk.}$

### 3.2 Conglomerates

In the conglomerate case, one manager is initially in charge of both projects. At period 1, the shocks of the two projects $\rho_A$ and $\rho_B$, affected by the same manager’s ability, are perfectly correlated, $\rho_A = \rho_B$. After observing the two shocks, the investors decide whether to split the big firm as well as which project to continue. Without moral hazard, the investors are also indifferent to the ex-post spinoff, since this option has no impact on the pledgeable income.

Due to the change in the correlation of the two shocks, the ex-post continuation of the two projects in the conglomerate case is different from the stand-alone case, as in Figure 2. In conglomerates, the two shocks are perfectly correlated, hence the two projects are either continued or liquidated together. By contrast, in stand-alone firms, the two shocks are independent, thus there are three possible situations: the two projects are continued together, one project is continued and the other is liquidated, and both are liquidated.

The difference in the ex-post continuation between the two organizational structures, however, does not imply the divergence in the ex-ante value. At period 0, the project is expected to face the same manager-specific shock whether it is managed in a stand-alone firm or in a conglomerate firm. In addition, without moral hazard, the project is continued if and only if its continuation value is greater than the magnitude of its shock. There is no interdependence on the continuation between the two projects. As a result, organizational structure is irrelevant for value.

The main results are summarized as follows.

**Proposition 1.**

In the case without moral hazard,

i) the project is continued if and only if its shock $\rho$ is lower than its continuation value $PR$.

ii) organizational structure is irrelevant for value.
Figure 2: In stand-alone firms, since the two shocks are independent, there are three possible situations: with probability $F(PR)^2$ both are continued, with probability $2F(PR)(1 - F(PR))$ one is continued and the other is liquidated, and with probability $(1 - F(PR))^2$ both are liquidated. In conglomerates, since the two shocks are perfectly correlated, with probability $F(PR)$ both projects are continued and with probability $1 - F(PR)$ both are liquidated.
In the frictionless environment, the traditional argument, including Myers (1968), Levy and Sarnat (1970), and Adler and Dumas (1975), is that diversified mergers cannot alter the total value. In this paper, we have a similar result. However, the traditional argument is based on the irrelevance of diversification on value, in contrast, our argument is based on the irrelevance of correlation on value. In this paper, the difference between conglomerates and stand-alone firms resides in the correlation of shocks among projects. Without moral hazard, the continuation of each project depends on its own shock rather than on the other’s. In this case, the correlation between the shocks would not matter for each project’s continuation decision and thereby its ex-ante expected value.

Other research, e.g., Lewellen (1971), Diamond (1984), Leland (2007) and Banal-Estanol et al. (2011), find that if there are frictions, i.e., bankruptcy cost or agency problem, diversification can add firm value by reducing default risk or agency costs. Similarly, we want to check whether correlation matters for financial constraints and value if the managers are subject to moral hazard.

4 Equilibrium with Moral Hazard

In this section, we study the moral hazard case where the manager, protected by limited liability, privately chooses between exerting effort and shirking. In this case, the income that can be pledged to the investors is strictly lower than the full value of the project. Hence, two types of inefficiency arise: i) ex-post inefficient liquidation at period 1 if the shock of the project is greater than its pledgeable income but lower than its full value; and ii) ex-ante credit rationing, i.e., the investors are not willing to contribute the initial investment at period 0 even if it is optimal to do so. The main goal of the present paper is to study which organizational structure is better at dealing with these inefficiencies. However, before the analysis, we first need to see how the final payoffs of the project are split between the investors and the manager in order to incentivize the manager.

4.1 Managerial Compensation and Income Pledgeability

At period 2, the project is subject to moral hazard in that the manager privately chooses between effort and shirking. In order to induce effort, the manager must be granted a positive rent. The income of the project cannot be totally pledged to the investors.
In our model, there are two possible cases at period 2: i) one manager only operates one project; ii) one manager operates both projects. In the first case, the manager is granted with $R_b$ in case of success and 0 in case of failure. The incentive compatibility constraint which guarantees that the manager prefers exerting effort rather than consuming private benefits is

$$\Delta R_b \geq B.$$  \hspace{1cm} (2)

It implies that, to be incentivized, the expected gain from exerting effort for the manager must be greater than the private benefit that he can enjoy by shirking. Hence, the manager is rewarded $\frac{B}{\Delta}$ in case of success and 0 in case of failure. The managerial compensation is linear in performance. The maximum pledgeable income to the investors is $P(R - \frac{B}{\Delta})$, denoted $a$.

In the second case, the manager receives a reward $\hat{R}_b$ when both projects are successful and 0 otherwise. This sharing rule for two independent projects is an optimal incentive scheme.\(^8\) The condition for the manager to prefer exerting effort on both projects rather than on one is

$$P^2\hat{R}_b \geq P(P - \Delta)\hat{R}_b + B,$$  \hspace{1cm} (3)

and the condition which guarantees that the manager works on both rather than on neither is

$$P^2\hat{R}_b \geq (P - \Delta)^2\hat{R}_b + 2B.$$  \hspace{1cm} (4)

It is easy to show that condition (3) is redundant given condition (4). Thus, the incentive compatible bonus that the manager obtains in case of two successes satisfies

$$\hat{R}_b \geq \frac{2B}{(2P - \Delta)\Delta}.$$  \hspace{1cm} (5)

In this case, the manager is granted $\frac{2B}{(2P - \Delta)\Delta}$ if both projects succeed and 0 otherwise. The managerial compensation is increasing and convex in performance. The maximum pledgeable income to the investors per project is $P(R - \frac{P - \Delta}{2P - \Delta} B)$, denoted $b$.

The optimal incentive schemes in the above two cases indicate the following proposition.

**Proposition 2.**

*The managerial compensation is more convex in performance if the projects are managed together than if the projects are operated alone.*

Proposition 2 implies that the convexity of managerial compensation is positively related to the number of projects managed together, i.e., firm diversification. In other words, the convexity of managerial compensation would be negatively correlated with the volatility of the firm’s final outcome. The literature has two opposite arguments. On one hand, Jensen and Meckling (1976) and Haugen and Senbet (1981) argue that, a convex compensation scheme leads to more risk taking behavior of the manager and hence increases the volatility of the firm. On the other hand, Smith and Stulz (1985), Starks (1987) and Carpenter (2000) argue that the risk-averse manager, who cannot perfectly hedge his risk, may mitigate the risk of the outcome to reduce his own risk exposure. Thus, the convexity of managerial compensation results in less volatility of the firm. We obtain a similar result as the second group. However, in the literature, the managerial compensation scheme is exogenously given, while in the present paper it is endogenously determined with risk neutral managers. Hence, Proposition 2 provides another mechanism to explain the negative relation between the convexity of managerial compensation and the firm’s volatility.

