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Re-evaluating the Separation of Banking and Commerce in the Era of BigTech: A Canonical Approach*

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Advances in information technology have given bigtech companies an informational advantage over banks. This development has two opposing implications: it (i) can narrow the information gap between banks and borrowers, while (ii) calling into question the traditional separation between banking and commerce. Assuming that no substantial information gap exists between bigtechs and banks and that bigtechs can own banks, this study examines how banks' lending decisions vary with ownership structure and how these decisions, in turn, affect allocative efficiency and the risk of bank failure. We show that integrating banks and bigtech can improve efficiency by extending additional loans to efficient but distressed firms that would otherwise be unable to obtain interim funding. This efficiency gain, however, is driven by the sharing of bigtech firms' information with banks. We also identify a scenario in which only a bigtech-affiliated bank lends to its subsidiary, and such lending can be ex ante inefficient because of distorted incentives within the conglomerate. Nonetheless, lending by an affiliated bank can increase ex ante welfare when the borrowing firm is of a high-risk, high-return type. At the same time, it may create a time-consistency problem for regulation, preserving a potential role for maintaining some degree of separation between banking and commerce.

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I. Introduction

Rapid advances in information technology and the rise of financial technology (fintech) services have cast doubt on the continuing effectiveness of the separation between banking and commerce. Over the past decade, dominant online platforms—often referred to as "bigtechs"—and fintech companies have begun to offer a wide range of financial services to consumers, often outside the confines of the highly regulated banking industry (Zamil and Lawson, 2022). Several core banking functions, such as transactional deposit-taking and the provision of liquidity backstops, which traditionally made banks *special* (Corrigan, 1982), can now also be offered by non-banking entities (Ford, 2019). At the same time, bigtechs have accumulated unprecedented volumes of data, which can be used to narrow the information gap between market participants.

As bigtech banking expands, so do concerns. Many of the alleged problems associated with the shrinking separation between banks and bigtechs—such as conflicts of interest, concentration of market power and anticompetitive behavior, heightened systemic risk, and complex organizational structures that impede consolidated supervision—are non-trivial (Patton, 2023; Zamil and Lawson, 2022). However, regulatory initiatives targeting bigtechs are also emerging (e.g., Borio et al., 2022; Crisanto et al., 2021; James and Quaglia, 2024). These initiatives aim to secure fairer access to bigtechs' data for third parties, thereby narrowing the information gap between bigtechs and others and enabling banks to gain borrower-level insight comparable to that of bigtechs. As these measures address information asymmetries that have long underpinned the traditional rationale for separating banking and commerce, one might conclude that, once fully implemented, the choice between separating and integrating banks and bigtechs becomes largely irrelevant. We do not share this view. Instead, we argue that in the era of bigtech banking, the effects of separation (or integration) must be re-evaluated from the perspective of incentives rather than information.

This study formally investigates the implications of bigtech's ownership of banks by examining the trade-off between ex ante efficiency and bank failure risks when there is no information gap about the creditworthiness of borrowers seeking interim financing. Specifically, we focus on a bank's decision whether to extend an interim loan to a distressed firm affiliated with a bigtech under two ownership structures: (i) an independent bank that has access to the bigtech's borrower-specific information (independent bank), and (ii) a bank owned by the bigtech (affiliated bank). As a subsidiary of the bigtech conglomerate, the affiliated bank is incentivized to maximize the group's total profit rather than its own standalone profit, effectively engaging in internal cross-subsidization.

We adopt the well-known framework of Diamond and Dybvig (1983) to analyze the impact of interim *lending* decisions under these alternative ownership structures and to compare their implications for efficiency and bank failure risk due to (in)solvency and (il)liquidity. In our setting, the interim period in Diamond and Dybvig (1983) is divided into two stages. In the first stage, the bank determines whether to lend to the distressed affiliated firm. In the second stage, a random fraction of non-strategic depositors attempt to withdraw before maturity. If the bank does not lend in the first stage, there is no bank failure triggered by a run, but there may also be no additional surplus for the economy, implying a potential inefficiency. When the bank does lend, the situation is reversed. Unlike Diamond and Dybvig (1983) and subsequent work, early withdrawal by a sufficiently large fraction of depositors— an exogenous event in our model—does not necessarily lead to bank failure on its own.1 Rather, it is the bank's lending decision that shapes the probability of a bank run and the likelihood of failure. By eliminating informational differences between independent and affiliated banks, we isolate how their differing incentives alone affect failure risk.

Our analysis yields the following main insights. In the absence of bank run risk, independent banks may decline to lend even when doing so would be socially desirable, whereas affiliated banks always lend to their distressed affiliates, and such lending is then always efficient. Introducing the possibility of a bank run changes the picture. Independent banks optimally avoid lending to their affiliates over a wider range of creditworthiness, while affiliated banks still lend in states where an independent bank would not. Unlike the no-run case, however, this affiliated lending is not always socially efficient once failure risk is taken into account. In the presence of bank failure risk, two distinct inefficiencies emerge: affiliated banks may engage in imprudent lending, whereas independent banks may refrain from lending that would be socially beneficial. This disparity arises from the banks' divergent objectives rather than from information gaps or classical moral hazard channels.

Independent banks maximize their own expected cash flows, while affiliated banks maximize the joint expected cash flows of the bank and the affiliated firm. This difference in objective functions implies that pecking-order considerations familiar from corporate finance (e.g., Myers and Majluf, 1984) can continue to matter even in the absence of information asymmetry, purely because the ownership structure reshapes the relative attractiveness of internal versus external finance.

Our framework also allows us to revisit the conventional rationale for separating banking and commerce under information asymmetry. In a setting with informational frictions, the absence of separation allows highly creditworthy firms with access to internal funds to avoid external financing. This shrinks the pool of borrowers in the external loan

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[1] Notably, several studies, including Rochet and Vives (2004), Goldstein and Pauzner (2005), Freixas and Ma (2014), and Jun and Yeo (2021), investigate bank runs initiated by strategic decisions of depositors.

market, raising equilibrium loan rates, increasing bank failure risk, and reducing expected welfare. By contrast, when banking and commerce are separated, “good” firms must participate in the external lending market, which lowers loan rates in a manner reminiscent of credit rationing (Stiglitz and Weiss, 1981). In that environment, the case for separation rests on information gaps rather than on incentive distortions from integration—distortions that separation alone cannot fully eliminate.

Mandating data-sharing from bigtechs to banks would sharply reduce information asymmetry and, consequently, loan rates. However, we show that removing information asymmetry can *expand* the range of borrower types to which banks optimally choose not to lend, even when such lending would be efficient, because the disappearance of risk premia erodes banks’ ex post surplus. From this perspective, relaxing the separation of banking and commerce and allowing internal lending may become desirable as the regulatory environment evolves to promote fair competition between traditional banks and bigtechs.

At the same time, closing the information gap does not remove the need for separating banking and commerce or for complementary prudential regulations. Although our numerical illustration is not definitive, it suggests that, despite an associated increase in failure risk, lending by an affiliated bank can raise ex ante welfare when the distressed affiliate is a high-risk, high-return firm. This finding helps account for the prominence of bigtech banking in some emerging economies. It also points to a potential time-inconsistency problem: as innovations by bigtechs (and their affiliates) naturally slow over time, the net welfare gain from internal lending declines, yet the regulatory regime may have already shifted toward greater integration. In this sense, some rationale for maintaining separation between banking and commerce persists even in a world with much smaller information frictions.

