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Private safe-asset supply and financial instability

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Abstract

This paper analyzes the private production of safe assets and its implications for financial stability. Financial intermediaries (FIs) originate loans, exert hidden effort to improve loan quality, and create safe assets by issuing debt backed by the safe payments from (i) their own loans and (ii) a diversified pool of loans from all intermediaries. I show that the interaction between effort and diversification decisions determines the aggregate level of safe assets produced by FIs. In the context of incomplete markets, I identify a free-rider problem: individual FIs fail to internalize how their effort influences the ability to generate safe assets through diversification, since the latter depends on the collective effort of all FIs. This market failure generates a novel inefficiency, that worsens as the scarcity of safe assets increases. The public provision of safe assets helps mitigate this inefficiency by reducing their scarcity, but it cannot fully resolve it. Moreover, the impact on the total private supply of safe assets is ambiguous: public safe assets reduce incentives for diversification (crowding-out effect), which in turn increases FIs' incentives to exert effort (the crowding-in effect).

Keywords: safe assets, financial intermediaries, moral hazard, securitization, regulation
JEL Codes: G20, G28

1. Non-technical summary

There is growing academic and policy interest in safe assets— financial instruments that maintain a stable value even in the face of adverse macroeconomic shocks. These assets are in high demand because they are good stores of value, serve as collateral, and help meet mandatory capital and liquidity requirements. Although highly rated government bonds are the quintessential source of safety supply, evidence suggests that financial intermediaries can also manufacture private alternatives, e.g., senior tranches of asset-backed securities. However, the private supply of safe assets carries inherent risks that may undermine financial stability. Understanding these risks is essential to ensure stability and efficiency in the financial system.

This paper offers key insights into the private production of safe assets and its implications for financial stability. In the model the the amount of private safe assets—financial intermediaries' safe debt liabilities—is determined by two key factors: (i) intermediaries' loan diversification level, and (ii) the quality of the loans they originate, which depends on intermediate's hidden screening effort.

When the demand for safe assets increases, financial intermediaries respond by increasing loan diversification through securitization: they sell loans that carry idiosyncratic risk (e.g., due to geographical or industry specialization) and, in return, buy a diversified pool of loans from other intermediaries, embedding a higher level of safe payoffs. However, securitization inevitably comes at the cost of lower loan quality. By shifting risk off their balance sheets, bankers have weaker incentives to screen borrowers, as part of the benefits accrues to outside investors. As a result, the optimal level of securitization strikes a balance between the benefits of loan diversification and the cost of reduced loan quality.

Nevertheless, bankers fail to efficiently combine these two inputs because they do not fully internalize how their screening efforts influence the ability to generate safe assets through diversification, which depends on the collective effort of all bankers. Specifically, individual bankers have an incentive to free-ride on others' efforts to improve loan quality, benefiting from the increased ability to issue safe debt while avoiding the full costs of enhancing loan quality.

Since bankers ignore the positive externality, they underestimate the benefits of screening, or equivalently, underestimate the costs of diversification. This leads to an inefficiently high securitization level and underinvestment in screening efforts, which harms loan quality in the production of private safe assets. The consequences of this inefficiency are twofold: first, the supply of safe assets becomes backward-bending, where after a certain point, an increase in the price of safe assets (or a decrease in the safe rate) leads to a decrease in its supply. Second, it underscores the need for policy intervention.

An effective policy is to impose a loan risk-retention requirement, to improve bankers' skin-in-the-game while curbing excessive securitization. This aligns with recent regulatory initiatives that mandate loan originators to retain a material net economic interest of no less than 5% in the securitization process. This paper further suggests that when securitization is driven by the demand for safety, this micro-prudential requirement should be sensitive to macro aspects such as the scarcity of safe assets, reflected in the safety premium. This is, the risk-retention requirement should decrease as the safety premium rises.

Furthermore, the paper also shows that in this context, capital regulation—often highlighted in the literature for its role in increasing bankers' skin-in-the-game—is not effective. Instead, the public provision of safe assets (e.g., government bonds), can mitigate the inefficiency but does not fully solve it. When safe assets are scarce, an increase in the government debt reduces the safety premium, ameliorating the scarcity. The lower safety premium, reduces bankers diversification level (crowding-out effect) and increases their screening efforts (crowding-in effect). However, the effect on private safe debt depends on whether the contribution of reduced diversification outweighs the benefits of screening.

2. Introduction

There is growing academic and policy interest in safe assets— financial instruments that maintain a stable value even in the face of adverse macroeconomic shocks. These assets are in high demand because they are good stores of value, serve as collateral, and help meet mandatory capital and liquidity requirements. Although highly rated government bonds are the quintessential source of safety supply, evidence suggests that financial intermediaries can also manufacture private alternatives (Krishnamurthy and Vissing-Jorgensen (2015)), e.g., senior tranches of asset-backed securities. However, the private supply of safe assets carries inherent risks that may undermine financial stability (e.g., Diamond (2020), Gorton and Ordoñez (2022), Segura and Villacorta (2023)). Understanding these risks is essential to ensure stability and efficiency in the financial system.

This paper provides important insights into the mechanism driving the private supply of safe assets by financial intermediaries. In the model, the amount of private safe assets —financial intermediaries' safe debt liabilities— is determined by two key factors: (i) the level of loan diversification, which affects intermediaries' asset-side risks, and (ii) the quality of the loans they originate, which increases the safe payoffs of the diversified loan portfolio. A central finding of the model is that when markets are incomplete, a free-rider problem can arise due to the misalignment between individual incentives and collective outcomes. In particular, financial intermediaries fail to internalize how their hidden efforts to improve loan quality affect the creation of safe asset through diversification, as this process depends on the collective effort of all intermediaries. This market failure gives rise to a novel inefficiency, that worsens as safe assets become scarcer, leading to a backward-bending supply curve of safe assets [1] and highlighting the need for policy intervention. This paper also examines the effectiveness of various policy tools in addressing this inefficiency.

I consider a two-date economy with two types of agents: savers and bankers. [2] Savers are infinitely risk-averse, and invest exclusively in risk-free assets. The aggregate wealth of savers thus determines the demand for safety in the economy. Bankers, in contrast, are risk-neutral and have access to a risky investment opportunity (e.g., loan origination). To cater to the safety demand, bankers can issue safe debt backed by their risky loan portfolio. However, to guarantee its safety, bankers can only pledge to debt holders the safe payoffs in their asset-side, namely the payoffs in the worst-case scenario.

[1] After a certain point, an increase in the price of safe assets (or a decrease in the safe rate) leads to a decrease in its supply.

[2] The model encompasses not just banks but a broader set of financial intermediaries. However, for simplicity, we refer to them as bankers.

Bankers are specialized along some geographic and industrial segments of the loan issuance market. This specialization exposes their loan portfolios to idiosyncratic risk, consisting of localized and sector-specific risks that are independent and identically distributed across bankers and fully diversifiable at the aggregate level. Bankers can enhance the quality of the loans they originate —thereby increasing their expected payoffs, particularly in adverse economic conditions — by exerting costly effort, such as implementing more rigorous borrower screening. Importantly, the return on bankers' screening efforts is relatively higher in bad states of the world. [3] A key friction in the model stems from the non-observability of this screening activity, which creates a moral hazard problem similar to Holmström and Tirole (1997), as bankers may have incentives to shirk when the risks of their loans are transferred to external investors.

When savers' wealth and demand for safe assets are low, bankers have sufficient safe payoffs from their loans to meet the safety demand. As a result, bankers retain all their loans in their balance sheets and do not transfer any risk. [4] Thus, their screening effort is set at the level that maximizes the value of their loans, ensuring that asset- and liability-side decisions are decoupled, in line with the result of Modigliani-Miller theorem.

At higher levels of savers' wealth, however, the safe payoffs from bankers' loan portfolios becomes insufficient to meet savers' demand for safety at the prevailing safe interest rate. As a result, the safe rate must fall to equilibrate the market, creating a spread with the risky rate — referred to as the *safety premium*. The safety premium differs from the standard risky premium, as the latter is always zero because bankers, who hold the risky assets, are risk-neutral. Instead, a positive safety premium indicates a scarcity of safe assets, and bankers profit from that premium when issuing safe debt.