Now we turn to the analysis on the pledgeable income. In both cases, the income that can be pledged to the investors per project, i.e., $a$ or $b$, is always lower than the full value of the project $PR$. At period 1, inefficient liquidation occurs if the shock is greater than the pledgeable income but lower than the full value. In addition, we also obtain that $a < b$, i.e., the manager can pledge more income to the investors per project if he operates both projects than if he only operates one project. The intuition is that, when the two projects are jointly managed, the manager can use one project as a collateral to raise financing for the other, referred to “cross-pledging” as in Tirole (2006).

**Proposition 3.**

In the case with moral hazard, after the occurrence of the two manager-specific shocks,

i) the income that can be pledged to the investors is always lower than the full value of the project.

ii) the pledgeable income per project is larger in the case where the manager is in charge of both projects than in the case where he is in charge of one project.

The first part of Proposition 3 is consistent with the argument in Jaffee and Russell (1976) and Stiglitz and Weiss (1981) that credit rationing is an equilibrium phenomenon if there is information asymmetry between borrowers and lenders. The second part is consistent with Diamond (1984) and Tirole (2006) that the cross-pledging of independent projects can mitigate
agency problem and increase income pledgeability. This cross-pledging effect is also similar to the coinsurance effect in Lewellen (1971), Leland (2007) and Banal-Estanoel et al. (2011). However, the underlying mechanisms are different. In their papers, the combination of two independent cash flows reduces default cost, while in this paper it mitigates the agency problem.

Generally speaking, financial constraint is loosened if more income can be pledged to the investor. Hence, we will study the ex-ante pledgeable income that the investors can obtain at period 0 in the two organizational structures.

4.2 Stand-alone Firms

In the stand-alone case, the two projects are operated separately by two different managers at period 0. At period 1, the two shocks $\rho_A$ and $\rho_B$ are independent. On observing the two shocks, the investors need to decide whether to merge the two firms as well as which project to continue.\footnote{Given merged, one manager is in charge of both projects, while the other is fired.}

There are four possible choices for the investors at period 1: i) continue both projects; ii) continue project $A$ while liquidating project $B$; iii) continue project $B$ while liquidating project $A$; iv) liquidate both. If both projects are continued together, it is preferable they be merged in order to exploit the cross-pledging benefit and increase income pledgeability. However, if only one project or none is continued, there is no scope for cross-pledging.

Here, we ignore any specific sharing rule among the investors, and only consider the total profit to them. This is due to the fact that as long as the action is profitable, there always exists some specific rule to split the cost and the income to benefit all investors. The total profit to the investors at period 1 is $2b - \rho_A - \rho_B$ in case i), $a - \rho_A$ in case ii), $a - \rho_B$ in case iii), and 0 in case iv). Denote $c = 2b - a = P\left(R - \frac{A - B}{2P - A B}\right)$. If both projects are bundled, the pledgeable income per project is $b$, while $a$ is the marginal pledgeable income for the first project and $c$ is the marginal pledgeable income for the second project, where $a < b < c$.

By comparing the net profit that the investors obtain in the four cases, we can see that if both projects can be continued alone ($\rho_A, \rho_B \leq a$), they are always continued together. If one project can be continued alone ($\rho_i \leq a$, where $i = A, B$) while the other cannot ($\rho_{-i} > a$), the other is saved only when its shock is not greater than the marginal pledgeable income for the second project ($\rho_{-i} \leq c$), otherwise, it is liquidated. If neither project can be continued alone ($\rho_A, \rho_B > a$), both projects can be continued together only when the total shock is lower than the total pledgeable income of bundling the two projects ($\rho_A + \rho_B \leq 2b$), otherwise, both are liquidated.
In stand-alone firms, the two projects are merged and continued together in the dark grey area, i.e., \( \rho_A + \rho_B \leq 2b \) and \( \rho_A, \rho_B \leq c \); one project is continued and the other is liquidated in the light grey area, i.e., \( \rho_i \leq a \) and \( \rho_{-i} > c \), where \( i = A, B \); both are liquidated in the white area, i.e., \( \rho_A + \rho_B > 2b \) and \( \rho_A, \rho_B > a \).

In summary, the conditions of continuation of the two projects, as in Figure 3, are as follows.\(^{10}\)

**Lemma 1.**

i) The two projects are merged and continued together if \( \rho_A + \rho_B \leq 2b \) and \( \rho_A, \rho_B \leq c \).

ii) Project A is continued while project B is liquidated if \( \rho_A \leq a \) and \( \rho_B > c \).

iii) Project B is continued while project A is liquidated if \( \rho_B \leq a \) and \( \rho_A > c \).

iv) Both projects are liquidated if \( \rho_A + \rho_B > 2b \) and \( \rho_A, \rho_B > a \).

Without moral hazard, the continuation of one project only depends on its own characteristics rather than on the other’s. However, Lemma 1 implies that, with moral hazard, the interdependence on the continuation between

\(^{10}\)See proof in Appendix.
the two projects or the two stand-alone firms arises due to the cross-pledging
effect.

Based on the interim continuation and liquidation conditions, we can simply obtain the continuation probability per project. Since the two projects are symmetric, we consider project $A$ as an example. In Figure 3, project $A$ is continued with project $B$ in the dark grey area. This probability is

$$q_1 = F(a)F(c) + \int_a^c \int_0^{2b-\rho_A} f(\rho_A)f(\rho_B)\,d\rho_B\,d\rho_A.$$  \hspace{1cm} (6)

In the upper light grey area, project $A$ is continued alone. This probability is

$$q_2 = F(a)(1 - F(c)).$$  \hspace{1cm} (7)

Thus, the total probability of continuation for project $A$ is $q_1 + q_2$. The corresponding expected liquidity injected to withstand the shock is

$$E\rho = \int_0^a \rho_A f(\rho_A)\,d\rho_A + \int_a^c \int_0^{2b-\rho_A} \rho_A f(\rho_A)f(\rho_B)\,d\rho_B\,d\rho_A.$$  \hspace{1cm} (8)

Due to the symmetry, project $B$ has the same continuation probability and expected liquidity injection at period 1. The distribution of the continuation of the two projects are in Figure 5(a).

Therefore, the ex-ante expected value per project at period 0 is

$$(q_1 + q_2)PR - E\rho - I,$$  \hspace{1cm} (9)

and the ex-ante expected return to the investors per project is

$$q_1b + q_2a - E\rho - I.$$  \hspace{1cm} (10)

The pledgeable income to the investors is $b$ if the project is continued with the other, while it is $a$ if the project is continued alone.