One might ask whether, in the context of the separation of banking and commerce, our bigtech-bank conglomerate differs meaningfully from a bank lending to firms in which it holds equity stakes (e.g., Berlin et al., 2015; Boyd et al., 1998; Santos, 1999). We address this concern by emphasizing two distinctions. First, most theoretical analyses of the integration or separation of banking and commerce—whether they favor integration (e.g., Pozdena, 1991), or not (e.g., Boyd et al., 1998)— focus on moral hazards and incentive distortions arising from information asymmetry. In our setting, by contrast, the bank has access to the bigtech’s information (either through partnership or regulatory mandates), so differences in bank behavior do not stem from asymmetric information about the creditworthiness of the affiliates. Thus, our analysis isolates the effect of differing objective functions induced by ownership. Second, while previous work on the separation of banking and commerce largely focuses on loan default risk rather than bank failure, we explicitly study banks’ lending decisions in the presence of run-driven failure risk as a central theme. To the best of our knowledge, only Carletti et al. (2023) examine how banks' lending decisions interact with bank-run risk, and their focus is on the role of government loan guarantees. In contrast, we study how differences in bank ownership structures themselves shape failure risk, abstracting from strategic depositor behavior and macroeconomic shocks in order to highlight the ownership channel. [2] Finally, we contribute to the emerging literature on bigtech banking and financial stability by providing a formal theoretical model of banks' lending decisions and their implications for efficiency and bank failure in the context of bigtech integration. While many policy reports and studies on bigtech banking and bank risk (e.g., BIS, 2019; FSB, 2019; Adrian, 2021; Bank of England, 2017; Carstens et al., 2021) discuss a wide range of issues, they often lack a rigorous theoretical treatment.3 Building on bigtech-lending evidence that documents improvements in information efficiency (Cornelli et al., 2023; Liu et al., 2022), and on classic theories of banking and lending (e.g., Diamond and Dybvig, 1983; Myers and Majluf, 1984; Stiglitz and Weiss, 1981), we model the policy trade-off induced purely by differences in ownership structure when bigtechs can substantially mitigate information asymmetry. We believe that our analysis fills a gap in the literature—both within and beyond the context of bigtech banking—and offers policy insights for the rapidly evolving landscape of banking and finance.

The remainder of this paper is organized as follows. Section 2 presents the first benchmark case, in which a bank partners with a bigtech but remains independent. Section 3 introduces the second benchmark case, in which a bank is affiliated with a bigtech, and no bank run occurs. Section 4 incorporates the possibility of a bank run and develops the results, supplemented by numerical examples. Section 5 concludes and discusses several regulatory implications.

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[2] Unlike Carletti et al. (2023), in our model, depositors' run decisions are not strategic, and macroeconomic conditions are excluded. The fundamental qualitative conclusions of our analysis remain unchanged within this framework, as lending influences the likelihood of a bank run.

[3] Several empirical studies have explored bigtech lending. Liu et al. (2022) and Cornelli et al. (2023) focus on the effects of bigtech loans on small businesses. They identify the complementary role of these loans in the loan markets and their contribution to efficiency, without covering the risks in banking. Conversely, Buchak et al. (2018) find that the expansion of fintech lending in the 2010s, frequently in the form of shadow banking, was largely attributable to discrepancies in regulation between traditional financial institutions and fintechs.

II. Benchmark I: Independent Bank Without the Possibility of a Bank Run

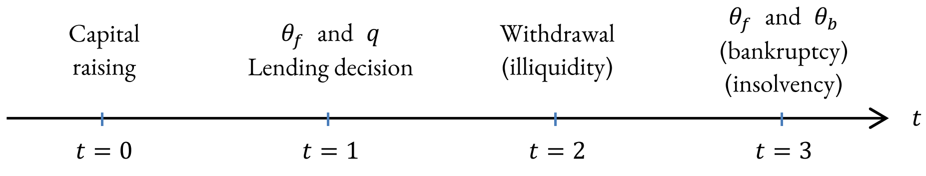
There is a firm affiliated with a bigtech (denoted by *f*, hereafter referred to as firm), and an independent deposit-taking institution (denoted by *b*, hereafter referred to as *bank*), assumed to have access to the information accumulated by bigtech through partnership or regulation. That is, we assume that the information gap between the firm and the bank is not significantly different from that in the case of banking-commerce integration.

The objective of an independent bank (or its management) is to maximize the total expected cash flows, which is the sum of its expected profits from lending and other operations (hereafter referred to as expected *cash flows*).

There are four stages (t = 0, 1, 2, 3). At $t = 0$, neither the bank nor the firm is engaged in full-scale business activities; both are in the capital raising stage. The firm operates at t = 1 and 3, the firm operates, incurring an upfront cost of c, and is in either the state G(ood) or B(ad) (i.e., $\theta_f \in \{G, B\}$), as a result of its operating activity. If $\theta_f = G$, then the firm earns its revenue k, whereas if $\theta_f = B$ the firm has zero revenue. Thus, its profit is $-c$. If $\theta_f = B$ at $t = 1$, the firm must borrow a loan from a bank to remain in business in the next period, which is $t = 3$ (not $t = 2$).

The bank decides whether to provide an emergency loan at $t = 1$. The size of the total deposits to the bank is normalized to 1. Thus, k and c represent the ratios to total deposits in the bank. The state of a bank $\theta_b \in \{G, B\}$ is determined at $t = 3$. If there is no bank failure, the principal plus interest at a rate r is paid to the depositors. However, in $t = 2$, the bank can become illiquid and fail due to a large portion of early deposit withdrawals, that is, a *bank run*. The bank may also fail at $t = 3$ because the borrowing firm fails to pay back, or becomes insolvent. Figure 1 shows the timing of events and actions at each stage. Events in parentheses are probabilistic and may occur only in some unlucky cases. Note that only the bank's decision on lending is strategic.

[Figure 1] Timing of events and actions



We assume that neither the firm nor the bank can influence interest rates. That is, the (risk-free) market rate (denoted by r) and lending rate (denoted by R) are treated as exogenous variables such that $0 < r < R < 1$. Finally, we assume away the possibility of a bank run and thus do not consider the event at $t = 2$. Details of events at each stage are described as follows.

2.1 $\boldsymbol{t = 0}$

Initially, the firm has a starting capital c. The bank raises a deposit base of 1 and bank capital of w. Thus, we can interpret c and w as ratios to the deposit amounts. The bank's deposits and capital at $t = 0$ can be used to lend to the firm at $t = 1$ and provide a buffer against potential liquidity issues caused by early withdrawals at $t = 2$.

2.2 $\boldsymbol{t = 1}$

If the firm's state θ_f is G, its cash flow is k; thus, its profit is $k - c$. Conversely, if $\theta_f = B$ the firm earns nothing and requires a loan of c to avoid bankruptcy and operate at $t = 3$.

Assumption 1 $r < c,\ r < w,\ w < c + r \ and \ c(1 + R) < k$

Inequality $w < c + r$ implies that when the bank provides a loan at $t = 1$ and both the bank and the firm fall into Bad state at $t = 3$, the bank's liquidity reserve w cannot cover the loss from the default and the interest owed to the depositors, that is, the bank becomes insolvent. Inequality $c(1 + R) < k$ implies that if the firm's state is Good, its rate of return from its operation is greater than the lending rate, suggesting that it can operate without external funding in the next period. However, if the firm's state is Bad, the firm earns no revenue while incurring a loss of c because it has already spent c on operating activities. Therefore, it records a net loss and its remaining capital is $c - c = 0$. In this case, the firm must borrow c from the bank at an exogenous market lending rate $R(> r)$ to continue operating. Otherwise, it faces immediate default and liquidation if it does not receive the loan. The expected profit of the loan recipient, or the borrowing firm, is

$$q(k - (1 + R)c). \tag{1}$$

where q is the firm's *survival rate*, or the probability that the firm in Bad state at $t = 1$ moves to Good state at $t = 3$, possibly interpreted as its creditworthiness.

For efficiency, the value of q needs to be correctly identified. The key point in bigtech banking, which we assume is the case, is that bigtech can do it, and not only affiliated but also independent banks can access that data through either partnership or regulation. If a firm is in Bad state ($\theta_f = B$) at $t = 1$ but Equation (1) is greater than zero, it is referred to as a "distressed, but efficient" firm.

If the bank lends, the remaining liquid assets of the bank becomes $1 + w - c$, that is, the loan to the firm is the bank's asset that cannot be sold off until maturity ($t = 3$). Hence, the bank is implicitly assumed to follow the originate-to-hold model.[4] The bank's expected cash flow (including deposits and returns) at $t = 3$ becomes

$$(1 + w) - (1 + r) + (1 - p)(1 + r) + (q(1 + R) - 1)c \tag{2}$$

where p is the probability with which the bank falls into Bad state, or $\Pr(\theta_b = B)$, at $t = 3$. Equation (2) implies that deposits gained at $t = 0$ net out to zero as they are returned, with interest r added, given that the bank survives at $t = 3$ with a chance of $1 - p$.

The bank's expected net cash inflows from lending are $(q(1 + R) - 1)c$. The term $-c$ suggests that the bank accepts the potential loss from the unsuccessful lending at $t = 3$. Thus, given that Equation (2) is an expected value, it always factors the potential loss arising from the firm's limited liability into its expected value calculations. We believe that this assumption aligns with actual industry practices in which banks should follow prudential regulations, which require them to maintain reserves to avert failure due to loan defaults.[5]

Whenever the bank provides a loan to the firm, the following inequality

$$q > 1/(1 + R) \tag{3}$$

always holds true. Note that q can be interpreted as the expected benefit, and the discount factor $1/(1 + R)$ as the opportunity cost.