To capitalize on this profitable opportunity, bankers are willing to increase their asset-side safe payoff to support larger amounts of safe debt in their liability-side. Similar to Gennaioli et al. (2013) and Segura and Villacorta (2023), they can achieve this by diversifying their loans through securitization: bankers sell claims on their loans that are exposed to idiosyncratic risk and, in turn, buy a diversified pool of loan claims from other bankers that embeds a higher level of safe payoffs. However, because markets are incomplete, these claims cannot be

[3]Screening refers to the process in which bankers invest in acquiring soft information about loan applicants, aiming to finance higher-quality firms and thus potentially reduce the proportion of bad borrowers in their loan portfolio. Consistent with the *cleansing effect* (see Caballero and Hammour (1991)), bad firms are more likely to default during recessions compared to good firms. In such periods, the value of maintaining a portfolio with a higher concentration of good firms is particularly high, as these firms tend to be more resilient and better able to survive economic downturns. Therefore, the benefits of screening are higher in future bad states.

[4]Notice that the promised payoffs to safe debt holders are risk-free and independent of bankers' screening efforts, meaning that the debt level does not directly influence bankers' screening activity.

contingent on aggregate states. As a result, although idiosyncratic risk is eliminated, the diversified portfolio remains exposed to aggregate risk.

However, the securitization process inevitably comes with the cost of reducing the quality of the loans originated. By transferring risk off their balance sheets, bankers have less incentives to screen their borrowers, as part of the benefits are accrued to outside investors. This prevents them from fully diversifying their loan portfolios, as they must retain some *skin-in-the-game* to signal to outside investors the quality of the loans they are trading. Thus, the optimal securitization level will trade-off the benefits of loan diversification and the cost of reducing the loan quality.

The amount of safe debt bankers can issue depends not only on the level of loan diversification but also on their screening efforts. [5] When the diversified pool consists of higher-quality loans, its safe tranche — the fraction of safe payoffs relative to the expected payoffs— expands, allowing bankers to issue more debt backed by this portfolio. Thus, the interaction between screening effort and diversification decisions determines the aggregate level of safe assets issued by bankers.

Nevertheless, bankers fail to efficiently combine these two inputs because they do not fully internalize how their effort influences the ability to generate safe assets through diversification, since the latter depends on the collective effort of all bankers. Specifically, individual bankers have an incentive to free-ride on others' efforts to improve loan quality, benefiting from the increased ability to issue safe debt while avoiding the full costs of enhancing loan quality.

Market incompleteness is a necessary but not sufficient condition for this market failure to arise. Indeed, market incompleteness becomes relevant only when two additional conditions hold: (i) the price of different states is not the same, and (ii) agents' actions affect outcomes differently across states. Condition (i) holds when safe assets are scarce and the safety premium is positive. In this case, the payoffs in the worst state become more valuable, as they determine the overall amount of safe assets in the economy. Condition (ii) holds because the return on bankers' screening efforts is relatively higher in bad states of the world. Under these conditions, the market mechanism fails to ensure that bankers fully internalize how their screening efforts affect the overall supply of safe assets, leading them to free-ride on the effort of others.

Since bankers ignore the positive externality, they underestimate the benefits of screening, or equivalently, underestimate the costs of diversification. This leads to an inefficiently high

[5] It is important to clarify that a bankers' screening choice does not affect the quality of safe assets, as safety is a binary characteristic. Instead, it affects the quantity of safe assets available in the economy.

securitization level and underinvestment in screening efforts. As a result, loan diversification is excessive, to the detriment of loan quality, in the production of private safe assets. The consequences of this inefficiency are twofold: first, the supply of safe assets becomes backward-bending, where after a certain point, an increase in the price of safe assets (or a decrease in the safe rate) leads to a decrease in its supply. Second, it underscores the need for policy intervention.

An effective policy is to impose a loan risk-retention requirement, to improve bankers' skin-in-the-game while curbing excessive diversification. This aligns with recent regulatory initiatives that mandate loan originators to retain a material net economic interest of no less than 5% in the securitization process. This paper further suggests that when securitization is driven by the demand for safety, this micro-prudential requirement should be sensitive to macro aspects such as the scarcity of safe assets, reflected in the safety premium. This is, the risk-retention requirement should decrease as the safety premium rises.

Furthermore, the paper also shows that in this context, capital regulation—often highlighted in the literature for its role in increasing bankers' skin-in-the-game—is not effective. Instead, the public provision of safe assets (e.g., government bonds), can mitigate the inefficiency but does not fully solve it. When safe assets are scarce, an increase in the government debt reduces the safety premium, ameliorating the scarcity. The lower safety premium, reduces bankers diversification level (crowding-out effect) and increases their screening efforts (crowding-in effect). However, the effect on private safe debt depends on whether the contribution of reduced diversification outweighs the benefits of screening.

Literature review. The interplay between private safe asset creation and financial stability has been a central focus in recent literature. In line with Gennaioli et al. (2013), Diamond (2020) and Segura and Villacorta (2023), this paper investigates the role of diversification, primarily through securitization, in creating safe assets. [6] Gennaioli et al. (2013) highlights the fragility that stems from neglected risks, while Diamond (2020) examines how the high demand for safety reshapes the financial system, resulting in larger and riskier intermediaries as well as more leveraged firms. Segura and Villacorta (2023) document a paradox where the demand for safe assets leads to the origination of riskier loans. This paradox is also present in my paper, but by assuming that the prospective return to screening is higher in adverse economic states, the free-rider problem emerges which plays a critical role in the private creation of safe assets.

[6]Diversification plays a crucial role in much of financial intermediation theory (e.g., Diamond (1984)); however, the role of diversification tends to be to reduce the cost of asymmetric information rather than to meet a demand for safe assets as in this paper.

Other studies have explored how financial intermediaries create safety by selling off risky assets in exchange for safe assets during economic downturns, before the worst-case scenario materializes (e.g., Stein (2012), Hanson et al. (2015), Ahnert and Perotti (2021), and Luck and Schempp (2023)). In line with these works, a key friction driving the inefficiency in the model is market incompleteness—the inability to write state-contingent contracts with outside investors. However, my paper diverges by emphasizing a novel inefficiency arising from ex-ante trades, rather than ex-post trades that cause fire-sale externalities.

The information-insensitive characteristic of safe assets has also been widely discussed (see Gorton (2017)). This strand highlights that a defining feature of safe securities is that all investors are symmetrically informed, enabling them to trade without fear of adverse selection (Dang et al. (2017), Gorton and Ordoñez (2022), Moreira and Savov (2017)). Unlike these studies, which focus on the information production of existing assets, I focus on the information gathering at the origination stage, which improves resource allocation and investment quality. Thus, I highlight a complementary source of fragility and, for simplicity, define safe assets as completely riskless (a binary characteristic), which is a sufficient condition for ensuring their liquidity (Gorton and Pennacchi (1990)).

This paper also examines the role of safe asset scarcity in hindering economic growth (Benigno and Nisticò (2017), Caballero and Farhi (2018) and Castells-Jauregui et al. (2024)),influencing the interaction between public and private safe assets (Krishnamurthy and Vissing-Jorgensen (2015), Gorton and Ordoñez (2022), Azzimonti and Yared (2019), Infante (2020), Perotti and Terovitis (2025)), and shaping regulation and monetary policy (Begenau (2020), Farhi and Tirole (2021) Vissing-Jorgensen (2023)).

This paper also relates to literature on trade in secondary financial markets and the impaired incentives of security issuers arising from informational frictions. In my model, hidden actions create a moral hazard problem similar to those studied in Hartman-Glaser et al. (2012); Chemla and Hennessy (2014); Vanasco (2017); Hébert (2018). Instead of focusing on optimal security design, this paper aims to explore how the incentive problem shapes the supply curve of safe assets and evaluates its efficiency in an environment with incomplete markets.

The paper is organized as follows: Section 3 introduces the model setup; Section 4 characterizes the equilibrium and outlines the key insights from the positive analysis; Section 5 conducts the welfare analysis and explores policy tools to address the inefficiencies; Section 6 concludes.

3. Model set-up

The model has two dates ($t \in \{0, 1\}$), one perishable good that can either be used for consumption or investment, and two groups of agents, each with a mass of one: (i) *savers* are endowed with $w < 1$ units of the perishable good at $t = 0$ and are infinitely risk-averse with utility $U^d = \min_z \{c^i_{1z}\}$, and (ii) *bankers* have deep pockets at $t = 0$ and are risk neutral with utility $U^b = c^i_0 + \mathbb{E}[c^i_{1z}]$, where c^i_{tz} is agent i's consumption at t and state $z \in \Omega \neq \emptyset$.