### 4.3 Conglomerates

In the conglomerate case, at period 0 both projects are managed by the same manager. At period 1, the shocks are perfectly correlated, thus the two projects are either continued or liquidated together. It is never optimal to spin off the two projects ex-post, since the cross-pledging benefit only exists when the two projects are jointly operated by the same manager. The pledgeable income per project is $b$ when both projects are merged and continued together. Therefore, the interim continuation conditions of the two projects, as in Figure 4, are as follows.
Continue Project A & B Liquidate Project A&B

\[ \rho \]

0 \[ \rho \]

\[ r \]

\[ a \]

\[ b \]

Figure 4: In conglomerates, both projects are continued if \( \rho_A = \rho_B \leq b \), while liquidated if \( \rho_A = \rho_B > b \).

**Lemma 2.**

_In conglomerates, the two projects are continued together if \( \rho_A = \rho_B \leq b \), otherwise, both are liquidated._

The distribution of the continuation of the two projects is in Figure 5(b). The interim continuation decision in the case with moral hazard seems similar to the case without moral hazard in that the two projects are either continued or liquidated together. However, the difference between the two still hinges on the existence of the interdependence on the continuation between the two projects. With moral hazard, the two projects depend on each other to be continued, when the shock is greater than \( a \) while lower than \( b \). In this case, both projects cannot be continued alone, but can be continued together if they use each other as collateral to raise financing.

Therefore, in the conglomerate case, the ex-ante expected value per project at period 0 is

\[
F(b)PR - \int_{0}^{b} \rho f(\rho) d\rho - I,
\]

where \( F(b) \) is the continuation probability and \( \int_{0}^{b} \rho f(\rho) d\rho \) is the expected liquidity injection to cover the shock.

The ex-ante expected return to the investors per project is

\[
F(b)b - \int_{0}^{b} \rho f(\rho) d\rho - I.
\]

For the investors, they obtain pledgeable income \( b \) per project if both projects are continued and 0 otherwise.

**4.4 Ex-ante Credit Rationing**

With moral hazard, the income of the project cannot be totally pledged to the investors. Credit rationing may occur at period 0 when the project initiates. In this subsection, we want to study whether conglomerates or stand-alone firms are better at relaxing the financial constraints by mitigating the ex-ante credit rationing problem. In general, ex-ante credit rationing is less likely to arise if the income that can be pledged to the investors is larger.
Figure 5: In stand-alone firms, both projects are continued with probability $q_1$, one project is continued while the other is liquidated with probability $2q_2$, both are liquidated with probability $1 - q_1 - 2q_2$. In conglomerates, both projects are continued with probability $F(b)$, and liquidated with probability $1 - F(b)$. 

(a) Stand-alone Firms

(b) Conglomerates
Hence, we compare the ex-ante pledgeable income generated in these two organizational structures.

In our setup, on observing the shock at period 1, the investors need to determine whether to inject liquidity to continue the project. The problem faced by the investors at period 0 is actually a real option problem. The pledgeable income is equivalent to the option value. In the case without moral hazard, at period 1, the continuation of each project only depends on its own shock. Hence, the option value that the investors obtain for each project is also determined by its own random shock. As a result, organizational structure is irrelevant for value. However, in the case with moral hazard, the interdependence on the continuation between the two projects arises; the continuation of each project depends not only on its own shock but also on the other’s. Hence, the option value that the investors obtain for each project is determined by both shocks. In this case, correlation matters for the option value. When the two shocks are more correlated, the risk the investors face is larger, thereby leading to a larger option value. As a consequence, when compared to stand-alone firms, conglomerates have an advantage in generating pledgeable income to the investors and can therefore relax financial constraints.11

Denote $PI_c$ as the ex-ante expected pledgeable income per project to the investors in the conglomerate case, and $PI_s$ as the ex-ante expected pledgeable income per project in the stand-alone case, where $PI_c = F(b) - \int_0^b \rho f(\rho) d\rho$, $PI_s = q_1 b + q_2 a - E\rho$ and $PI_c > PI_s$.

**Proposition 4.**

i) If $PI_s \geq I$, the projects can always obtain financing at period 0 whether they are operated in a conglomerate firm or in two stand-alone firms.

ii) If $PI_s < I \leq PI_c$, the projects can only obtain financing at period 0 if they are operated in a conglomerate firm.

iii) If $PI_c < I$, the projects can never be financed at period 0 regardless of organizational structure.

Proposition 4 implies that conglomerates are better at mitigating ex-ante credit rationing than stand-alone firms. In this paper, the relaxation of the financial constraint stems from cross-pledging. However, in the presence of ex-post reorganizational option at period 1, stand-alone firms also can take advantage of the cross-pledging benefit. As a result, the advantage of conglomerates relative to stand-alone firms does not come from the fact that cross pledging only exists in conglomerate firms, but from the fact that more correlated shocks lead to better exploitation of cross pledging.

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11Rigorous proof is in Appendix.
Project A is continued in the conglomerate case but liquidated in the stand-alone case.

Project A is continued in the stand-alone case but liquidated in the conglomerate case.

Figure 6: In the light grey area, i.e., $\rho_A \in [a, b]$ and $\rho_B \in (2b - \rho_A, +\infty)$, project A is liquidated in the stand-alone case while continued in the conglomerate case. It represents the relative cost if the two projects are managed in two stand-alone firms. In the dark grey area, i.e., $\rho_A \in (b, c]$ and $\rho_B \in [0, 2b - \rho_A]$, project A is continued in the stand-alone case while liquidated in the conglomerate case. It represents the relative benefit if the two projects are managed in two stand-alone firms.

Proposition 4 also indicates that if the initial investment need is large, the projects can only be initiated in a conglomerate firm and ex-ante credit rationing is the main concern. In this case, conglomerates can create value due to their advantage in relaxing financial constraints. Nevertheless, if the initial investment need is small, the projects can always be initiated regardless of organizational structure. In this case, ex-ante credit rationing is not an issue. Whether conglomerates can create or destroy value does not depend on their relative abilities in relaxing the ex-ante financial constraints but their relative abilities in mitigating ex-post inefficient liquidations.

4.5 Ex-post Inefficient Liquidation

With moral hazard, ex-post inefficient liquidation occurs at period 1 if the shock of the project is lower than its full value but greater than the income
that can be pledged to the investors. In this subsection, we consider the case where $PI_s \geq I$, i.e., the projects are always initiated regardless of organizational structure. In this case, we study which organizational structure is better at alleviating ex-post inefficient liquidation.