The expected cash flow with no lending is represented as

$$w - r + (1 - p)(1 + r). \tag{4}$$

The difference in the bank's expected cash flow between lending and non-lending, or difference between Equations (2) and (4) is $(q(1 + R) - 1)c$. The sum of the difference and the expected profit of the firm from the loan, $q(k - (1 + R)c)$, leads to

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[4] In the case of an originate-to-distribute model, banks could securitize their loans (asset-backed securities, ABS) and sell them to the market in advance.

[5] In subsection 2.4, we examine the scenario involving limited liability. It turns out that adding complexity to the model does not significantly alter the analysis, aside from the range of R applicable to loan issuance.

$$qk - c, \tag{5}$$

which is the increase in the expected welfare from the lending in the absence of a bank run. A positive value of Equation (5) indicates a positive expected welfare from the lending. Notably, the interest rate of the loan, R, does not influence this outcome.

The individual rationality condition of the bank for the loan provision is given by $q(1+R) > 1$ according to Equation (3); thus, Equation (5) is positive, and, hence, the expected welfare of the loan is positive.

Assumption 2 $1/(1+R) > c/k$ *and* $q > c/k$*, that is, Equations (3) and (5), respectively, are satisfied.*

Provided that Assumption 2 is satisfied, it is always ex ante profitable for a firm to secure a loan whenever it is in Bad state at $t = 1$, and the expected welfare from lending to the firm, in the absence of a bank run, is always positive.

However, if the bank's individual rationality, represented by Equation (3), is not satisfied, it chooses NOT to lend to the firm even if lending is socially efficient.[6] Proposition 1 summarizes this finding.

Proposition 1 *Provided Assumptions 1 and 2 are satisfied, an independent bank lends to a distressed firm if and only if the following inequality*

$$1/(1+R) > q > c/k, \tag{6}$$

is NOT satisfied.

In summary, even without the possibility of a bank run, an independent bank sometimes decides not to provide a loan to a troubled firm, even if doing so would enhance the expected welfare under Assumptions 1 and 2. This is because the bank is primarily concerned with whether its opportunity cost is smaller than its expected return, and not with the firm's expected profit.

We also note that the range in Equation (6) *expands as R decreases*. This implies the counterintuitive result that, in the absence of a bank run or information gap, the subsequent reduction in the loan rate would *reduce* the expected welfare. We will address this issue further in Sections 3 and 4.

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[6] One might question whether it is possible to have a situation in which no business loans are made owing to an exogenously given lending rate. However, this should not be understood as a market equilibrium rate, but rather as a device for comparing the differences in decision-making between affiliated and independent banks.

2.3 $t = 3$

Because we assume no bank run, nothing occurs at $t = 2$ in this case. Both the bank and the firm reach $t = 3$ unless the firm in Bad state at $t = 1$ failed to secure a loan. We additionally assume that the states of the firm and the bank are determined independently, excluding the effects of macroeconomic conditions and concentrating on the difference in the lending decisions of affiliated and independent banks.

If the firm was in Bad state at $t = 1$ but returns to Good state at $t = 3$, it generates cash flows of k and repays the loan with interest $c(1 + R)$ to the bank. Given Assumption 1, $k - c(1 + R) > 0$, the firm survives. By contrast, if the firm falls into Bad state again, it faces liquidation. The remaining capital of the firm is zero, indicated by $c - c = 0$. It is liquidated without incurring additional losses. This is the result of a convenient simplification in which the value of the firm's initial capital is c at $t = 0$. This simplified assumption does not alter the core findings of the model.

If the bank's state is Good at $t = 3$, it receives a return with the rate of r from its investment, along with another inflow of new deposits normalized to 1. In other words, the bank receives an inflow of 1 + r as its new assets. However, if the bank's state is Bad at $t = 3$, then there is no profit or new deposit. Given Assumption 1, the bank's net cash flows fail to stay positive, or $1 + w - c - (1 + r) < 0$. This inability to fulfill deposit obligations triggers bank failure due to its insolvency at $t = 3$.

Proposition 2 *Without the possibility of a bank run, bank failure due to insolvency occurs if (i) the firm has fallen into Bad state at both* $t = 1$ *and secured a loan, but falls into Bad state again at* $t = 3$*, and (ii) the bank falls into Bad state at* $t = 3$.

Note that no bank failure due to insolvency occurs when the bank does not lend, or when the bank or the firm is in Good state at $t = 1$.

2.4 Limited Liability on Bank

In case of bank failure, the bank is shut down and obligated to meet deposit obligations until it has exhausted all remaining assets. In this case, limited liability can place a limit on shareholder and manager losses.

The probability of bank failure due to insolvency is $p(1 - q)$ after lending at $t = 1$. If limited liability is applied, and both the bank and the firm are in Bad state at $t = 3$, the bank's expected cash flow is now represented as Equation (7):

$$(1 + w) - (1 + r) + (1 - p)(1 + r) + (q(1 + R) - 1)c + p(1 - q)c. \tag{7}$$

Equation (7) adds a new positive term to equation (2), $p(1-q)c$, accounting for the scenario in which the firm and bank enter Bad state at $t=3$ and limited liability applies to the bank in the event of bank failure due to insolvency of the bank. Limited liability relieves the bank from fulfilling its residual deposit obligations, which total c. Consequently, the expected cash flow of the banking institution is increased.

Under limited liability, the requirement for the bank's expected cash flows to be positive is represented as

$$w - r + q(1+R)c - 1 + p(1-q)c > 0. \tag{8}$$

If Equation (8) holds, the expected welfare from lending is larger than that from non-lending. Notably, the added term $p(1-q)c$ is non-negative, potentially leading to scenarios in which Equation (7) is greater than zero even if R is too low to make Equation (2) positive. This highlights the potential moral hazard that distorts lending decisions under limited liability, which is reminiscent of the findings by Rochet (1992).

Proposition 3 *The application of limited liability to the bank in the case of bank failure due to insolvency reduces the lower bound of the lending rate R and the firm's survival rate q. Consequently, the ranges of R and q that lead the bank to lend to the firm would be extended.*

In conclusion, the application of limited liability to the bank in the event of its insolvency enables the possibility of offering loans at lower rates or to borrowers with higher risk profiles, an option that would not be feasible in the absence of limited liability.

III. Benchmark II: Independent Bank with the Possibility of a Bank Run

Now, we turn our attention to the potential occurrence of a bank run. As aforementioned, a random proportion of depositors withdraw prior to the maturity date after a bank has made a lending decision, influencing the probability of a bank run.

3.1 $t=2$: Bank Run can Occur

If a bank fails at $t=3$ due to insolvency after having provided a loan at $t=1$, this failure is regarded as unavoidable. In the case of unavoidable bank failure, early withdrawals at $t = 2$ are not inefficient (e.g., Freixas and Rochet, 2008).

However, even if the bank can remain solvent at $t = 3$, depositors' early withdrawals at $t = 2$ may trigger a bank run and subsequent failure if the bank lacks sufficient liquid assets to respond. Importantly, this type of bank failure is inefficient because it can be avoided by preventing early withdrawals. The following model further explores this issue.

Some depositors choose to withdraw early at $t = 2$, sacrificing the promised interest at $t = 3$ by r. To meet these early withdrawal requests, the bank sells some, or even all of its (including illiquid) readily available assets with discounts on the market.[7] Importantly, we recognize that liquidating a significant amount of assets in a short time frame typically results in a decrease in their price.[8]

To simplify the model, we assume that the bank has no immediate cash reserves but that all of its assets can be converted to cash with some discount. We define $L(0 < L < 1)$ as an exogenous proportion of deposits with demands for early withdrawal, assumed to be a random variable that follows a uniform distribution $U[0, 1]$.[9] Equation (9) indicates the condition under which the bank can meet the demands for early withdrawal by selling its assets at a discount without encountering failure:

$$\frac{a}{1+d} > L. \tag{9}$$

where a is the portion of the bank's assets it sells at a discount rate d, reflecting the influence of large-scale asset sales on prices.