Bankers' investment project. Bankers have access to a constant-return-to-scale investment project that requires an investment of one unit at $t = 0$. The project's stochastic return, R, is subject to two sources of risk: (i) aggregate risk, which is common to all projects and indexed by $\omega \in \{\mathbf{g}ood, \mathbf{b}ad\}$, and (ii) idiosyncratic risk, which is *iid* across bankers' projects and indexed by $\iota \in \{\mathbf{s}uccess, \mathbf{f}ail\}$. [7] If the good state occurs with probability $1 - \pi_b$, the project always succeeds yielding a return of $\overline{R}$. However, if the bad state occurs with probability π_b, the project is at risk of failure, and the payoff structure is as follows:

$$\begin{cases} \overline{R} & \text{with probability} \quad e^i \\ \underline{R} & \text{with probability} \quad 1 - e^i \end{cases}$$

where $\underline{R} < 1 < \overline{R}$. Hence, in the bad state, the project faces a positive probability of failure; thus, the expected return in this state is lower compared to the good state. The probability of success in the bad state, denoted by $e^i \in [0, 1]$, is determined by bankers' screening effort. The higher is the screening effort, the higher is the project's success probability in the bad state and consequently raises the project's expected payoff. Also note that effort has an effect only in the bad state, reducing the project's exposure to it. However, the safe payoffs of the project, given by $\underline{R}$, remains unaffected by the screening choice. [8]

While this effort improves the project's return prospects, it entails a (non-pecuniary) cost per unit of investment, given by $c(e^i)$ where $c : [0, 1] \to \mathbb{R}_+$, such that $c'(e^i), c''(e^i) > 0$ and $c'''(e^i) = 0$ for $\forall e^i \in (0, 1)$. In addition, $c(0) = 0$, $c'(0) = 0$ and $c'(1) > \pi_b\left(\overline{R} - \underline{R}\right)$, ensuring that corner solutions for screening effort are excluded in equilibrium. The screening effort that maximizes the project's expected payoffs net of the effort cost, denoted by e^o, is

[7] The investment project captures, in reduced form, the loans granted by financial intermediaries to the the real sector. The idiosyncratic risk at the intermediary level reflects the fact that intermediaries cannot fully diversify idiosyncratic risk with the loans they grant due to frictions that force them to specialize along some geographic or industrial segment of the loan issuance market.

[8] As it will be later explained, the results do not depend on this assumption.

implicitly determined by:

$$\pi_b \left(\overline{R} - \underline{R}\right) \; - \; c'(e^o) \; = \; 0 \tag{1}$$

where $e^o \in (0,1)$. Therefore, when $e^i \neq e^o$, the project's net expected return is lower than it would be if $e^i = e^o$. Notably, while the safe payoffs of individual projects are unaffected by the screening efforts, it will soon become clear that higher collective screening efforts positively affect the overall safe payoffs in the economy. Hence, within the range $e^i \in [0, e^o)$, an increase in screening intensity improves the quality of the project, as both dimensions of an asset that are valued improve, namely, expected and safe payoffs. For simplicity, I assume that under e^o the net expected return equals one:

$$\mathbb{E}_{e^o}\left[R\right] - c\left(e^o\right) = 1 \tag{2}$$

where $\mathbb{E}_e\left[.\right]$ denotes the expectation operator for effort level e. When $e^i \neq e^o$, the projects' net payoff falls below one. Note, however, that even in this case, investing in the project is not socially wasteful, as the investment is essential for producing safe assets valued by savers.

Information friction. Screening effort is unobservable to outside investors. If the mapping between this effort and the project's payoffs was completely deterministic, outside investors could easily infer each banker's effort from the observed payoff. However, because the project's payoff provides only a noisy signal of this hidden action, effort is not contractible. This friction creates a moral hazard problem, similar to that in Holmström and Tirole (1997), when risky financial claims on the project — whose value depends on the sellers' effort — are sold, transferring risks to outside investors.

Competitive and incomplete financial markets. Savers only value assets' payoff in the worst case scenario, hence, they prefer riskless investments. Bankers can meet this demand while raising funds for their project, by issuing a safe debt contract. However, they must guarantee that the debt obligations are met under all contingencies. This means, they can only pledge to debt holders the lowest possible realization of their assets' payoffs, this is, their *safe collateral*.

Bankers can expand their safe collateral diversifying the risk of their project. To achieve this, bankers trade risky financial claims on their project's payoffs. Specifically, they sell claims exposed to their own project-specific risk and purchase the *market portfolio* — a diversified pool of claims from other bankers.

However, financial markets are incomplete, meaning that financial claims cannot be contingent on the aggregate state of the economy. Specifically, while the payoffs of these claims can depend on the project's outcomes, they cannot be directly linked to specific aggregate states. [9] This friction imposes limitations on risky financial claims. Without loss of generality, I focus on unlevered equity claims as the only type of risky financial claim that bankers can trade in the secondary market. [10] Hence, the market portfolio, formed by pooling these unlevered equity claims sold by all bankers, eliminates idiosyncratic risks but remains exposed to aggregate risk. Consequently, only the safe tranche — determined by the payoffs in the bad state — expands the safe collateral.

The value of a risky claim depends on the seller's unobservable effort. Hence, the price, $p\left(\hat{e}^i\right)$, is determined by the market's belief about this effort, $\hat{e}^i$, where $p:[0,1]\rightarrow\mathbb{R}$. Note that the price of the market portfolio is determined by the average effort expected from all bankers, denoted $\hat{e}^m$ [11]

Bankers' maximization problem. When redundant, I omit the i index for simplicity. The timing of bankers' decisions unfolds as follows. First, bankers raise external funds (if any), by issuing safe debt. Specially, they raise $q^s d$ units of funds where q^s is the competitive price of safe claims, and d is the amount of safe claims promised to debt holders. The remainder is financed with inside equity, k. Second, they invest in the project and decide on the level of screening effort, e^i. Third, they decide on their trade strategy in the secondary market: the fraction of the project to sell, s, and the amount of the market portfolio to purchase, b. Finally, at $t=1$, the asset-side payoffs are realized and distributed among the different claimants.

Bankers take prices as given, $\langle q^s, p\left(\hat{e}\right)\rangle$, and decided on the aforementioned variables to maximize their utility given by:

$$\underbrace{\mathbb{E}_{e^i}\left[R\right] \;-\; c\left(e^i\right)}_{\text{Net payoffs from the project}} \;-\; \underbrace{\left(\mathbb{E}_{e^i}\left[R\right]s \;-\; \mathbb{E}\left[P\left(\hat{e}^m\right)\right]\,b\right)}_{\text{Payoff from trade in the secondary market}} \;-\; \underbrace{d}_{\text{Financing costs}} \;-\; \underbrace{k}_{\text{Opportunity cost}} \tag{3}$$

where redundant constants have been dropped. Note that $P\left(\hat{e}^m\right)$ is the payoff of the market portfolio, which depends on the quality of the underlying loans and takes two possible values: in the good state $P_g\left(\hat{e}^m\right)=\overline{R}$ and in the bad state $P_b\left(\hat{e}^m\right)\equiv\hat{e}^m\overline{R}+\left(1-\hat{e}^m\right)\underline{R}$. Note that, due to risks diversification, the safe payoffs of the market portfolio exceeds that of individual

[9]Following the terminology in Biais et al. (2021), I assume that financial markets are not exogenously complete. Furthermore, I will later demonstrate that markets are also not endogenously complete due to the moral hazard problem.

[10]The results and insights of this paper rely on the assumption that the traded claims are not contingent on the aggregate state. For simplicity, I focus on the simplest type of financial claim that satisfies this condition.

[11]The idiosyncratic shock is the only source of heterogeneity among bankers once risks materialize. Therefore, the gains from trade stem from the desire to insure against this idiosyncratic risk by acquiring a well-diversified portfolio. In this context, the specific portfolio choice — i.e., how much to buy from each banker — is irrelevant under a no-arbitrage condition. For simplicity, I assume that each bnaker buy the same amount from the rest, thus $\hat{e}^m=\int\hat{e}^i di$.

projects, $P_b(\hat{e}^m) > \underline{R}$. Additionally, the opportunity cost of investment for bankers is foregone consumption at $t = 0$. This maximization problem is subject to the budget constraint:

$$1 \leq k + q^s d \tag{4}$$

The available funds at the time of the investment in the project are sufficient to meet or exceed the project's unit investment requirement. Note that bankers can raise more resources than required for their project, as they may use the surplus in the secondary market. The budget constraint faced by bankers when deciding on secondary market trades is:

$$p\left(\hat{e}^i\right) s + (k + q^s d - 1) = p(\hat{e}^m)\, b \tag{5}$$

As previously mentioned, prices in the secondary market depend on the market's belief about the seller's effort level, $\hat{e}^i$, since the actual level e^i is unobservable. The same intuition applies to the market portfolio. The feasibility constraint for the fraction of the project that can be sold is:

$$0 \leq s \leq 1 \tag{6}$$

Bankers must also ensure the safety of debt by holding sufficient safe collateral. The safe collateral constraint is:

$$d \leq \underline{R}(1 - \hat{s}) + P_b(\hat{e}^m)\, \hat{b} \tag{7}$$

This constraint depends on the expected future trade in the secondary market, $\left\langle \hat{s}, \hat{b} \right\rangle$. While trade in the secondary market is observable, this occurs after the debt contract is signed, thus, the constraint depends on the expected future trades. The safe collateral has two components: (i) the lowest payoffs from the retained (i.e., unsold) fraction of the bankers' projects, and (ii) the lowest payoffs from the market portfolio, which equals the payoffs in the bad state.