Due to symmetry, we take project $A$ as an example, and see how its continuation depends on the organizational structure. When its shock is too low $\rho_A \leq a$ (too high $\rho_A > c$), the project is always continued (liquidated) regardless of organizational structure. However, when $a < \rho_A \leq c$, the continuation of project $A$ depends on whether it is managed in a conglomerate firm or in a stand-alone firm. If $a < \rho_A \leq b$, project $A$ is always continued in the conglomerate case, while it is liquidated in the stand-alone case if the other shock turns out to be large, i.e., $\rho_B > 2b - \rho_A$. In this case, project $A$ is less likely to be continued in stand-alone firms than conglomerates. The decrease in the probability of continuation is $\int_a^b \int_{2b-\rho_A}^{+\infty} f(\rho_A)f(\rho_B)d\rho_Bd\rho_A$ as the light grey area in Figure 6. If $b < \rho_A \leq c$, the project is always liquidated in the conglomerate case, while it is continued in the stand-alone case if the other shock turns out to be small, i.e., $\rho_B \leq 2b - \rho_A$. In this case, project $A$ is more likely to be continued in stand-alone firms than conglomerates. The increase in the probability of continuation is $\int_b^c \int_0^{2b-\rho_A} f(\rho_A)f(\rho_B)d\rho_Bd\rho_A$ as the dark grey area in Figure 6.

**Proposition 5.**

The benefit in ex-post continuation of stand-alone firms relative to conglomerates is that the project with shock $\rho_i \in (b, c]$ is saved by the other project with shock $\rho_{-i} \leq 2b - \rho_i$; The cost in ex-post continuation is that the project with shock $\rho_i \in (a, b]$ is dragged down by the other project with shock $\rho_{-i} > 2b - \rho_i$.

The rationale behind Proposition 5 is that if the project is operated in a conglomerate firm, the shock of other project has exactly the same magnitude. However, if the project is operated in a stand-alone firm, the magnitude of the other project’s shock can be small or large. If the other shock turns out to be small, the project is more likely to be continued when it is managed in a stand-alone firm than in a conglomerate firm. If the other shock turns out to be large, we obtain an opposite result. In our model, the project can be continued in conglomerates if only if its shock is lower than $b$. In stand-alone firms, the project, even with a shock larger than $b$, can be saved by the other with a small shock. Alternatively, the project, even with a shock lower than $b$, can be dragged down by the other with a large shock. As a result, if the likelihood of small shocks relative to large ones (i.e., the ratio of high-skilled managers relative to low-skilled ones) increases, conglomerates will be less able to mitigate ex-post inefficient liquidation than stand-alone firms.
Example: the manager-specific shock is uniformly distributed over $[0, \phi]$.

The difference between the light grey area and the dark grey area in Figure 6 represents the difference of continuation probability per project between the conglomerate case and the stand-alone case, which is written as following.

$$dp = \int_a^b \int_{2b-\rho_A}^{+\infty} f(\rho_A)f(\rho_B)d\rho_Bd\rho_A - \int_b^c \int_0^{2b-\rho_A} f(\rho_A)f(\rho_B)d\rho_Bd\rho_A. \quad (13)$$

If the manager-specific shock is uniformly distributed over $[0, \phi]$, i.e., $f(\cdot) = \frac{1}{\phi}$, by computing equation (13) we find that i) if $\phi \leq b$, the maximum shock is sufficiently small, hence both projects can always be continued regardless of organizational structure; ii) if $b < \phi \leq 2b$, the likelihood of large shocks relative to small ones is small, hence, the projects are more likely to be continued in stand-alone firms than in conglomerates. iii) if $\phi > 2b$, the likelihood of large shocks relative to small ones is large, thus the projects are less likely to be continued in stand-alone firms than in conglomerates.

Moreover, we can also compare the value difference per project between the two organizational structures, which is represented in the following equation.

$$dv = \int_a^b \int_{2b-\rho_A}^{+\infty} (PR - \rho_A)f(\rho_A)f(\rho_B)d\rho_Bd\rho_A - \int_b^c \int_0^{2b-\rho_A} (PR - \rho_A)f(\rho_A)f(\rho_B)d\rho_Bd\rho_A. \quad (14)$$

By computing the above equation when $f(\cdot) = \frac{1}{\phi}$, we find that i) if $\phi \leq b$, stand-alone firms and conglomerates generate the same value per project; ii) if $b < \phi \leq \phi^*$, where $\phi^* \in (b, 2b)$, stand-alone firms generate a larger value per project than conglomerates; iii) if $\phi > \phi^*$, stand-alone firms generate a smaller value per project than conglomerates. Generally speaking, more continuation leads to larger value. Hence, the qualitative argument on value is similar to that on continuation probability. However, $\phi^* < 2b$. It indicates that the range for stand-alone firms dominating conglomerates in terms of value is smaller than in terms of continuation probability. This is because, the expected cost to withstand shocks is larger in the stand-alone case than in the conglomerate case.

**Proposition 6.**

*If the shock is uniformly distributed over $[0, \phi]$,*

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12See proof in Appendix.
i) relative to conglomerates, the continuation probability for each project in stand-alone firms is the same if $\phi \in [0, b]$, larger if $\phi \in (b, 2b]$, and smaller if $\phi \in (2b, +\infty)$.

ii) relative to conglomerates, the value per project generated by stand-alone firms is the same if $\phi \in [0, b]$, larger if $\phi \in (b, \phi^*]$, and smaller if $\phi \in (\phi^*, +\infty)$, where $\phi^* \in (b, 2b)$.

This result tells us that conglomerates can generate a larger value than stand-alone firms if $\phi$ is sufficiently high, i.e., $\phi > \phi^*$, i.e., the likelihood of large shocks to small ones is large.

Our results show that in terms of relaxing ex-ante financial constraints, conglomerates are always better than stand-alone firms, while in terms of total value, conglomerates can either be better or worse than stand-alone firms depending on the distribution of manager-specific shock. If the ratio of high-skilled managers relative to low-skilled ones increases, conglomerates are more likely to destroy value.

5 Discussion

5.1 firm-specific Shocks

The main element driving the results in the present paper is the fact that projects are subject to manager-specific shocks. Nevertheless, our results are robust in a much broader environment. Here we will discuss the situations in which the results still hold.

The main implication for manager-specific shocks is that the shocks of the two projects become more correlated if they are managed in one conglomerate firm. In addition to manager-specific shocks, there are other productivity shocks leading to an increase in the correlation across projects in the conglomerate case, such as, quoted in footnote 5 in Gabaix (2011), the shocks coming from “a decision of the firm’s research department, of the firm’s chief executive officer, of how to process shipments, inventories or which new line of products to try” or the shocks stemming from “changes in capacity utilization, and, particularly, strikes.” In fact, as long as the shock is company-specific rather than project-specific, our results are robust. This is because firm-specific shocks always make projects more correlated when they are managed in one conglomerate than in separate firms.
5.2 Hedging

In the case with moral hazard, the outside investors may not be willing to provide liquidity to continue the project when the shock occurs, even if it is optimal. This naturally raises the question as to whether or not it is best for firms to hedge ex-ante, by hoarding liquidity or using credit lines, to deal with the shortage in liquidity ex-post. This issue was addressed in Holmstrom and Tirole (1998). Their main assumption is that managers have all the bargaining power, and this, in turn, generates the need for hedging.