As the loan reduces the bank's liquid assets, a lower amount of liquid assets becomes available to address early withdrawal requests. Thus, the bank becomes more vulnerable to bank failure. After lending and early withdrawals, the bank's expected net cash flow becomes

$$1 + w - L(1 + d) + c(q(1 + R) - 1) + (1 - p)(1 + r) - \\ (1 - L)(1 + r). \tag{10}$$

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[7] The assumption of the originate-to-hold model of loan implies that banks cannot raise cash by selling loan claims or issuing financial instruments backed by loans at a discount.

[8] For instance, the recent Silicon Valley Bank's bank run in the U.S. illustrates that even assets considered relatively liquid, risk-free, and secure, such as US Treasuries, are vulnerable to triggering a bank run.

[9] We assume an exogenous, random proportion of early withdrawal so that the interim illiquidity problem is affected only by a bank's interim lending decision, not by depositors' aggregate decisions. Thus, risk aversion need not play any role in our model, unlike the assumption of risk-averse depositors, which is crucial for the bank's role as a liquidity-insurance provider in Diamond and Dybvig (1983). Finally, we note that risk aversion also plays no role in models of speculative run, which adopt global games (e.g., Freixas and Ma, 2014; Morris and Shin, 2001; Rochet and Vives, 2004).

Due to the uniform distribution assumption of L that increases the likelihood of tail events, we assume the following for mathematical consistency:

Assumption 3 $r < R < d < c < w$,[10] and $d < 1$.

As $d > r$, Equation (10) is always smaller than Equation (2), or the expected cash flow with no possibility of early withdrawals, $w - r + (1 - p)(1 + r) + c(q(1 + R) - 1)$.

When the bank decides to provide the loan, the amount of readily available assets for the bank is $1 + w - c$. Early withdrawals lead to a subsequent bank failure due to insufficient liquidity, even if the bank can remain solvent at $t = 3$, if

$$\frac{1+w-c}{1+d} \leq L, \tag{11}$$

or if L is greater than the threshold portion of early withdrawal derived from Equation (11), denoted as

$$\bar{\mathrm{L}} := \frac{1+\mathrm{w}-\mathrm{c}}{1+\mathrm{d}}$$

By Assumptions 1 and 3, we establish that $w - c < d$, and $0 < \bar{L} < 1$. Due to the uniform distribution assumption, $\bar{L}$ also denotes the probability that an otherwise solvent bank avoids failure due to bank run, or

$$\Pr(L < \bar{L}) = \bar{L}.$$

The probability of bank failure due to a liquidity shortage caused by early withdrawals with loan provision is represented by the following:

$$\Pr(L > \bar{L}) = 1 - \Pr(L < \bar{L}) = 1 - \frac{1+w-c}{1+d} = \frac{d-w+c}{1+d}, \tag{12}$$

which is less than half due to $d < 1$.

Note that the probability of bank failure due to a bank run $\Pr(L > \bar{L})$ is not affected by q or R, the firm's survival or loan rates, respectively. Unlike the expected cash flows of the bank, only the decision to lend, rather than the loan interest or the firm's survival rates, influences the risk of bank failure. We explore the cases in which these factors influence the

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[10] Sometimes $d < w$ and $d < c$ may not be consistent with the values in reality. A more realistic assumption on the probability distribution of L can eliminate the need for Assumption 3, but would complicate the computation without additional economic insights.

risk of bank run in Section 4.

To simplify the setting, we assume that a bank is always restructured in case of bank failure.

Assumption 4 *In the event of a bank failure, the bank's remaining assets are effectively reset to zero: the bank's any ex-post losses or gains are transferred to society.*

Assumption 4 means that the bank's net losses or remaining assets, represented by Equation (13), are wiped out of the bank after a bank run. If the bank lends at $t = 1$, its anticipated cash flow when the early withdrawal is greater than the threshold (i.e., bank run) is

$$q(1+R)c + 1 + w - c - E_L[L|L > \bar{L}](1+d) - (1 - E_L[L|L > \bar{L}])(1+r) \quad (13)$$

where $E_L[L \,|\, L > \bar{L}]$ is the expected amount of early withdrawals in case of bank run. As L is uniformly distributed between 0 and 1, we can derive

$$E_L[L|L > \bar{L}] = \frac{1}{2} + \frac{1+w-c}{2(1+d)}, \text{ and } E_L[L|L < \bar{L}] = \frac{1+w-c}{2(1+d)}.$$

From the shareholders' and managers' perspectives, the bank's expected cash flows are positive only if they avoid bank failure and zero in the case of a bank failure. From now on, we use $E_L[L]$ to refer $E_L[L|L < \bar{L}]$ if necessary. The bank's anticipated cash flow in this case is

$$1 + w - c - E_L[L](1+d) + q(1+R)c + (1-p)(1+r) - (1 - E_L[L])(1+r)$$

As the bank may not be solvent at $t = 3$, lending to a firm at $t = 1$ changes the expected cash flow of the bank at $t = 3$ to

$$\left(\frac{1+w-c}{1+d}\right)[w - r - c + E_L[L](r-d) + q(1+R)c + (1-p)(1+r)]. \quad (14)$$

Note that, other things being equal, the amount of the independent bank's expected cash flows increases in R due to Assumption 4.

As seen in the first benchmark case, even though a loan improves social welfare ex ante, the bank may choose not to lend because of the potential risk of bank failure if Equation (14) is less than Equation (4), or

$$\left(\frac{1+w-c}{1+d}\right)[w-r-c+E_L[L](r-d)+q(1+R)c+(1-p)(1+\ r)]$$
$$<w-r+(1-p)(1+r)$$

holds true. Subsequently, we have the following inequality that specifies the range of q in which the bank chooses NOT to lend even if lending is efficient.

$$\frac{1}{1+R}\left(\left(\frac{d-w+c}{1+w-c}\right)\frac{w-r+(1-p)(1-r)}{c}-\left(\frac{1+w-c}{2(1+d)}\right)\frac{r-d}{c}+1\right)>q>\frac{c}{k} \tag{15}$$

As $d>r$, $\left(\frac{d-w+c}{1+w-c}\right)\frac{w-r+(1-p)(1+r)}{c}-\left(\frac{1+w-c}{2(1+d)}\right)\frac{(r-d)}{c}$ in Equation (15), the additional term compared to Equation (6), must be positive. Thus, by comparing the range described in Equation (15) with that in Equation (6), we obtain the following proposition.

Proposition 4 *Compared to the absence of the risk of bank failure, such risk due to early withdrawals (i.e., bank run) expands the range of the survival rate q for which the bank does not provide loans, even if it is socially desirable.*

Proposition 4 exposes the opposing interests between the firm and the bank facing the possibility of a bank run. Although borrowing is always better for the firm, the bank lends only when its expected additional cash flow is positive. Given the risk of a bank run, the bank refuses to lend for a wider range of q than the range in Equation (6), highlighting the crucial role of bank failure risk in determining the range q in which a loan is rejected (or approved).

As we can see from Equation (6), the range described by Equation (15) *expands as* R *decrease*s. Assuming there is no information asymmetry among market participants regarding the true value of q, there is no risk premium in the exogenous loan rate R, unlike in the case of information asymmetry. In other words, the separation of banking and commerce may *lower* the ex ante welfare by expanding the range of firms that cannot access interim financing. However, we present the case of inefficient lending from the integration of banks and bigtech in Section 4.

The joint profit of the firm and the bank is the sum of Equation (1), the expected profit of the firm, and (14), the expected cash flows reflecting the loan-induced bank failure of the bank, represented as

$$q\big(k-c(1+R)\big)+\bar{L}(w-r+E_L[L](r-d)+q(1+R)c+(1-p)(1+r)-c),$$

which can be rewritten as

$$q(k - c(1 + R)) \\ +(\tfrac{1+w-c}{1+d})\left(w - r + \left(\tfrac{1+w-c}{2(1+d)}\right)(r - d) + q(1 + R)c + (1 - p)(1 + r) - c\right) \quad (16)$$

As $r < c$ and $r < R < d$, Equation (16) is smaller than the sum of Equations (1) and (2), or

$$qk + w - r + (1 - p)\,(1 + r) - c,$$

which is the sum of the expected profit of the firm and the expected cash flow of the bank in the absence of bank failure. This highlights the trade-off between lending and risk, as the combined cash flows are lower than the individual profits without bank failure.

In addition, Equation (16) indicates a decreasing linear relationship between the joint profit, the combined expected cash flows, and R, which leads to Proposition 5.

Proposition 5 *With the risk of a bank run, the combined expected cash flow of the firm and the bank decreases with the loan rate* R.