It is important to note that the safe collateral depends on bankers' screening efforts in a nuanced way. Banker's individual effort (actual or as perceived by the market) does not directly affect the safe collateral because the lowest return of their project is independent of their effort. [12] However, collective efforts of all bankers improve the diversified payoffs in the bad state, thereby increasing the safe payoffs associated with the market portfolio. In other words, when the market portfolio comprises claims on better quality projects that fail less frequently, the lowest return of this portfolio increases. Therefore, indirectly, bankers' screening efforts contribute to the availability of safe payoffs in the economy.

While effort itself cannot be directly observed, bankers' incentives to exert effort can

[12] But even if effort influenced the lowest return, the safe collateral would depend on the belief about this effort, not on the actual effort.

be perfectly inferred from other observable choices. The incentive compatibility constraint ensures that bankers' incentives to exert effort are aligned with the market's beliefs about this hidden actions:

$$\hat{e}^i = \underset{e' \in [0,\bar{e}]}{argmax} \quad c_0^i + \mathbb{E}_{e'}\left[c_{1z}^i\right] - c(e') \tag{8}$$

Equilibrium definition. A symmetric competitive equilibrium consists of a vector of prices $\langle q^s, p(e)\rangle$, bankers' allocation $\langle k^*, d^*, s^*, b^*\rangle$ and their effort level $\langle e^*\rangle$, and depositors' investment in safe assets such that the following conditions hold:

1. Bankers' choices are the solution to maximizing (3) subject to (4)-(8).
2. Savers maximize their consumption in the worst case scenario.
3. The market for safe debt clear at competitive price q^s.
4. The secondary market clear at competitive prices $p(e)$.
5. Beliefs are consistent: $e^* = \hat{e}^i$, $s^* = \hat{s}$ and $b^* = \hat{b}$.

4. Equilibrium

In this section, I give a characterization of the equilibrium. First, I solve for the equilibrium in the market for risky financial claims, conditional on the equilibrium in the safe debt market. This intermediate step is useful for characterizing the supply schedule of safe debt by bankers. Finally, I describe the equilibrium in the safe debt market and discuss the key insights. But before, let me introduced the following lemma. The proofs of the lemmas and propositions are provided in the appendix.

Lemma 4.1. *Safe debt must be demandable to ensure that bankers have the incentive to maintain sufficient safe collateral.*

Bankers can adjust their safe collateral by trading in the secondary market after issuing safe debt. This creates potential incentives for bankers to deviate from their initial promises, say by holding less safe collateral than required to meet their debt obligations. This would potentially reduce the promised payments to debt holders. However, the risk of debt holders withdrawing their funds acts as a disciplinary mechanism, deterring bankers from reneging on their commitments and ensuring they hold sufficient safe collateral.

Lemma 4.2. *The price of the risky financial claims equals the present value of its expected return, this is,* $p\left(\hat{e}^i\right) = q\,\mathbb{E}_{\hat{e}^i}\left[R\right]$ *where* q *is the market discount factor.*

Under a no-arbitrage condition, the price of risky financial claims is equal to the present value of their expected return, discounted by the market discount factor. Lemma (4.2) further shows that when bankers signal greater effort, the price of their claims increases to reflect the improved expected return prospects. However, the market discount factor remains unaffected by individual screening efforts. Additionally, while Lemma (4.1) suggests that bankers hold sufficient amount of safe collateral to meet their debt obligations, Lemma (4.2) also ensures that $s = \hat{s}$ and $b = \hat{b}$. This means, that when issuing debt, bankers can act as if they can commit to a specific trading strategy.

Note that bankers discount factor is one, which might differ from the market discount factor q. In addition, when the price of safety exceeds their discount factor, $q^s > 1$, bankers earn a rent of $q^s - 1$ on each unit of debt issued. In this scenario, they effectively engage in a carry trade: using their asset returns in worst-case scenarios as collateral for riskless debt while capturing the upside in better states of the world. Consequently, issuing debt becomes a profitable activity, prompting them to issue as much as their safe collateral allows. Thus, the safe collateral constraint becomes binding.

Consistent with the incentive compatibility constraint, the optimal screening level is implicitly determined in:

$$\pi_b\left(\overline{R} - \underline{R}\right)(1 - s) - c'\left(e^*\right) = 0 \tag{9}$$

Due to a moral hazard problem, bankers do not fully internalize the benefits of their screening effort when they sell risky financial claims, as part of the benefits accrue to outside investors. However, bankers bear the full cost of their effort. Thus, their incentive to exert screening effort stems from their *skin-in-the-game*—the exposure to their actions—achieved by retaining a fraction of their risky project on their balance sheet.

The optimal effort, as a function of the fraction s sold, is denoted by $e^*(s)$ where $e^* : [0,1] \to [0, e^o]$. When bankers retain their entire project, the effort level that maximizes the project's expected return is achieved, i.e., $e^*(0) = e^o$. Conversely, as bankers sell more of their project, their effort declines monotonically, eventually reaching the zero lower bound when the project is entirely sold, i.e., $e^*(1) = 0$. The range of the optimal effort indicates an efficiency loss when $s > 0$, and the quality of the project deteriorates as s increases. Also note that the debt does not directly influence bankers' incentives to exert effort, as the payoffs of safe claims remain unaffected by this choice.

The optimal fraction expected to be sold (and consistent with the actual sale that occurs later) is determined by the following optimality condition, assuming an interior solution:

$$\underbrace{p\left(\hat{e}^i\right)}_{\text{Price}} - \underbrace{\mathbb{E}_{e^i}\left[R\right]}_{\text{Expected return}} - \underbrace{(q^s-1)\underline{R}}_{\downarrow\text{ Safe collateral}} - \underbrace{\frac{\partial p\left(\hat{e}^i\right)}{\partial \hat{e}^i}\left(-\frac{\partial \hat{e}^i}{\partial s}\right)s}_{\downarrow\text{ Skin-in-the-game}} = 0 \tag{10}$$

where $p\left(\hat{e}^i\right) = q\mathbb{E}_{\hat{e}^i}\left[R\right]$, $\frac{\partial p\left(\hat{e}^i\right)}{\partial \hat{e}^i} = q\frac{\partial \mathbb{E}_{\hat{e}^i}[R]}{\partial \hat{e}^i}$ and $\hat{e}^i = e^*(s)$. Bankers will not sell any fraction of their project if the market price is lower than or equal to their expected return. For bankers to sell, the market price must be sufficiently high to compensate for two sources of costs associated with selling risky claims. First, selling risky claims reduces bankers' safe collateral available for issuing debt, a profitable activity when $q^s > 1$. Second, a higher s implies lower skin-in-the-game, signaling to outside investors weaker incentives to exert effort. As a result, the price of the claim decreases to reflect the downgrade in its payoff prospects, reducing the proceeds from the sale. The optimal s trades-offs these costs and benefits.

The decision to purchase the market portfolio depends on the marginal costs (left-hand side) and the marginal benefits (right-hand side):

$$\underbrace{p\left(\hat{e}^m\right)}_{\text{Price}} \lesseqgtr \underbrace{\mathbb{E}\left[P_\omega\left(\hat{e}^m\right)\right]}_{\text{Expected return}} + \underbrace{(q^s-1)P_b\left(\hat{e}^m\right)}_{\uparrow\text{ Safe collateral}} \tag{11}$$

Bankers are willing to pay a price higher than the expected return of the portfolio only when $q^s > 1$, as issuing debt becomes profitable and the diversified pool helps expand the safe collateral boosting their debt capacity. If the cost of purchasing the portfolio exceeds the benefits, bankers will not invest in the market portfolio. Conversely, if the benefits outweigh the costs, they allocate all available resources to acquiring it. Bankers are indifferent to the quantity purchased only when the marginal cost equals the marginal benefit.

So far, I have shown how bankers' optimal choices depend on market prices. I will now proceed by describing the equilibrium prices in the secondary market, conditional on the equilibrium in the safe asset market.

Equilibrium in the secondary market. The equilibrium price must ensure that $s = b$. Note that in a symmetric equilibrium $e^i = e^{-i} = e^m$.