Intuitively, it is optimal to continue the project if and only if $\rho < \rho^*$. In this case, the manager’s expected payoff is

$$U_M = F(\rho^*)PR - \int_0^{\rho^*} \rho f(\rho) d\rho - I.$$ (15)

The break-even condition for the investors is

$$F(\rho^*)a - \int_0^{\rho^*} \rho f(\rho) d\rho - I = 0.$$ (16)

We can show that $a < \rho^* \leq PR$. The optimal contract is such that the investors should provide liquidity as long as $\rho \leq \rho^*$. Another essential assumption driving the entrepreneur’s need for liquidity hoarding or credit lines is that the investors have no commitment power. With this assumption, ex-post the investors are not willing to withstand any shock larger than the pledgeable income they can obtain, i.e., $a$. Thus, the firm should ex-ante hoard liquidity or set a credit line with financial intermediaries. In this paper, however, the investors have all the bargaining power, the conflict of interest between ex-ante and ex-post decisions of the investors no longer exist. The problem faced by the investors is actually a real option problem. Any liquidity hoarding or credit lines would reduce the option value.

According to our theory, financial constrained firms do not hedge. This is consistent with the current literature. Rampini and Viswanathan (2012) argue that the opportunity cost to hedge future financing needs is forgone current investment, which is higher for financially constrained firms. Thus, more financially constrained firms hedge less. Our theory complements their study by taking a real option approach.

5.3 Competitive Capital Market

In our model, the investors have all the bargaining power. In this subsection, we instead assume a competitive capital market and check the robustness of our results. With this assumption, the managers will maximize their

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profit (equivalent to the total payoff) subject to the investors’ break-even constraint. The maximum pledgeable income that the investors can obtain is still \( PI_s \) in the case of two small firms, and \( PI_c \) in the case of one big firm. We have already shown that \( PI_s < PI_c \).

First, consider the case where \( PI_s < I \leq PI_c \). The projects can only be initiated if they are managed within the same firm. The main conclusion that big firms can better deal with an ex-ante credit rationing problem is still robust in a competitive capital market. The difference here is that the maximum shock \( \rho' \) that a large firm can withstand at period 1 would be different. This should satisfy the investors’ break-even condition.

\[
F(\rho')b - \int_0^{\rho'} \rho f(\rho)d\rho - I = 0. \tag{17}
\]

It can be shown that when \( PI_c \geq I \), then \( b < \rho' \leq PR \). In a competitive capital market, the maximum shock that can be withstood becomes larger.

Second, consider the case where \( PI_s \geq I \). The projects are always initiated regardless of organizational structure. In this case, ex-ante credit rationing is not a concern. In addition, the advantage in relaxing financial constraints does not indicate big firms create value. I will illustrate this point through a simple example. Consider the case where the shock can either be 0 or \( S \) with equal probability. Assuming \( 2(b - I) < S < 3b - 4I \), the shock can be withstood only if the other project does not encounter a shock.\(^{14}\) If the two projects are operated in a big firm at period 0, the two shocks are perfectly correlated. Thus, the projects are either continued or liquidated together with equal probability. The total expected payoff is \( PR - 2I \). If the two projects are operated in two small firms at period 0, the two shocks are independent. Hence, the projects are continued together except the case where both encounter a shock. The probability of continuation for either project is \( \frac{3}{4} \). The expected total payoff is \( \frac{3}{2} PR - \frac{1}{2} S - 2I \). It is clear that the expected payoff in the case of two small firms is larger than that in the case one big firm. In this case, big firms destroy value. Therefore, our qualitative results on the impact of the size of the firm on pledgeable income and total payoff are robust in a competitive capital market.

\(^{14}\)If the shocks are always withstood, the expected net profit for the investors is \( 2(b - \frac{1}{2} S - I) \). If the shock can only be withstood if the other projects has no shock, the expected net profit for the investors is \( 2\left(\frac{3}{2} b - \frac{1}{2} S - I\right) \). The assumption ensures that the former profit is negative while the latter is positive.
5.4 The cost of changing management

In our basic setup, the two projects are always merged when they are continued together at period 1. It is impossible to have two small firms coexist after the shocks. One way to address this problem is to assume a fixed cost $C$ to change the management. In the case of one big firm, the manager in charge of both projects is always the same at different periods. However, in the case of two small firms, the manager of one project is changed after with ex-post merger. Thus, we only consider the case of two small firms.

If $C \geq 2(b - a)$, i.e., the cost to change the management is higher than the gain of the pledgeable income from ex-post merger, the two small firms would never be merged at period 1. Each project is continued if and only if its shock is lower than $a$. Hence, two small firms coexist after the shocks if $\rho_A, \rho_B \leq a$.

If $C < 2(b - a)$, the cost to change the manager is lower than the gain of the pledgeable income from ex-post merger. At period 1, the pledgeable income that the investors can obtain in ex-post merger is scaled down to $2b - C$. The optimal continuation and liquidation decision is that i) continue and merge both projects if $\rho_A, \rho_B \leq c - C$ and $\rho_A + \rho_B \leq 2b - C$; ii) continue project $i$ and liquidate project $-i$ if $\rho_i \leq a$ and $\rho_{-i} > c - C$ ($i = A, B$); or iii) liquidate both.

Thus, the cost in changing the management reduces further reduces the ability of small firms to boost pledgeable income and relax financial constraints. The conclusion, that big firms are better at relaxing the initial financial constraint, is always robust. Furthermore, we can still say that relaxing financial constraints for big firms does not imply they create value is still robust, as long as the cost of switching the management is small. In this case, the comparable advantage of small firms in dealing with ex-post inefficient liquidation is not diluted.

5.5 Endogenous Investment

Our previous analysis focuses on the fixed investment case. In this sub-section, we extend the analysis to the endogenous investment case and see whether our results still hold. We assume a convex investment cost function for each project $c(I)$, where $c$ is continuous and twice differentiable, satisfying the monotonicity and the convexity conditions $c' > 0$ and $c'' > 0$. The follow-up shocks, payoffs and private benefits are scaled at per unit of investment. The optimal investment must be such that its marginal cost is equal to its marginal benefit to the investors.

With moral hazard, the optimal investment per project in the stand-alone
case is
\[ c'(I) = q_1b + q_2a - E\rho. \tag{18} \]
while in the conglomerate case, the optimal investment per project is

\[ c'(I) = F(b)b - \int_0^b \rho f(\rho) d\rho = \int_0^b F(\rho) d\rho. \tag{19} \]

The larger the benefit to the investors, the more they are willing to invest in the project at the initial stage. As we know, conglomerates always generate a larger utility to the investors than stand-alone firms in the case of fixed investment, i.e., \( \int_0^b F(\rho) d\rho > q_1b + q_2a - E\rho \). In other words, the marginal benefit to the investors is larger in the conglomerate case than in the stand-alone case. Therefore, in the endogenous investment case, conglomerates are better at increasing initial investment than stand-alone firms. This is exactly equivalent to the result in the fixed income case that conglomerates are better at mitigating ex-ante credit rationing. With respect to ex-post inefficient liquidation, the result on the comparison between the two organizational structures is similar to the fixed investment case, due to the same magnitude of shocks and continuation values per unit of investment.