Without the possibility of a bank run, the loan simply transfers liquidity between the firm and the bank, as mentioned earlier, and therefore should not affect the expected welfare. However, with the possibility of a bank run, if the firm in Bad state at $t = 1$ falls into Bad state again at $t = 3$, a higher R amplifies the bank's expected losses due to the uncollectible loan. Thus, the bank's potential losses from loan default become more pronounced with a higher loan rate.

As demonstrated, in the absence of a bank run, the sum of the firm's expected profit and the bank's expected cash flow is equal to the expected welfare. This is because the bank, in its decision-making, completely internalizes the externality resulting from the limited liability of the firm in consecutive Bad states. However, this simple summation no longer leads to the expected welfare when the possibility of a bank run is considered. If hit by a bank run, the bank is liquidated, but is not responsible for any loss greater than its remaining assets. The uncollected loans and remaining deposits are transferred to the society. Thus, Equation (16) is no longer an accurate representation of social welfare. The welfare measure must be revised to reflect the loss of principal on deposits that were not withdrawn early and loans that the firm successfully repays, both of which are now borne by the society rather than the bank.

The expected welfare from lending is the sum of the firm's expected profits without considering its limited liability and the bank's expected cash flows, represented as

$$qk - c + w - r - \Pr(L > \bar{L})\left(E_L[L|L > \bar{L}](d - r)\right) \\ + \Pr(L < \bar{L})\,[E_L[L|L < \bar{L}](r - d) + (1 - p)(1 + r)], \quad (17)$$

which increases in q and k. As seen in our earlier analysis, once the loan is provided, the loan rate R does not affect social welfare because the loan is again an exchange of liquidity between the firm and the bank.

Note that Equation (17), which represents the welfare incorporating the social cost of uncollected deposits and interest, is less than Equation (16), which is the sum of the expected profits of the firm and the expected cash flow of the bank. This observation highlights the effect of bank failure costs on social welfare.

3.2 Relationship between Lending, Firm Survival, and Risk of a Bank Run

Until now, the probability of a bank run, represented by Equation (12), does not reflect the lending rate R nor the survival rate of the borrowing firm q. Now, we expand the model to incorporate the situation in which lending to the firm affects the probability of a bank run and subsequent failure due to illiquidity.

Until now, the lowest bound of early withdrawal has been defined as zero as L follows the uniform distribution between zero and one. However, once the bank provides a loan, the expected amount of loss from a loan default can be regarded as withdrawn ex ante from the bank's liquidity reserve. In other words, lending at $t = 1$ increases the lower bound of L to a value greater than zero. Let the lower bound of the uniform probability distribution of L, denoted by $\underline{L}$, be a function of the amount of loan c,[11] loan rate R, and borrower's survival rate q, represented as

$$\underline{L}(q, R, c) := (1 - q)(1 + R)c,$$

which is the expected amount of loss from a loan default.[12]

$\underline{L}$ decreases with q and increases with c and R. Because $\bar{L}$, the threshold of early withdrawal for a bank run to occur, is not affected by q or R, the likelihood of a bank run changes in the same direction. Note that if the firm's survival is guaranteed (that is, $q = 1$) at $t = 3$ or the bank decides not to issue a loan to the firm (that is, $c = 0$), L, the ex ante loss from a loan default, remains zero, highlighting the influence of these factors on the probability distribution of L.

Assuming that L follows a uniform distribution $L \in U[L, 1]$, the probability that no bank failure occurs due to bank run is as follows:

$$Pr(L < \bar{L}) = \frac{\bar{L} - \underline{L}(q,R,c)}{1 - \underline{L}(q,R,c)} = 1 - \frac{(d-w+c)/(1+d)}{1-(1-q)\,(1+R)c}\ , \tag{18}$$

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[11] Notably, c is the amount of the loan but not the cost of production for this case.

[12] Note that the inequality $(1 - q)(1 + R)c < \bar{L}$ must hold true.

which is smaller than $\bar{L} = \frac{1+w-c}{1+d}$.

With Assumption 4, the expected amount of cash flow of the bank is set to zero in case of a bank run. Then, the bank's expected amount of cash flows is now represented as

$$\Pr(L < \bar{L}) \begin{bmatrix} w - r + E_L[L|\underline{L} < L < \bar{L}](r-d) \\ +q(1+R)c + (1-p)(1+r) - c \end{bmatrix} \tag{19}$$

where

$$E_L[L|\underline{L} < L < \bar{L}] = \frac{1+w-c}{2(1+d)} + \frac{(1-q)(1+R)c}{2}.$$

Equation (18) and (19) lead to Proposition 6.

Proposition 6 *As the survival rate of the borrowing firm, q, increases, the likelihood of bank failure due to illiquidity (i.e., bank run) decreases, and the amount of the bank's expected cash flows increases.*

Unlike the case of q, the loan rate R has a non-monotonic effect on an independent bank's expected cash flow. Knowing that $\frac{\bar{L}-\underline{L}}{1-\underline{L}} = 1 - \frac{1-\bar{L}}{1-\underline{L}}$, the first derivative of Equation (19) is

$$-\frac{1-\bar{L}}{(1-\underline{L})^2}[w - r + E_L[L|\underline{L} < L < \bar{L}](r-d) + q(1+R)c + (1-p)(1+r) - c]\frac{\partial \underline{L}}{\partial R}$$
$$+\left(1 - \frac{1-\bar{L}}{1-\underline{L}}\right)\left[\frac{1-q}{2}(r-d) + q\right]c\frac{\partial \underline{L}}{\partial R}$$

where $\frac{\partial \underline{L}}{\partial R} = (1-q)c$. Because $\underline{L}$ is linear in R, and Equation (19) is positive whenever an independent bank decides to lend, we can easily check that the first derivative decreases with R, implying that the second derivative of Equation (19) with R is negative.

When q is sufficiently close to 1 and R is close to 0, the first derivative can be approximated as

$$-(1-\bar{L})\left[-\big(w - r + (1-p)(1+r)\big) - \frac{\bar{L}}{2}(d-r) - \frac{\bar{L}c}{1-\bar{L}}\right]c\frac{\partial \underline{L}}{\partial R}$$

which is obviously positive and leads to the following proposition.

Proposition 7 *The expected amount of cash flow of an independent bank shows an inverted u-shape in* R*: it increases when* R *is close to zero, but eventually starts to decrease as* R *increases.*

Finally, the expected welfare can still be represented by Equation (17), except $\Pr(L < \bar{L})$ and $E_L[L|L < \bar{L}]$ are now replaced by $\Pr(\underline{L} < L < \bar{L})$, and $E_L\left[L|\underline{L} < L < \bar{L}\right]$, respectively.

Now we derive the difference in the expected welfare from the internal lending by the affiliated bank. Suppose the affiliated bank issues a loan to the subsidiary firm with the survival rate q', which satisfies the range described in Equation (15). Then, by Equation (17), the expected welfare can be represented as

$$\begin{aligned} & q'k - c + w - r - \Pr(L > \bar{L}|q')\big(E_L[L|L > \bar{L}](d-r)\big) \\ & \qquad + \Pr(L < \bar{L}|q')\left(E_L\left[L|\underline{L} < L < \bar{L}, q'\right](r-d) + (1-p)(1+r)\right) \end{aligned} \tag{17′}$$

Differentiating Equation (17′) by q' leads to

$$\begin{aligned} & k - \frac{1-\bar{L}}{(1-\underline{L})^2}\frac{d-r}{2}\frac{\partial \underline{L}}{\partial q'} - \frac{1-\bar{L}}{(1-\underline{L})^2}\left(\underline{L}\frac{d-r}{2} - (1-p)(1+r)\right)\frac{\partial \underline{L}}{\partial q'} \\ & -\left(1 - \frac{1-\bar{L}}{1-\underline{L}}\right)\left(\frac{d-r}{2}\right)\frac{\partial \underline{L}}{\partial q'}. \end{aligned} \tag{20}$$

Because $\frac{\partial \underline{L}}{\partial q} = -(1+R)c < 0$, we have the following proposition.

Proposition 8 *When lending influences the risk of bank run, for a sufficiently large* p*, the expected welfare increases in* q *and decreases in* R*. Thus, high* R *creates two opposing effects: it reduces the range for which welfare-enhancing loan is not provided, described in Equation (15), but decreases the expected welfare from a loan due to the increased risk of bank run.*

Note that if q' is in the range described in Equation (15), k needs to be sufficiently high for an internal lending to be efficient, or enhance the expected welfare. In other words, internal lending to high-risk, high-return type firms would be beneficial, as seen in Section 4.2.