Lemma 4.3. *The equilibrium market discount factor:*

$$q = \kappa\left(\hat{e}^m\right)q^s + \left(1-\kappa\left(\hat{e}^m\right)\right)$$

where $\kappa\left(\hat{e}^m\right) \equiv \frac{P_b(\hat{e}^m)}{\mathbb{E}[P(\hat{e}^m)]}$ *is the fraction of safe claims in the market portfolio.*

The equilibrium market discount factor is the weighted average of the prices of risky and safe claims, where the weights correspond to the fractions of risky and safe payoffs embedded in the market portfolio. Note that, based on their opportunity cost, bankers are willing to pay a unit price for each unit of expected return. Then, the market discount factor equals the discount factors of bankers and savers only when $q^s = 1$. If $q^s > 1$, then $q^s > q > 1$.

Bankers are indifferent with the amount of the market portfolio to purchase at the equilibrium price. Consequently, the optimal s determines the amount of b, and eventually d. Essentially, s reflects bankers' diversification level chosen to achieve a specific level of debt. Substituting the equilibrium discount factor in Equation (10):

$$(q^s - 1) \underbrace{\left(P_b\left(\hat{e}^m\right) - \underline{R} - \kappa\left(\hat{e}^m\right) \left(- \frac{\partial \left(\mathbb{E}_{e^i}\left[R\right] - c\left(e^i\right)\right)}{\partial s} \right) \right)}_{\Delta \text{ Safe collateral}} - \underbrace{\left(- \frac{\partial \left(\mathbb{E}_{e^i}\left[R\right] - c\left(e^i\right)\right)}{\partial s} \right)}_{\Delta \text{ Net expected payoffs}} = 0 \qquad (12)$$

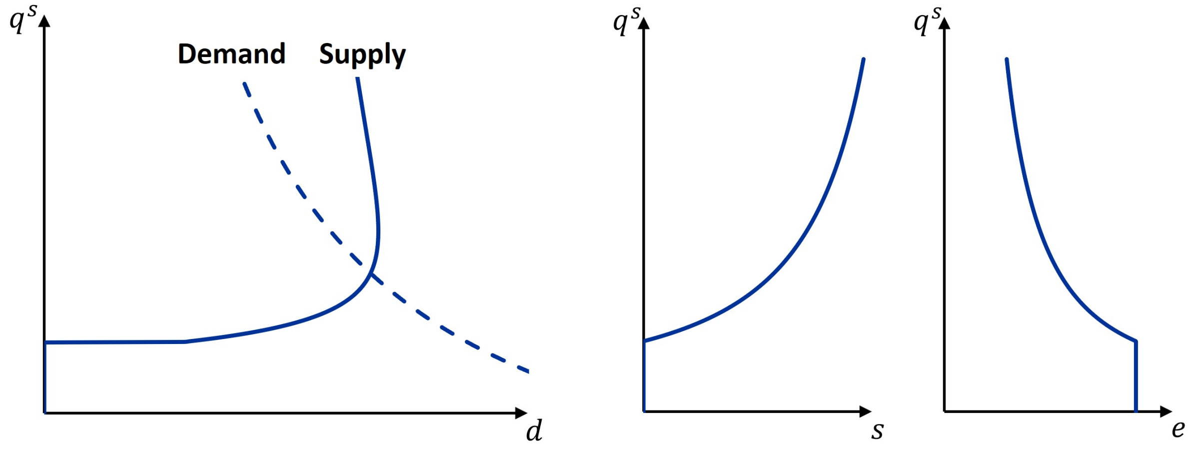
where $-\frac{\partial\left(\mathbb{E}_{e^i}[R]-c\left(e^i\right)\right)}{\partial s} = \left(\frac{\partial\left(\mathbb{E}_{e^i}[R]-c\left(e^i\right)\right)}{\partial e^i}\right)\left(-\frac{\partial e^*(s)}{\partial s}\right)$, and based on Equation (9), $\frac{\partial\left(\mathbb{E}_{e^i}[R]-c\left(e^i\right)\right)}{\partial e^i} = \frac{\partial \mathbb{E}_{e^i}[R] s}{\partial e^i}$. Equation (12) revels the underlying forces driving trade in the secondary market. On one hand, higher diversification increases bankers' safe collateral, enhancing their debt capacity and enabling them to capture the spread $(q^s - 1)$. On the other hand, higher diversification also implies that bankers retain less skin-in-the-game, leading to weaker screening incentives and, consequently, lower project quality. This decline in effort reduces the net expected return, with a fraction $\kappa\left(\hat{e}^m\right)$ ultimately contributing to a decrease in safe collateral.

Equilibrium in the safe debt market. Taking the equilibrium in the secondary market into account, and $e = e^i = e^m$, the safe collateral constraint now boils down to:

$$d \leq \underline{R} + \left(P_b(e) - \underline{R}\right) s$$

Therefore, bankers' debt capacity is exclusively determined by two factors: the level of diversification and the quality of the projects, which depends on their screening efforts. However, since this effort is unobservable, a tension exists between these two inputs. A higher level of diversification reduces bankers' exposure to idiosyncratic risk, making their asset portfolio safer. Yet, diversifying risks requires selling risky claims on their project's payoffs, which decreases their *skin-in-the-game* and weakens the screening incentives, inevitably lowering the quality of the project.

This raises an important question: How does the interplay between diversification and screening effort shape the supply of safe assets or debt? The following lemma outlines the supply schedule.



Lemma 4.4. *Bankers' supply of safe debt as a function of q^s:*

- *If $q^s < 1$, bankers do not supply debt.*
- *If $q^s = 1$, the supply of debt from bankers is perfectly elastic up to the safe payoffs of their own project , $\underline{R}$.*
- *If $q^s > 1$, the supply of debt from bankers is backward-bending: it initially increases with q^s, but beyond a certain point, further increases in q^s cause the supply of safe debt to decrease.*

Bankers supply debt only when they earn a non-negative rent, i.e., $q^s \geq 1$. When $q^s = 1$, bankers are indifferent to the amount of debt issued, provided their project's safe collateral alone guarantees the debt's safety. They avoid incurring the costs of diversification while the safe collateral constraint remains non-binding. In this case, their screening efforts are set at the efficient level that maximizes the value of their project. However, when $q^s > 1$, issuing debt becomes profitable. To maximize their gains, bankers find it optimal to increase debt issuance up to the limit allowed by their safe collateral constraint, causing it to become binding.

When the safe collateral constraint is binding, diversifying the asset side can help relax this constraint by increasing bankers' safe collateral. However, greater diversification comes at the cost of reduced screening efforts, which ultimately lowers the quality of their projects. At the aggregate level, the resulting decline in loan quality across the economy negatively impacts bankers' safe collateral.

The supply of safe assets from bankers becomes sensitive to q^s when $q^s > 1$, but the relationship is non-monotonic due to the interaction of two opposing forces. As q^s rises, bankers increase their level of diversification, while their screening effort declines. Initially, the positive contribution of diversification to safe collateral outweighs the negative impact of lower project quality, leading to an increase in the supply of safe debt as q^s grows. However, beyond a certain point, the negative effect of reduced screening effort offsets the benefits of diversification. As a result, the supply of safe debt paradoxically begins to decline with further increases in q^s.

This dynamic also raises an important question: why prioritize diversification over screening when both are key inputs in determining the safe collateral? Since screening effort is unobservable, bankers' incentives are determined solely by their optimal skin-in-the-game, which is inversely related to their diversification level. Thus, q^s does not directly influence their screening incentives but affects them indirectly by shaping the optimal level of diversification. Even if screening effort directly influenced the safe payoffs of bankers' individual projects, the debt they could raise would still depend on beliefs about their effort rather than the effort itself. Hence, their screening effort would still be determined by their skin-in-the-game, and only diversification would directly respond to q^s.

Therefore, the supply of safe debt by bankers is backward-bending. This market failure stems from bankers not fully internalizing the impact of their actions on the economy-wide availability of safe collateral—a topic explored in detail in the next section.