5.6 Managerial ability and final output

In our setup, the managerial ability only has impact only on the intermediate shock and no influence on the final output. In this subsection, we will show that our results are still robust even when the final output is a function of the managerial ability. At period 2, if the project succeeds, its final output is \( R(\rho) \), where \( R'(\rho) \leq 0 \). In other words, the final output is larger if the manager is more skillful.

The dilemma faced by the investors is still a real option problem. At period 1, on observing the shock, the investors need to decide whether to continue or liquidate the project. In this case, both the intermediate shock and the final output are random variables. Both are essential in determining the investors’ decision, since the shock represents the cost while the final output represents the continuation value. In this subsection, we construct a new random variable \( X = R(\rho) - \rho \), reflecting the net continuation value at period 1. With moral hazard, the investors must compare the net continuation value \( X \) of each project with the marginal incentive rent that must be given to the manager. If the net continuation value is enough to compensate the marginal rent to the manager, the investors will provide liquidity to continue the project since they will get a nonnegative profit. In the conglomerate case, \( X_A = X_B \). In the stand-alone case, \( X_A \) and \( X_B \) are independent. In this
scenario, conglomerates still have the advantage relative to stand-alone firms in relaxing financial constraints, since the increase in the correlation of the two projects’ net continuation values also leads to a larger option value. In addition, in the conglomerate case, the other project always has the same net continuation value, while in the stand-alone case, the net continuation value for the other project may be small enough to hurt continuation or big enough to help the continuation. As a result, whether conglomerates or stand-alone firms are better at mitigating ex-post inefficient liquidation depends on the distribution of net continuation value, i.e., the distribution of manager-specific shock.\(^{15}\)

### 5.7 Ex-post Increasing Returns to Scale

By merging two projects at period 1, the incentive rent to the manager is reduced and the pledgeable income is increased. The correlation across projects in big firms helps exploit this cross-pledging benefit and thus relaxes financial constraint. In addition to cross pledging, our results are robust with other types of ex-post increasing return to scale, such as economies of scale, market power, complementarity in research and technology. With these positive synergies, mergers at period 1 also boost the pledgeable income. The continuation and liquidation decisions of each project depend on both shocks, thus correlation can still help exploit ex-post increasing returns to scale and relax ex-ante financial constraints.

### 6 Empirical Implications

Unlike stand-alone firms, conglomerates can bring multiple projects under the same manager, therefore increasing the correlation across projects and enhancing the aggregate volatility. In other words, the distribution of firm size matters for the level of aggregate volatility. Firm size is measured in the number of projects under the same roof. If the ratio of large firms relative to small ones increases, the aggregate volatility goes up.

**IMPLICATION 1:** The aggregate volatility increases with the ratio of large firms relative to small ones.

Gabaix (2011) shows that when the distribution of firm size is fat-tailed, idiosynchratic shocks to individual firms do not average out. He finds that the idiosynchratic shocks of the largest 100 firms in the United States can explain

\(^{15}\)See rigorous proof in Appendix.
about one-third of aggregate shocks in output growth. This is consistent with implication 1 that the aggregate volatility from individual firms increases when the ratio of large firms relative to small ones goes up.

The next implication characterizes the relationship between the managerial compensation and the number of projects the manager is in charge of. Proposition 2 simply yields the following implication.

**IMPLICATION 2:** The managerial compensation is more convex in performance with a larger number of projects under management.

The convexity of the managerial compensation can be reflected in the use of equity and options in a manager’s compensation package. Hence, we expect more diversified firms use more equity or options to reward managers. May (1995) finds a positive relation between firm diversification and the proportion of personal wealth vested in firm equity, while Denis et al. (1997) find a negative relation between the two. As argued in Aggarwal and Samwick (2003), these two tests are misleading since they treat the level of managerial incentives as exogenously determined. Aggarwal and Samwick (2003) use a setup where incentives are set in equilibrium and find a significant positive relation. They show that the negative relation in Denis et al. (1997) is the result of unobserved, firm-specific factors. We see the same positive association between the convexity of managerial compensation and firm diversification. However, according to our setup, this positive relation should be more significant when the credit constraint is the main concern. Hence, one possible way to distinguish our hypothesis from others is to investigate how this relation changes with the financial constraint.

Implication 3 is directly based on Proposition 4.

**IMPLICATION 3:** Conglomerates are better at relaxing financing constraints than stand-alone firms.

The relaxation of financial constraints may be reflected in different ways. Berger and Ofek (1995) find that conglomerates are significantly more leveraged than their comparable stand-alone firms. In contrast, Comment and Jarrell (1995) find no significant association between leverage and firm diversification. These mixed observations do not necessarily indicate that conglomerates have no advantage in relaxing the financial constraint. In fact, relaxing financial constraints may be reflected in the reduction in the cost of capital rather than the increase in the leverage. Hann et al. (2012) find that, on average, conglomerates have a lower cost of capital than comparable portfolios of stand-alone firms. In addition, the benefit of conglomerates may be more evident in the environment where credit rationing is the main
concern for the firm as in our setup. Kuppuswamy and Villalonga (2010) treat the 2007 – 2009 crisis as an exogenous shock of credit rationing for firms and find that conglomerates have significantly lower cash ratios, better credit ratings, and are more leveraged relative to comparable focused firms. However, whether the financial benefit in conglomerates stems from diversification, correlation or efficient resources allocation through internal capital market is still not clear. Future work should be done in order to identify different hypothesis.

The advantage of conglomerates in relaxing financial constraints does not indicate superiority in terms of total value. If ex-ante credit rationing is not an issue, whether conglomerates create or destroy value depends on the distribution of manager-specific shocks. If the ratio of high-skilled managers relative to low-skilled ones increases, small shocks are more likely to occur and conglomerates become more likely to destroy value.

IMPLICATION 4: When credit constraint is the main concern for firms, conglomerates can create value. However, when credit constraint is not an issue, conglomerates can destroy value if the ratio of high-skilled managers relative to low-skilled ones is sufficiently large.