IV. Case of a Bigtech-Affiliated Bank

This section examines the lending decisions of a bank affiliated with a bigtech company when lending to a subsidiary firm in distress, a case of *internal lending*. We focus on how lending decisions differ from those of an independent bank, which is assumed to have access to the same information as the affiliated bank through a partnership or regulation; thus, there is no significant information gap.

Now, a bigtech owns both a bank and a subsidiary firm, referred to as the bigtech conglomerate (or its management). Compared with an independent bank, a bigtech-affiliated bank has a different incentive: to maximize the sum of the expected cash flows of its affiliated banks *and* the profits of its affiliated firms. The "distortion" of incentive arises precisely because the bank, as a subsidiary of the BigTech conglomerate, is incentivized to maximize the conglomerate's total profit rather than its own standalone profit, a form of internal cross-subsidization. Thus, the incentives of an affiliated bank and an independent bank are different even if they can access the same information accumulated by the bigtech.

4.1 Lending Decision of a Bigtech-Affiliated Bank

We first analyze the situation without considering the possibility of a bank run. Given Assumption 2, the affiliated firm's expected profit from securing a loan is always positive. Thus, the joint profit, or the sum of the expected cash flow of the affiliated bank and the expected profit of the affiliated firm, is the sum of Equations (1) and (2), represented as

$$qk + w - r + (1 - p)(1 + r) - c. \tag{21}$$

Note that Equation (21) does not include the lending rate R, which leads to the following conclusion regarding the affiliated bank's decision. In the absence of the risk of a bank run, an affiliated bank always chooses to lend to another affiliated firm, because it maximizes the expected total profit of the bigtech conglomerate.

Proposition 9 *Assuming that no bank run occurs and Assumption 2 is satisfied, a bigtech-affiliated bank always lends to its affiliated firm when the firm is in Bad state at t = 1.*

In the absence of bank failure risk, the rate of internal lending does not affect the maximization of the bigtech conglomerate's total expected profit or social welfare. Consequently, in no scenario is an efficient loan rejected because the rejection does not satisfy the bank's individual rationality. Moreover, this implies that the lending choices of the affiliated bank (vs. an independent bank) are superior for welfare.

Note that there is no information gap on the affiliate's creditworthiness or the true value of q. Thus, no moral hazard problem occurs. We emphasize that the difference in the lending decision and resulting efficiency between an independent and an affiliated bank stems from the different objectives of the banks.

When there is a risk of bank failure due to a bank run, the affiliated bank's lending decisions are distorted due to its inability to fully internalize the cost of the firm's loan default. This outcome contrasts with the case of an independent bank's lending decision in which individual rationality may not be satisfied at t=1, leading to the decision of non-lending and potentially inefficient premature liquidation of the distressed firm.

Difference in the total expected cash flow from internal lending

Recall the conditions for q under which an independent bank, faced with its risk of bank failure, does NOT lend at an exogenous lending rate R even if the lending is efficient, as represented in Equation (15).[13] The total expected cash flows of the bigtech conglomerate will be the sum of Equations (1) and (19) or

$$\begin{aligned}&q'(k-(1+R)c)\\&+\Pr(L<\bar{L}|q')[w-r+E_L[L|q'](r-d)+q'(1+R)c+(1-p)(1+r)-c],\end{aligned} \tag{22}$$

which decreases with R and increases with q'.

Given the range of q', $\Pr(L<\bar{L},q')$, the probability that the affiliated bank avoids a bank run, decreases, or the risk of bank failure due to bank run increases. In addition, as shown in Equation (22), the expected additional cash flow of a bank obviously decreases with the risk of bank run.

Equation (23) represents the extra expected cash flow from lending to the affiliated firm, derived by subtracting Equation (4), a bank's expected cash flow from non-lending, from Equation (22).

$$\begin{aligned}&q'k-c+\Pr(L<\bar{L}|q')[E_L[L|q'](r-d)]\\&+\Pr(L>\bar{L}|q')\,(c-(w-r)-(1-p)(1+r)-q'(1+R)c).\end{aligned} \tag{23}$$

where

[13] Note that internal lending likely demands a lower rate than an exogenous loan rate, although we do not consider such a situation and apply the idea of market-based transfer pricing.

$$\Pr(L > \bar{L}|q') = \frac{(d-w+c)/(1+d)}{1-(1-q')(1+R)c}.$$

Difference in the expected welfare from internal lending

The expected welfare in the case of lending by an affiliated bank should be the same as that in the case of lending by an independent bank. When the affiliated bank issues a loan to the affiliated firm, the expected additional welfare compared to that from non-lending is given by subtracting Equation (4), $w - r + (1-p)(1+r)$, from Equation (17′), as

$$\begin{aligned} &q'k - c + \Pr(L < \bar{L}|q')\,[E_L[L|\underline{L} < L < \bar{L}, q'](r-d)] \\ &+\Pr(L > \bar{L}|q')\big(E_L[L|L > \bar{L}](r-d) - (w-r) - (1-p)(1+r)\big). \end{aligned} \tag{24}$$

Difference between the expected cash flow and welfare

Subtracting Equation (24) from Equation (23) (or subtracting Equation (17′) from Equation (22)), the difference between the combined payoff and the welfare is derived as

$$\frac{(d-w+c)/(1+d)}{1-(1-q')(1+R)c}\left(c + \left(\frac{d-w+c}{2(1+d)} + \frac{1}{2}\right)(d-r) - q'(1+R)c\right) \tag{25}$$

The aggregate welfare impact changes with different combinations of variable values. Suppose that the lending does not satisfy the individual rationality condition for an independent bank, or $1 - q'(1+R) > 0$, and the additional welfare, represented by Equation (24), is less than zero. In this case, a loan to the subsidiary firm is inefficient. However, if the value of Equation (25) is greater than zero and if the expected joint profit, represented by Equation (23), is positive, the affiliated bank chooses to lend to the distressed subsidiary firm. This inefficiency arises because the bank does not fully internalize the entire loss from a bank failure, thereby shifting some of the losses to society.

By contrast, suppose that the inequalities $1 - q'(1+R) > 0$ and $c + E_L[L|L > \bar{L}](d-r) - q'(1+R)c > 0$ are satisfied as aforementioned, but Equation (24) is now greater than zero. Under these conditions, lending is deemed efficient from an ex ante perspective because of the positive expected welfare gain. However, an independent bank would refrain from lending in this scenario. Proposition 10 summarizes these points.

Proposition 10 *There exists some* q *where the risk of bank run makes interim lending inefficient (i.e., the expected welfare gain is negative), but an affiliated bank still chooses to lend to the subsidiary firm, and vice versa.*

Deriving an analytical proof of Proposition 10 is practically not tractable, but we show its existence from the numerical example in Section 4.2.

We emphasize that the difference in lending decisions and subsequent outcomes arises not from information asymmetry between affiliated and independent banks, which we have assumed away, but rather from the difference in the objectives of banks. From a policy standpoint, we argue that the separation of banking and non-banking continues to be significant in bigtech banking. At this point, it remains inconclusive whether the ownership of a bank by a bigtech leads to a decrease in expected welfare compared to when banks are independent. In Section 4.2, we attempt to gain insights into the welfare differences due to different bank ownership structures through numerical and graphical examples.