Proposition 1. *The equilibrium depends on savers' demand for safe assets, leading to two possible scenarios:*

1. ***Abundance of safe assets:*** *When the demand for safe assets is low ($w \leq \underline{R}$), the equilibrium price of safe assets is $q^s = 1$. The equilibrium safe debt level is demand-driven, $d^* = w$; there is no risk diversification; and screening effort is set at the efficient level $e^* = e^o$.*

2. ***Scarcity of safe assets**: When the demand for safe assets is high ($w > \underline{R}$), the equilibrium price of safe assets is $q^s = \frac{w}{d^*} > 1$, where the equilibrium safe debt is $d^* = \underline{R} + (P_b(e^*) - \underline{R})\, s^*$; the diversification level $s^* > 0$ is determined by Equation (10); and the screening effort $e^* < e^o$ is determined by Equation (9).*

When savers' wealth is limited and the demand for safety is low, the safe payoffs of individual projects are sufficient to meet the safety demand without requiring costly diversification. In this scenario, safe assets are abundant, and bankers are the marginal holders of safe claims. Consequently, the prices of safe and risky claims (related to the price that bankers would be willing to pay for a risky claim) must be equal. If the price of safe claims were higher (lower), bankers' supply would exceed (fall short of) than the demand—a situation that cannot occur in equilibrium.

At higher levels of savers' wealth, the demand for safe assets exceeds the safe payoffs of individual projects, creating a scarcity of safe assets. In this scenario, the price of safe claims rises above the price of risky claims to incentivize diversification, which is costly due to the moral hazard problem. This price spread, known as the *safety premium*, compensates bankers for the costs associated with risk diversification.

The safety premium differs from the standard risk premium.While the risk premium compensates risk-averse investors for bearing risk, in this framework, risk-neutral bankers hold risky claims, so no risk premium is required, and it is zero in equilibrium. Instead, the safety premium reflects a scarcity rent earned by bankers due to their unique ability to issue safe debt that is in high demand. As a result, when safe assets are scarce, a discontinuity arises in the price of assets at the zero-risk boundary. This discontinuity is entirely determined by the interplay of supply and demand for safe assets.

The existence of the safety premium challenges the seminal results of Modigliani and Miller (1958) (MM). In the MM framework, there is no connection between a financial intermediary's financing and investment decisions; essentially, the intermediary offers the same loan regardless of its equity-debt mix. However, the existence of the safety premium explains why financial intermediaries that can issue safe liabilities are highly leveraged, as issuing debt is profitable.

This deviation from the MM assumptions has significant implication. Financial intermediaries must reduce asset-side risk to sustain higher levels of safe debt, which may conflict with maximizing their total economic value. While risk diversification increases the supply of safe liabilities, it also lowers the quality of investments and the overall economic value generated by intermediaries compared to those not focused on creating safe assets.

5. Welfare analysis

In the presence of frictions, the market outcome is clearly not first best; removing the frictions imposed by the non-observability of screening effort would increase efficiency. However, in practice, policymakers often must take these frictions as given, which raises the question of whether decentralized equilibrium allocations are constrained-efficient. In other words, can a policymaker, subject to the same constraints as private agents, improve upon the market outcome?

To answer the posed question, I solve the problem of a social planner who decides at $t = 0$ on the consumption of savers (c^d_z) and bankers (c^b_{tz}) to maximize the weighted sum of their utility, with respective Pareto-efficient weights W and $1 - W$:

$$U^{sp} = W \left[\underset{\omega}{min} \left\{ c^d_{1z} \right\} \right] + (1 - W) \left[c^b_0 + \mathbb{E}_e \left[c^b_{1z} \right] - c(e) \right] \tag{13}$$

To achieve a specific consumption allocations across agents, the social planner first transfers all resources from savers to bankers so that they can invest them, otherwise, these resources would be wasted. Then, the social planner decides on the future transfer of resources from bankers to savers, denoted as d^{sp}. This transfer is riskless, as savers value only the safe payoffs. Hence, ignoring redundant constants, the social planner's utility can be expressed as:

$$U^{sp} = W d^{sp} + (1 - W) \left[\mathbb{E}_e \left[R \right] - c \left(e^{sp} \right) - d^{sp} \right] \tag{14}$$

If the transfer is higher than the safe payoffs of individual projects, the social planner must diversify the projects. Hence, the social planner takes a fraction s^{sp} of each project and, in exchange, allocates to each banker the equivalent fraction of the diversified pool. Note that since $e^i = e^m$, the value of the fraction of the project diversified, $\mathbb{E}_{e^i} \left[R \right] s^{sp}$, cancels out in the objective function with the value of the diversified portfolio bankers receive in exchange, $\mathbb{E}_{e^m} \left[R \right] s^{sp}$. Then, the safe collateral constraint:

$$d \leq \underline{R} \left(1 - s^{sp} \right) + P_b \left(e^{sp} \right) s^{sp} \tag{15}$$

Note that the social planners takes into account how their choices affect economy-wide variables such as e^m. hence, the social planner internalizes that the safe collateral depends on the collective effort level. However, the social planner is subject to the same moral hazard problem as bankers. As a result, the screening effort is determined by Equation (9), thus $e^{sp}(s) = e^*(s)$.

The competitive equilibrium is constrained-efficient if and only if there exist positive weights that ensure the social planner's optimal choices, given the constraints, align with those in the decentralized economy.

I demonstrate that, under certain conditions, the competitive equilibrium is not constrained-efficient. This becomes evident when substituting $\frac{W}{1-W} = q^s$ into the planner's first-order condition for s:

$$(q^s - 1) \underbrace{\left(P_b(e) - \underline{R} - \frac{\partial P_b(e)}{\partial e} \left(-\frac{\partial e^*(s)}{\partial s} \right) s \right)}_{\Delta \text{ Safe collateral}} - \underbrace{\left(\frac{\partial \left(\mathbb{E}_e [R] - c(e) \right)}{\partial e} \right) \left(-\frac{\partial e^*(s)}{\partial s} \right)}_{\Delta \text{ Net expected payoffs}} = 0 \quad (16)$$

Note that a wedge exists between the private and socially optimal diversification level when $q^s > 1$ and $\frac{\partial P_b(e)}{\partial e} \neq \kappa(e) \frac{\partial \mathbb{E}_e[R]}{\partial e}$ where $\kappa(e) \equiv \frac{P_b(e)}{\mathbb{E}_e[R]}$. To see this more clearly, after some algebra, the additional term in the social planner's first-order condition:

$$\phi \equiv -(q^s - 1) \left(\frac{\partial P_b(e)}{\partial e} - \kappa(e) \frac{\partial \mathbb{E}_e [R]}{\partial e} \right) \left(-\frac{\partial e^*(e)}{\partial s} \right) s \leq 0$$

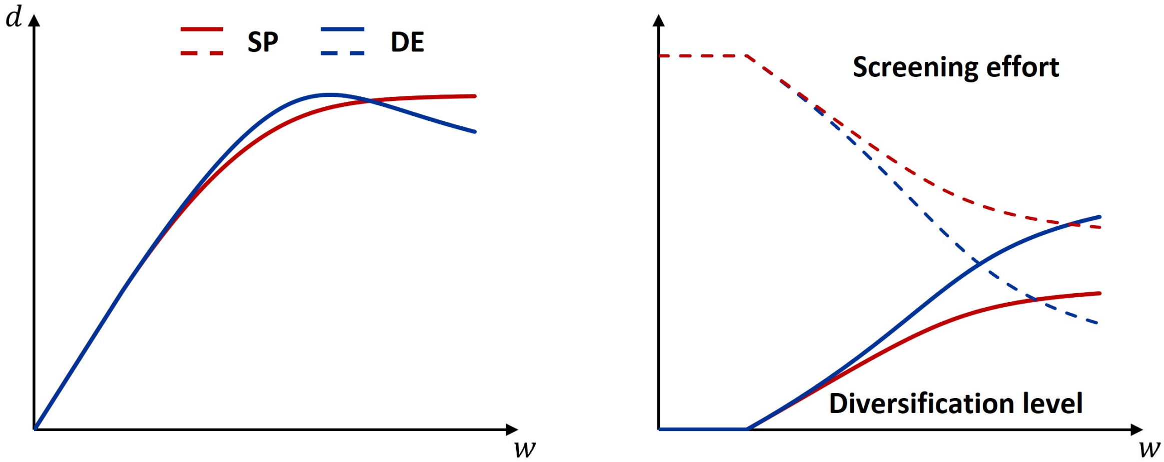
Since $\frac{\partial P_b(e)}{\partial e} > \kappa(e) \frac{\partial \mathbb{E}_e[R]}{\partial e}$, the sing of ϕ is negative when the safety premium is positive and $s > 0$. This suggests that bankers are underestimating the cost of diversification, which is equivalent to underestimating the benefits of screening effort. Before delving into the sources of this inefficiency, the following proposition outlines its impact on the equilibrium allocation.