This implication is consistent with the dramatic reversal in the empirical view towards conglomerate mergers; positive during the 1960s and 1970s while negative in the 1980s and 1990s. Bhide (1990) argues that due to technological, economic and regulatory changes during 1970s and 1980s, information asymmetries become less of an issue in corporate financing. Hence, credit constraint is a significant concern for firms during the 1960s and 1970s. Our theory predicts that conglomerates can create value in a credit constrained environment, which is consistent with the positive view towards conglomerate mergers during this period. Credit constraint, however, becomes less important in the 1980s and 1990s. Our theory implies that conglomerates are more likely destroy value if the ratio of high-skilled managers to low-skilled ones is larger. During this period, the increased competition in the managerial labor market (Murphy and Zabojnik (2004)) and the improvement in CEO education (Palia (2000)) would reduce the proportion of low-skilled managers and increase the proportion of high-skilled ones. In this context, my model predicts that conglomerates are more likely to destroy value, which is consistent with the negative view towards conglomerates during this period.

To test implication 4, one difficult point is to quantify the managerial talent. One way is to directly measure the managerial talent, as in Bloom and Van Reenen (2007). They use an innovative survey data to score the management practice of 732 medium-sized firms in the United States, France,
Germany, and the United Kingdom. Another way is to indirectly measure the managerial talent, as in Bushman et al. (2010). They decompose the firm’s total performance into two parts: one part affected by managerial talent and the other part unrelated to managerial talent. With these proxies, we may be able to test whether conglomerates create or destroy value with the evolvement of financial constraint and managerial talent.

7 Conclusion

The relaxation of financial constraints for conglomerates relative to stand-alone firms has been empirically well documented. The conventional wisdom attributes conglomerates’ advantage in relaxing financial constraints to diversification. By putting several projects under the same top manager, however, large firms can increase their correlation by exposing them to the same manager-specific shock. I challenge the conventional wisdom and show that this positive correlation enhances conglomerates’ ability to relax financial constraints. In addition, by taking account of manager-specific shocks, our theory predicts that when credit rationing is the main concern, conglomerates always create value. However, when credit rationing is not an issue, whether conglomerates create or destroy value depends on the distribution of managerial talent. Large firms are more likely to destroy value if the ratio of highly-skilled managers relative to low-skilled ones becomes larger. These predictions fit quite well with the parallel evolution of the managerial labor market and the empirical view toward conglomerate mergers from the 1960s to the 1990s in the US.

A Continuation conditions in the conglomerate case

Continue both projects if $2b - \rho_A - \rho_B \geq a - \rho_A$, $2b - \rho_A - \rho_B \geq a - \rho_B$ and $2b - \rho_A - \rho_B I \geq 0$. These three inequalities hold when $\rho_A + \rho_B \leq 2b$ and $\rho_A, \rho_B \leq c$.

Continue project $A$ while liquidate project $B$ if $a - \rho_A > 2b - \rho_A - \rho_B$, $a - \rho_A > a - \rho_B$ and $a - \rho_A \geq 0$. Hence, $\rho_A \leq a$ and $\rho_B > c$.

Similarly, continue project $B$ while liquidate project $A$ if $\rho_B \leq a$ and $\rho_A > c$.

Liquidate both projects if $2b - \rho_A - \rho_B < 0$, $a - \rho_A < 0$ and $a - \rho_B < 0$. Hence $\rho_A + \rho_B > 2b$ and $\rho_A, \rho_B > a$. Q.E.D.
B  The income that can be pledged to the investors is larger in the conglomerate case than in the stand-alone case

In the conglomerate case, the expected return or the expected pledgeable income to investors can be transformed as

\[
F(b)b - \int_{0}^{b} \rho f(\rho) d\rho - I = \int_{0}^{b} (b - \rho) f(\rho) d\rho - I \\
= \int_{0}^{b} \int_{0}^{+\infty} (b - \rho_{A}) f(\rho_{A}) f(\rho_{B}) d\rho_{B} d\rho_{A} - I \\
= \int_{0}^{a} \int_{0}^{+\infty} (b - \rho_{A}) f(\rho_{A}) f(\rho_{B}) d\rho_{B} d\rho_{A} \quad ① \\
+ \int_{a}^{b} \int_{0}^{+\infty} (b - \rho_{A}) f(\rho_{A}) f(\rho_{B}) d\rho_{B} d\rho_{A} - I \quad ②
\]

In the stand-alone case, the expected return to investors can be transformed as

\[
q_{1} b + q_{2} a - E\rho - I \\
= \int_{0}^{a} \int_{0}^{c} (b - \rho_{A}) f(\rho_{A}) f(\rho_{B}) d\rho_{B} d\rho_{A} + \int_{0}^{a} \int_{c}^{+\infty} (a - \rho_{A}) f(\rho_{A}) f(\rho_{B}) d\rho_{B} d\rho_{A} \quad ①' \\
+ \int_{a}^{b} \int_{0}^{c} (b - \rho_{A}) f(\rho_{A}) f(\rho_{B}) d\rho_{B} d\rho_{A} \quad ②' \\
+ \int_{b}^{c} \int_{0}^{2b - \rho_{A}} (b - \rho_{A}) f(\rho_{A}) f(\rho_{B}) d\rho_{B} d\rho_{A} - I \quad ③'
\]

(21)

It is easy to see that ① > ①', ② > ②' and ③' < 0, hence the investors obtain a larger expected return in the conglomerate case. Q.E.D
C  Continuation probability per project in the conglomerate case v.s. the stand-alone case: example

The shock of each project is uniformly distributed according to $[0, \phi]$. The density function is $\frac{1}{\phi}$.

1) If $\phi \leq b$, $dp = 0 - 0 = 0$.

2) If $b < \phi \leq c$, $dp = \int_{2b-\phi}^{\phi} \int_{2b-\rho_A}^{\rho_A} \frac{1}{\phi^2} d\rho_B d\rho_A - \int_{b}^{\phi} \int_{0}^{2b-\rho_A} \frac{1}{\phi^2} d\rho_B d\rho_A = \frac{(\phi - 2b)(\phi - b)}{\phi^2} < 0$.

3) If $\phi > c$, $dp = \int_{a}^{b} \int_{2b-\rho_A}^{\rho_A} \frac{1}{\phi^2} d\rho_B d\rho_A - \int_{b}^{c} \int_{0}^{2b-\rho_A} \frac{1}{\phi^2} d\rho_B d\rho_A = \frac{(b-a)(\phi-2b)}{\phi^2}$.

We obtain that $dp \leq 0$ if $c < \phi \leq 2b$, otherwise, $dp > 0$.

Thus, if $\phi \leq b$, $dp = 0$; if $b < \phi \leq 2b$, $dp \leq 0$; if $\phi > 2b$, $dp > 0$. Q.E.D.

D  The value per project in the conglomerate case v.s. the stand-alone case: example

1) If $\phi \leq b$, $dv = 0 - 0 = 0$.