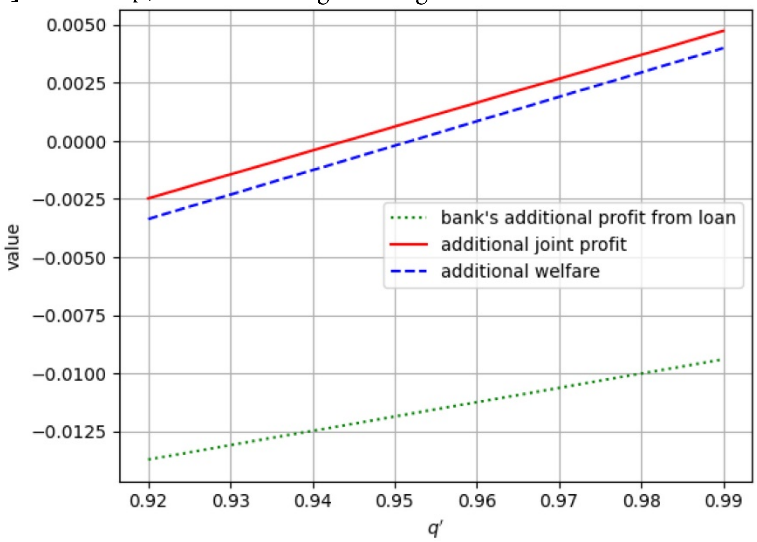
4.2 Numerical and Graphical Examples

We employ numerical and graphical examples to better illustrate our findings and draw further implications. Figures 2 and 3 respectively depict the expected additional cash flows and expected additional welfare of the bigtech conglomerate as functions of q. Values of the exogenous variables are assumed to be r=0.03, R=0.05, c=0.06, d=0.055, w=0.08, and p=0.001, with k=0.102 in Figure 2 and k=0.095 in Figure 3. To successfully interpret the graphs, only expected additional cash flows are included, whereas those associated with deposits are excluded. As explained earlier, if c and k are interpreted as ratios of total deposits normalized to 1, values of c=0.06 and k=0.1 may be appropriate for a bank owned by a bigtech conglomerate; however, such a high ratio is rarely realistic for independent banks.

Figure 2 shows an example; When q is 0.95 or slightly less,[14] the expected additional cash flow of the bigtech conglomerate from internal lending by the affiliated bank is positive, although the expected welfare gain is less than zero. However, for q > 0.96, the expected additional cash flows and welfare gains are positive, and internal lending in this case is efficient. Figure 3 illustrates the case in which, for all q, the expected additional cash flow and welfare gain are less than zero and no lending occurs. In addition, an independent bank does not lend when the expected additional joint profit of the bigtech conglomerate and expected welfare gains are negative, as shown in Figure 3, and even when they are positive, as shown in Figure 2.

[14] According to the Korea Ratings (2023), the average one-year default rate during 1998-2022 was 3.63% for BB, 7.17% for B, and 7.92% for CCC.

[Figure 2] In some q', internal lending with negative additional welfare occurs.

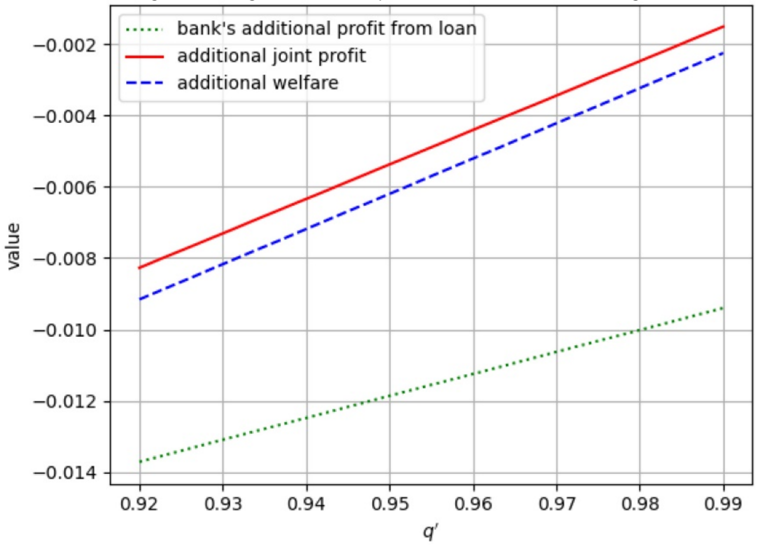


Our findings imply that when faced with an independent bank's refusal to lend, internal lending by an affiliated bank is inefficient if the firm's G(ood) state revenue, k, is low; conversely, it becomes efficient for higher firm profits in Good state. However, because of the assumption that early withdrawals follow a uniform distribution for simplicity, calculations from these mathematical examples should be interpreted with caution. Figure 4 shows an example of the exaggeration of withdrawal size and bank run risk; the expected early withdrawal at t=1 is 0.48, almost half of the total deposits. To eliminate the possibility of bank failure without lending, we reduced the discount rate d for asset securitization (via a fire sale at t=1) to 5.5%. This rate is significantly lower than typical market discount rates during a fire sale. We acknowledge that this deviates from the standard de facto rate.[15] However, this adjustment was necessary due to the limitations of the uniform distribution, which assigns disproportionately high probabilities to extreme values.

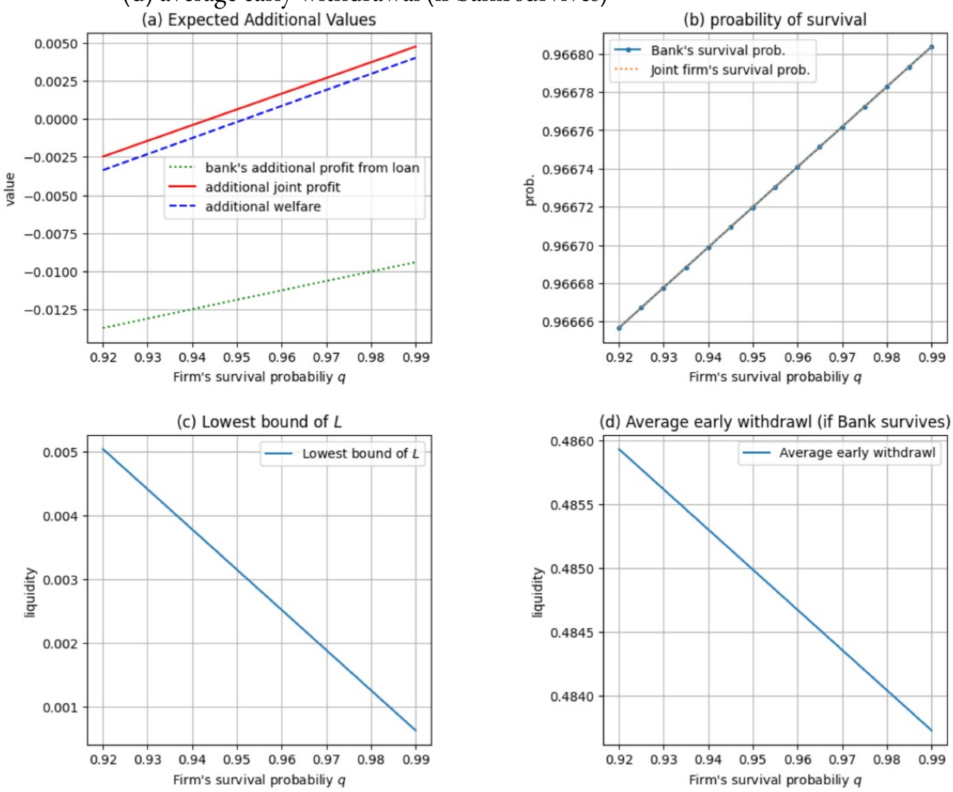
Figure 4 comprises four panels: (a) duplicates Figure 2; (b) shows the survival probability of the bank and the bigtech conglomerate; (c) plots $\underline{L}$; the lower bound on the level of early deposit withdrawals, as a function of q; (d) plots the average withdrawal size (conditional to bank survival) as a function of q. Note that the effects on the profit of the bigtech conglomerate, sum of the bank's total cash flow and the affiliated firm's profit, and welfare shown in Figures 2 and 3 are sensitive to k, which is the revenue of the firm (k=0.102 and 0.095 in Figures 2 and 3, respectively). This sensitivity again results from the assumption of a uniform distribution for L.

[15] It is usually more than 20% and went up as high as 50% during the global financial crises.

[Figure 3] Additional gain is negative for any q'; no internal lending occurs.



[Figure 4] (a) Figure 1 redrawn, (b) bank's survival rate, (c) lowest bound of L, (d) average early withdrawal (if bank survives)



Although these limitations require cautious interpretation of the results of numerical examples, they suggest the following implications. First, the presence of banks affiliated with bigtech is neither inherently beneficial nor detrimental to the expected welfare. Internal lending may occur even if it is inefficient in terms of expected welfare, but an independent bank may not provide a loan even if it is efficient. Second, as the value of k increases, internal lending is more likely to improve expected welfare. That is, despite the associated increase in the risk of bank failure, internal lending can potentially increase the expected welfare if the affiliate in trouble is a high-risk, high-reward type (that is, high k and low q). This insight may help to explain the prevalence of bigtech banking in emerging economies.