Proposition 2. *A comparison between the social planner's (sp) and decentralized equilibrium's (*) allocations:*

- ***Abundance of safe assets****: When the demand for safe assets is low ($w \leq \underline{R}$), the competitive equilibrium is constrained-efficient.*
- ***Scarcity of safe assets****: When the demand for safe assets is high ($w > \underline{R}$), the competitive equilibrium is not constrained-efficient:*
  1. *The diversification level is inefficiently high: $s^{sp} < s^*$.*
  2. *The screening efforts are inefficiently low: $e^{sp} > e^*$.*
  3. *Safe debt could be inefficiently high or low, depending on the level of safety demand.*

Three key conditions are necessary for the emergence of inefficiencies: market incompleteness, the scarcity of safe assets, and the outcome of screening efforts varies across states. Each of these factors plays a critical role, and their implications will be discussed in detail next.

At the heart of this inefficiency is market incompleteness, which arises because agents cannot trade state-contingent contracts. When markets are complete, agents can trade contracts that pay off based on each possible state of the world, enabling them to fully internalize the value of their actions in every state. However, in incomplete markets, this flexibility is lost.



To illustrate this point, consider a simple example highlighting the difference between complete and incomplete markets in this setup:

$$\underbrace{q\mathbb{E}_{\hat{e}^i}\left[R\right]}_{\text{Incomplete markets}} \quad = \quad \underbrace{q_g\mathbb{E}_{\hat{e}^i}\left[R|\omega=g\right]+q_b\mathbb{E}_{\hat{e}^i}\left[R|\omega=b\right]}_{\text{Complete markets}}$$

where q_g and q_b represents the state-contingent prices for the good state and the bad state respectively. For instance, when agents assess how their expected screening effort influences the value of the claims, their decisions may deviate from the true economic value:

$$q\frac{\partial\mathbb{E}_{\hat{e}^i}\left[R\right]}{\hat{e}^i} \neq q_g\frac{\partial\mathbb{E}_{\hat{e}^i}\left[R|\omega=g\right]}{\hat{e}^i}+q_b\frac{\partial\mathbb{E}_{\hat{e}^i}\left[R|\omega=b\right]}{\hat{e}^i}$$

This discrepancy arises under the aforementioned two conditions: (i) when prices differ across states, $q_g \neq q_b$ and (ii) the outcome of screening efforts varies across states, i.e., $\frac{\partial\mathbb{E}_{\hat{e}}[R|g]}{\hat{e}^i}\frac{1}{\mathbb{E}_{\hat{e}^i}[R|g]} \neq \frac{\partial\mathbb{E}_{\hat{e}^i}[R|b]}{\hat{e}^i}\frac{1}{\mathbb{E}_{\hat{e}^i}[R|b]}$.

Condition (i) holds when safe assets are scarce and the safety premium is positive. The scarcity of safe assets implies that the value of an additional unit of resources in the bad state exceeds its value in the good state. This disparity arises because resources in the bad state directly contribute to the safe payoffs in the economy, which in turn determine the availability of safe assets that are in high demand. As a result, an extra unit of resources in the bad state alleviates the scarcity of safe assets by loosening the binding safe collateral constraint faced by bankers. [13]

[13]Note that the scarcity prevents the marginal rate of substitution across date/states and group of agents from equalizing hold which sets up the stage for inefficiencies to rise. As highlighted by Dávila and Korinek (2018), when the latter condition is met, even re-distributive externalities that are zero-sum across agents at a given date/state can have a welfare implication.

Condition (ii) holds because screening is relatively more effective during worse states of the world. Screening activity refers to bankers' investment in gathering soft information about loan applicants to identify and finance higher-quality firms and households, thereby reducing the proportion of bad borrowers in their loan portfolios. This aligns with the *cleansing effect* described by Caballero and Hammour (1991), which suggests that during recessions, bad firms are more likely to default than good firms. In such periods, maintaining a portfolio with a higher concentration of good firms becomes particularly valuable, as these firms are more resilient and better positioned to survive economic downturns. The screening technology assumed in this paper is consistent with this theory and supports a positive value for ϕ defined in Equation (5) .

Under these three conditions, the market mechanism fails to ensure that bankers fully internalize how their screening efforts impact the overall supply of safe assets. In particular, each banker's effort contributes to (a) increasing the expected return of both individual projects and the market portfolio, and (b) expanding the safe tranch — the fraction of safe payoffs relative to the total expected payoffs— only of the market portfolio. While bankers internalize effect (a), they fail to internalize effect (b). This misalignment between individual incentives and collective outcomes creates a free-rider problem: bankers rely on the costly screening effort of others to improve their safe collateral, and thus increase their issuance of profitable debt. By doing so, they benefit from the collective actions without bearing the full costs of screening themselves.

This inefficiency results in underinvestment in screening effort, or equivalently, in an inefficiently high level of diversification. The cause is that bankers underestimate the cost of diversification, this is, the benefit derived from screening effort. The direction of the inefficiency in the debt level depends on the relative strength of the two forces at play.

The described inefficiency is welfare-reducing and calls for policy intervention. Next, I will discuss the effectiveness of different policy tools in implementing constrained efficiency. Specifically, I have already shown that the market allocation lies below the efficient frontier, and I will now explore policy alternatives that could bring the market outcome to this frontier. However, the question of how to distribute the resulting welfare gains between savers and bankers—that is, determining which specific point on the efficient frontier to reach—is beyond the scope of this discussion. I will briefly note that policymakers can achieve a desired distribution by influencing relative prices. Recall that $\frac{W}{1-W} = q^s$, meaning that by transferring resources between savers and bankers at $t = 0$, policymakers can adjust relative prices accordingly.

5.1. Risk-retention policy

Given the impact of the inefficiency, it is natural to propose that policymakers should effectively require bankers to retain a higher fraction of their projects. This idea is formalized in the following proposition:

Proposition 3. *For a given q^s, policymakers should require bankers to retain a fraction s^{sp} of their project, as determined by Equation (16). This retention requirement decreases as the safety premium increases.*

Interpreting bankers' projects as pools of loans they have granted and their trading in the secondary market as part of the securitization process, this policy discussion offers fresh insights into recent initiatives targeting securitization within the broader context of the Capital Markets Union (CMU).

A key insight of the model is that financial intermediaries find it optimal to retain some skin-in-the-game for each loan they securitize provided that all risks are accurately reflected in the prices. By doing so, they signal the quality and risk level of these loans to outside investors, thereby limiting excessive declines in their price. This stands in stark contrast to the practices observed during the financial crisis, where many risks were overlooked and inadequately priced. In this regard, the model highlights the importance of simple, transparent, and standardized (STS) securitization markets—a new initiative aimed at enhancing investors' ability to perform due diligence and make informed assessments of the creditworthiness of securitization instruments, ultimately supporting the efficient pricing of these products.

However, the model demonstrates that even when an STS framework is perfectly implemented, there remains scope for additional policy intervention. Specifically, a risk-retention policy is necessary to enhance welfare and ensure that intermediaries fully internalize the costs of their actions. This aligns with recent regulatory initiatives requiring loan originators to retain a material net economic interest in the securitization of no less than 5%, with the object to improve their skin-in-the-game.

This model is not designed to offer a precise quantitative assessment of the optimal retention rate. However, it provides valuable qualitative insights for shaping policy design. Specifically, the findings suggest this micro-prudential rule should account for macroeconomic factors like the scarcity of safe assets. Hence, when securitization is primarily driven by the demand for safety, the optimal risk-retention rate should decrease as the safety premium rises, as indicated by Equation (16).

5.2. Capital regulation

Many paper in the literature underscore the key role of capital requirements in improving banks' skin-in-the-game and their incentives. In this setup, the capital ratio is k, which equals to $1 - q^s d$.

Proposition 4. *Capital regulation is ineffective in addressing the inefficiency.*

To understand why, note that when bankers sells safe claims to outside investors, the value of these claims is independent of sellers' screening activity. As a result, selling safe debt to savers does not directly undermine bankers' screening incentives. However, it does have an indirect effect: to ensure the safety of these claims, bankers must achieve a certain level of diversification. This is accomplished by selling riskier claims on their projects, ultimately leading to a moral hazard problem.

Crucially, the inefficiency arises not from the quantity of safe claims produced but from how they are produced. Specifically, the mix of diversification and screening effort is tilted in favor of diversification, from a social welfare perspective. Could a policymaker, however, indirectly address the inefficiency by limiting d through capital regulation?

In the case where savers inelastically allocate their resources to safe assets and the size of loan investment remains fixed, the capital ratio is exogenously determined in equilibrium, namely, $1 - q^s d = 1 - w$. However, even in a more flexible setting where capital regulation could directly target d and influence indirectly diversification incentives, this tool may still prove ineffective. As previously demonstrated, d is often too low from a social welfare standpoint. In those cases capital regulation cannot address the problem.