2) If $b < \phi \leq c$,

$$dv = \int_{2b-\phi}^{\phi} (PR - \rho_A) \frac{1}{\phi^2} d\rho_B d\rho_A - \int_{b}^{\phi} \int_{0}^{2b-\rho_A} (PR - \rho_A) \frac{1}{\phi^2} d\rho_B d\rho_A$$

$$= \frac{(\phi - b)(\phi - 2b)}{\phi^2} PR - \frac{(\phi - b)(\phi^2 + b\phi - 8b^2)}{6\phi^2}$$

$$= \frac{\phi - b}{6\phi^2} (-\phi^2 + (6PR - b)\phi + 8b^2 - 12bPR)$$

If $a^2 + 6aPR - 5ab - 2b^2 \geq 0$, we can show that $dv \leq 0$ when $\phi \in [b, c]$. Otherwise, there exists $\phi^* = \frac{1}{2}[(6PR - b) - \sqrt{3(11b^2 - 20bPR + 12(PR)^2)}]$, such that when $\phi \in [b, \phi^*]$, $dv \leq 0$, and when $\phi \in [\phi^*, c]$, $dv > 0$.

3) If $\phi > c$,

$$dv = \int_{a}^{b} \int_{2b-\rho_A}^{\rho_A} (PR - \rho_A) \frac{1}{\phi^2} d\rho_B d\rho_A - \int_{b}^{c} \int_{0}^{2b-\rho_A} (PR - \rho_A) \frac{1}{\phi^2} d\rho_B d\rho_A$$

$$= \frac{(b-a)(\phi - 2b)}{\phi^2} PR - \frac{-4a^3 + 3a^2(4b - \phi) + b^2(-8b + 3\phi)}{6\phi^2}$$

$$= \frac{b-a}{6\phi^2} \{((6PR - 3(a+b))\phi - (12bPR + 4a^2 - 8b^2 - 8ab)) \}
E Managerial ability and final output

The final output is also a function of managerial ability, i.e., \( R(\rho) \). Denote \( X = R(\rho) - \rho \), the net continuation value of the project, which is a decreasing function of \( \rho \). In addition, denote \( r_1 = P_B X_{A}, \quad r_2 = P_B X_{B}, \quad r = \frac{P_B}{2P_B - X_{A}}, \) where \( 2r = r_1 + r_2 \) and \( r_2 < r < r_1 \). \( r_1 \) is the rent to the manager for the first project he manages, \( r_2 \) is the incremental rent to the manager for the second project he operates, and \( r_3 \) is the rent to the manager per project if he manages the two projects.

In the stand-alone case, \( X_A \), the net continuation value for project \( A \), and \( X_B \), the net continuation value of project \( B \) are independent due to the combination of the characteristics of the two managers. At period 1, on observing \( \rho_A \) and \( \rho_B \), i.e., \( X_A \) and \( X_B \), the investors decide which project to be continued and which project to be liquidated. There are four possible cases for the investors: i) continue both projects, ii) continue project \( A \) while liquidate project \( B \), iii) continue project \( B \) while liquidate project \( A \), and iv) liquidate both projects. The net profit the investors obtain is \( X_A + X_B - 2r \) in case i), \( X_A - r_1 \) in case ii), \( X_B - r_1 \) in case iii) and 0 in case iv).

By comparing the net profit for the investors in the four cases, we can obtain the continuation conditions as following: i) if \( X_A + X_B \geq 2r \) and \( X_A, X_B \geq r_2 \), the investors will continue both projects; ii) if \( X_A \geq r_1 \) and \( X_B < r_2 \), the investors will only continue project \( A \); iii) if \( X_B \geq r_1 \) and \( X_A < r_2 \), the investors will only continue project \( B \); and iv) if \( X_A + X_B < 2r \) and \( X_A, X_B < r_1 \), the investors will liquidate both.

In the conglomerate case, the net continuation values for project \( A \) and \( B \) are perfectly correlated, i.e., \( X_A = X_B \). Hence, the two projects are continued together if \( X_A = X_B \geq r \), otherwise, both are liquidated together. Denote the c.d.f of \( X H(\cdot) \) and p.d.f \( h(\cdot) \).

According to Figure 7, in the conglomerate case, the expected return per project that the investors obtain at period 0 (take project \( A \) as an example)
Figure 7: In stand-alone firms, the two projects are merged and continued together in the dark grey area, i.e., $X_A + X_B \geq 2r$ and $X_A, X_B \geq r_2$; one project is continued and the other is liquidated in the light grey area, i.e., $X_i \geq r_1$ and $X_{-i} < r_2$, where $i = A, B$; both are liquidated in the white area, i.e., $X_A + X_B < 2r$ and $X_A, X_B < r_1$. In conglomerates, both projects are continued if $X_A = X_B \leq r$, while liquidated if $\rho_A = \rho_B > r$. 
is
\[
\int_r^{R(0)} (x_A - r)h(x_A)dx_A
= \int_{r_1}^{R(0)} \int_{-\infty}^{r_2} (x_A - r)h(x_A)h(x_B)dx_Bdx_A + \int_{r_1}^{R(0)} \int_{r_2}^{R(0)} (x_A - r)h(x_A)h(x_B)dx_Bdx_A
\]
\[
+ \int_r^{r_1} \int_{2r-x_A}^{R(0)} (x_A - r)h(x_A)h(x_B)dx_Bdx_A + \int_{r_2}^{r} \int_{2r-x_A}^{R(0)} (x_A - r)h(x_A)h(x_B)dx_Bdx_A
\]

(22)

In the stand-alone case, the expected return per project for the investors is
\[
\int_{r_1}^{R(0)} \int_{-\infty}^{r_2} (x_A - r_1)h(x_A)h(x_B)dx_Bdx_A + \int_{r_1}^{R(0)} \int_{r_2}^{R(0)} (x_A - r_1)h(x_A)h(x_B)dx_Bdx_A
\]
\[
+ \int_{r}^{r_1} \int_{2r-x_A}^{R(0)} (x_A - r_1)h(x_A)h(x_B)dx_Bdx_A + \int_{r_2}^{r} \int_{2r-x_A}^{R(0)} (x_A - r_1)h(x_A)h(x_B)dx_Bdx_A
\]

(23)

It is easy to see that \( A > A' \), \( B > B' \) and \( C' < 0 \). Hence, the investors obtain a larger expected return in the conglomerate case. In other words, conglomerates have advantage relative to stand-alone firms in relaxing the ex-ante constraint.

In addition, from Figure 7, we can see that: in the conglomerate case, the project is always continued with the other as long as \( X_i \geq r \), while in the stand-alone case, the project is continued with \( r_2 \leq X_i < r \) when the other project has a large net continuation value, i.e., \( X_i - r \geq 2r - X_A \), while the project is liquidated with \( r \rightleftharpoons X_i < r_1 \) when the other project has a small net continuation value, i.e., \( X_i < 2r - X_A \). Thus, comparing with the conglomerate case, the stand-alone case may lead to more or less continuation depending on the distribution of \( X \), i.e., the distribution of the manager-specific shock.

**References**