The result also has a negative implication: a time-inconsistency problem may arise in bigtech banking from the relaxation of the separation of banking and commerce. Bigtech and its affiliates usually provide innovative products and services in their early stages. The integration of banking and bigtech would be beneficial in this case. However, as their overall productivity and thus return eventually decrease over time, the net welfare gain from internal lending by bigtech would become smaller. From then on, the integration of banking and bigtech is no longer desirable. We elaborate this point further.

We implicitly assume that the value created by bigtech will eventually decrease with time. If the assumption is correct, at the initial growth stage of bigtech, the regulator would be inclined to permit the bigtech-bank integration to capture the efficiency gains by lending to the "efficient but distressed firms." However, the regulator would be tempted to separate the bank from the bigtech ex post, as k decreases with time. On the other hand, bigtech can correctly infer the regulator's time-inconsistency problem. As long as the regulator cannot credibly commit to the integration, the outcome would be either the regulator sticks to the separation of banking and bigtech from the beginning, or no bigtech-affiliated bank enters, which requires significant amount of fixed costs at the time of entry.

Specifically, the situation of no affiliated bank creates another problem. If bigtechs had affiliated banks, regulations would be able to ban "preferential treatments" for their banks, and require the sharing of bigtech's information with rivals, that is, independent banks. Without affiliated banks, however, bigtechs may no longer be obliged to share their information with other banks, implying that the information gap between (independent) banks and borrowers would get wider.

One potential regulatory approach to address the issue of potentially inefficient internal lending is to reinforce the loan-loss provision or bank capital requirement for internal lending. This policy measure would consequently increase the cost of internal lending by affiliated banks, while potentially reducing the societal burden in the event of defaults.

4.3 Discussion

Here, we briefly compare and discuss the properties of the outcome when there is a discrepancy, or information asymmetry, between the internal and external assessments of a firm's creditworthiness.

If an information gap exists around the boundary of a firm, the asymmetry can potentially lead banks to ask for a higher loan rate, or even refuse to provide a loan. Suppose that a subsidiary firm seeks a loan, but not from its affiliated bank. Rational market participants, or other banks, may perceive the pursuit of external financing by the firm as an indication of a lower survival rate than the prevailing consensus denoted by $\hat{q}$, or $q < \hat{q}$. Suppose also that they have a strong belief that the survival rate of a borrower is below $\hat{q}$ whenever it attempts to secure external capital, or Pr($q \leq \hat{q} | external$)=1. Subsequently, we can derive an equilibrium that reinforces this belief, particularly given the readily available internal financing options for the bigtech subsidiary firm via its affiliated bank. This could result in the loan being declined or the imposition of higher interest rates by other financial institutions, which would compel the firm to rely on its internal resources for funding, reminiscent of the pecking order theory of corporate finance.

Without the separation of banking and commerce, firms with a high q and access to internal financing do not seek a loan from other banks. Thus, the loan rate R increases further, subsequently reducing the expected welfare due to the increase in the risk of bank failure. Due to information asymmetry, the separation of banking and commerce causes "good" firms to join the lending market, which reduces the loan rate, reminiscent of credit rationing. Moreover, when R is too high, Proposition 7 implies that if R is lowered, banks can expect a higher amount of expected cash flows. This suggests that the separation of banking and commerce is particularly necessary in the presence of an information gap.

Mandating bigtech to share information with banks would significantly reduce information asymmetry, consequently lowering the loan rate by eliminating the risk premium. However, the lowered rate would expand the range of creditworthiness that banks choose *not* to lend, even if lending is efficient, by removing the risk premium, which is also an ex post surplus for banks. From this perspective, relaxing the separation of banking and commerce and providing loans to firms in the range may be beneficial as regulations evolve to encourage fair competition between traditional banks and bigtechs.

However, closing the information gap does not eliminate either inefficient lending by affiliated banks or inefficient non-lending by independent banks, due to the difference in incentives between banks and bigtechs. We suggest that in the era of bigtech banking, where the information gap becomes much narrower, the integration of bigtech and banks can be beneficial; however, this requires stricter requirements for bank capital (or liquidity reserves) to reduce the risk of bank failure. By contrast, as long as the information gap still exists, the separation of banking and commerce will still play a role, specifically considering that bigtechs will eventually become more mature and less innovative.

V. Concluding Remarks

Motivated by the rise of the platform economy and worldwide regulatory shifts, this study theoretically examines how bigtechs' integration with banks and mandatory third parties' access to bigtechs' information affect lending decisions, bank failure risks, and welfare. In particular, we examine the differences in banks' lending decisions under different ownership structures (independent vs. affiliated) and how these decisions, influenced by differing incentives but not by information gaps, affect the risk of bank failure.

Our findings suggest that eliminating the information gap between bigtech and banks can enhance ex ante welfare by enabling big tech-affiliated banks to provide loans to distressed subsidiaries. Integrating banks and bigtech can provide efficient but distressed subsidiaries with access to capital, which would otherwise be unavailable due to the elimination of risk premiums for banks and the insufficient expected return on investment for an independent bank. However, this internal lending is not always desirable; it can exacerbate the consequences of limited liability and the risk of a bank run. Although not conclusive, our numerical example suggests that lending by an affiliated bank, despite the associated increase in bank failure risk, can potentially increase ex ante welfare if the subsidiary is of a high-risk, high-reward type. It also suggests that the integration between banks and bigtech is beneficial as long as bigtech conglomerates continue to launch innovative services and products, but not in the long run, as their innovations will eventually dwindle, creating a consistency problem in regulatory policies. Ultimately, the welfare effects are contingent on the interplay between key variables of the firm and exogenous variables such as the market rates of loan and deposit, bank capital, and the borrowing firm's cost of operation.

Prudential regulations in the case of bank-bigtech integration, such as implementing more stringent loan loss provision requirements or introducing differentiated deposit insurance rates, can mitigate the risks associated with bank runs and insolvency to some extent. We also note that as long as the information gap exists, the separation of banking and commerce will continue to play a role, although reduced somehow, in the era of bigtech banking. Finally, the incentive effect itself continues to exert a significant influence on bigtech banking operations, separately from the information asymmetry.

Finally, we reiterate that the values of the variables and resulting bank run probabilities used in our numerical examples are not consistent with the numbers observed in reality. This limitation stems from the assumption of a uniform distribution of the rate of early deposit withdrawals, which allows us to derive analytical results. For more precise quantitative implications, it is necessary to adopt a more realistic probability distribution in future studies. Furthermore, it is important to consider the role of deposit insurance in the future, as it influences banks' risk-taking behavior, affecting the lending decisions of independent and affiliated banks differently.

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빅테크 시대에서의 은산분리 원칙에 대한 재평가: 이론적 접근*

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초 록 정보통신기술의 발달로 인해 빅테크 기업이 기존 은행 대비 정보 우위를 점하게 됨에 따라 다음과 같은 중요한 함의를 내포한다: (i) 빅테크의 데이터를 활용하여 은행과 차입자 간 정보 비대칭을 완화할 가능성이 커졌으며, (ii) 빅테크의 은행 소유 허용 여부와 관련하여 전통적인 금산(은산)분리 원칙에 대한 재검토 필요성을 제기한다.

본 연구는 은행이 빅테크의 정보에 동등하게 접근할 수 있고, 빅테크도 은행을 소유할 수 있다는 전제 하에, 소유구조가 은행의 대출 의사결정에 미치는 영향을 분석하고, 나아가 이것이 자원배분의 효율성과 은행 부실 위험에 미치는 효과를 고찰하였다. 분석 결과는 은행과 빅테크의 결합은 정보 공유를 통해 유동성 제약을 겪는 기업들에게 추가 대출을 제공함으로써 단기적인 자원배분의 효율성을 향상시킬 수 있음을 보여준다. 그러나 빅테크가 은행을 소유하는 구조에서는 그룹 전체의 이익 극대화 유인으로 인해, 부실 위험이 높은 계열사에도 대출이 실행될 수 있다. 이는 은행의 리스크를 가중시켜 사회적 비효율을 초래할 가능성이 있음을 시사한다. 수리 예제 분석 결과, 차입 기업이 고위험·고수익 유형일 경우 계열사에 대한 지원이 은행 위험을 증가시킴에도 불구하고 사회적 후생을 증대시킬 가능성이 존재함을 확인하였다. 그러나 이는 규제 당국에게 은산분리 완화와 관련한 시간 비일관성(time inconsistency) 문제를 야기할 수 있어, 일정 수준의 은산분리 규제는 여전히 유지할 필요가 있음을 시사한다.

핵심 주제어: 은행 실패, 은행예금 조기인출사태, 빅테크, 금산분리

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