5.3. Public supply of safe assets

In this section, I analyze how the public supply of safe assets by the government or by central banks interacts with the private supply provided by bankers, as well as with the inefficiency present in the model. For simplicity, I will treat both sources of supply as perfect substitutes for savers, despite being produced differently.

The government has access to a storage technology that yields a unit return. It can issue d^G units of a safe bond at a price q^s and invest the proceeds in the storage technology. Additionally, the government has the ability to tax or transfer resources to agents, where a positive (negative) value of $t^i_{1\omega}$ represents a lump-sum transfer (tax) to agent $i \in \{\text{bankers}, \text{savers}\}$ at time $t = 1$.

The government's budget constraint is:

$$(q^s - 1)d^G = t^{\mathrm{i}}_{1\omega}$$

At time $t = 0$, the government invests $q^s d^G$ in its storage technology, which yields $q^s d^G$ at time $t = 1$. Since $q^s \geq 1$, it follows that $(q^s - 1) \geq 0$ and $t^i_{1\omega} \geq 0$. Without loss of generality, I assume that the transfer is directed to bankers and that savers purchase all the government bonds. Savers' demand for private safe debt is now given by:

$$d^d = \frac{w}{q^s} - d^G$$

While the public supply of safe debt shifts the demand curve for private safe assets downward, the banker's safety supply curve remains unaffected. The new equilibrium with the public supply is summarized in the following propositions.

Proposition 5. *The equilibrium depends on the demand for safe assets by savers and the supply of safe assets by the goverment, leading to two possible scenarios:*

1. ***Abundance of safe assets****: When the demand for safe assets is low* $\left(w \leq \underline{R} + d^G\right)$*, the equilibrium price of safe assets is* $q^s = 1$*. The equilibrium safe debt issued by bankers is* $d^R = w - d^G = d^* - d^G$*; there is no risk diversification; and the screening effort is set at the efficient level* $e^R = e^* = e^o$*.*

2. ***Scarcity of safe assets****: When the demand for safe assets is high* $(w > \underline{R})$*, the equilibrium price of safe assets is* $q^s = \frac{w}{d^R + d^G} > 1$*, where the equilibrium safe debt issued by bankers is* $d^R = \underline{R} + \left(P_b(e^R) - \underline{R}\right) s^R \lesseqgtr d^*$*; the optimal diversification level* $0 < s^R < s^*$ *is determined by Equation (16); and the screening effort* $e^* < e^R < e^o$ *determined by Equation (9).*

When safe assets are abundant, public debt has no impact on equilibrium allocations. This is because public bonds crowd out private debt on a one-to-one basis, leaving the total supply of safe assets in the economy unchanged. Additionally, the quality of private investment remains at its efficient level.

When safe assets are scarce, and bankers diversify their project risks to meet the high demand for safety, the earlier conclusion no longer applies. In this context, public debt increases the overall supply of safe assets, alleviating the scarcity and thereby reducing the safety premium. A lower safety premium diminishes bankers' incentives to diversify their project risks, as the profitability of expanding safe collateral to issue additional safe debt decreases. As a result, their skin-in-the-game increases, enhancing their screening efforts. Consequently, public debt leads to an improvement in the quality of private investment.

However, the effect of public debt on the amount of private debt is ambiguous due to the offsetting effects of reduced diversification and enhanced screening on the available safe collateral. If the negative impact of reduced diversification (crowd-out effect) outweighs the positive effect of higher screening quality (crowd-in effect), public debt crowds-out private debt. Conversely, if the positive contribution of improved screening quality (crowd-in effect) offsets the negative impact of lower diversification (crowd-out effect), public debt crowds-in private debt.

Proposition 6. *While public debt helps mitigate the welfare-reducing inefficiency, it does not fully eliminate it.*

What, then, is the welfare effect of public debt? The inefficiency described earlier becomes increasingly severe as the scarcity of safe assets grows. Public debt helps to alleviate this scarcity in the safe asset market, thereby mitigating the inefficiency. However, it does not completely resolve the issue as private safe assets continue to be produced inefficiently.

This model, however, cannot determine the optimal share of public and private safe assets. I have assumed that the government possesses superior technology to produce safe assets, meaning that a higher level of public debt will always improve welfare. However, I did not model the costs associated with this form of supply, so the analysis could lead to incorrect conclusions. The objective of this exercise, rather, was to understand the interplay between private and public supply of safety at an arbitrary level of public supply.

6. Conclusion

I study the determinants of private safe asset supply and their implications for financial stability. The paper examines the interaction between financial intermediaries' asset-side diversification activities, achieved through securitization, and the quality of their loan portfolios, shaped by their screening efforts. However, due to a moral hazard problem, securitization undermines loan quality. As a result, intermediaries must decide how to combine these two activities to create safe claims in the form of safe debt on the liability side. In the context of incomplete markets, I identify a free-rider problem: intermediaries fail to internalize how their effort influences the ability to generate safe assets through diversification, since the latter depends on the collective effort of all intermediaries. This underscores the role for policy intervention.

The policy discussion provides key insights into corrective policy tools, shedding light on current policy initiatives and debates. Specifically, a risk-retention policy is effective in restoring efficiency, and the paper outlines important considerations for its design. While capital regulation is ineffective for this purpose, the public supply of safe assets (e.g., government bonds) can help alleviate but not fully resolve the inefficiency.

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Mathematical Appendix

Proof of lemma 4.1

If bankers deviate from the safe collateral commitment level such that $d > \underline{R}\left(1-\tilde{s}\right) + P_b\left(\hat{e}^m\right)\tilde{b}$, where $\left\langle \tilde{s}, \tilde{b} \right\rangle$ represents the deviation from the committed trade values, savers may withdraw their funds. I need to prove that (i) savers have an incentive to withdraw if the banker fails to act as promised, and (ii) bankers prefer to comply with their promises rather than face withdrawals from savers.

Upon withdrawal, savers receive $q^s d$ and can reinvest the proceeds. Savers could choose to buy the market portfolio at a price $p\left(\hat{e}^m\right)$, but they only value the safe tranche of its expected payoffs. Alternatively, bankers, who have extra resources that they did not use to invest in loans, may face a profitable opportunity by buying the market portfolio and selling the safe tranche to savers at a price $\hat{q}^s$, ensuring $P_b\left(\hat{e}^m\right)b = d$. This strategy yields bankers with a net payoff of $\left(\hat{q}^s P_b\left(\hat{e}^m\right) - p\left(\hat{e}^m\right)\right)b$ at $t=0$, and an expected payoff of $\left(1-\pi_b\right)\left(P_g\left(\hat{e}^m\right) - P_b\left(\hat{e}^m\right)\right)$ at $t=1$. Given the equilibrium price $p\left(\hat{e}^m\right)$ established in Lemma (4.3), the net expected return of this strategy is positive for bankers if $\hat{q}^s \geq q^s$. If the inequality is strict, bankers would allocate all the unused endowment (not invested in their projects) to this strategy. However, since I assume bankers have deep pockets, in equilibrium, $\hat{q}^s = q^s$.

As a result, depositors will always withdraw their funds if bankers deviate from the committed safe collateral level, as they can still obtain the promised return of $\frac{1}{q^s}$ through alternative investments. Thus, if bankers deviate from their commitment, they must pay $q^s d$ instead of d. Given that in equilibrium $q^s \geq 1$, as shown in Proposition (1), then bankers have no incentives to deviate from their commitment.

Proof to lemma 4.2

The last decision at $t=0$ is to choose how much to sell and buy in the secondary market, and the rest of the variables are predetermined by then. Based on Lemma (4.1), bankers will always hold sufficient safe collateral to meet their debt obligations. However, they can adopt different trading strategies to achieve the required level of safe collateral. For instance, they could sell a higher fraction of their project and, in exchange, purchase individual claims from other bankers, b^{-i} as these claims have the same associated safe collateral. If they pursue this strategy, the expected return is given by:

$$\mathbb{E}_{\hat{e}^{-i}}\left[R\right]b^{-i}-\mathbb{E}_{\hat{e}^{i}}\left[R\right]s=\mathbb{E}_{\hat{e}^{-i}}\left[R\right]\frac{p\left(\hat{e}^{i}\right)}{p\left(\hat{e}^{-i}\right)}s-\mathbb{E}_{e^{i}}\left[R\right]s \tag{17}$$

Since the effort decision has already been made and aligns with actual effort, we have $e^i = \hat{e}^i$, which depend on the expected trade at that point, and not on the potential deviation we propose. Moreover, to ensure that bankers maintain the same level of safe collateral, they must satisfy $s \leq b^{-i}$, which is feasible as they can allocate additional resources if this strategy proves profitable.

A no-arbitrage condition requires that the expected return from this strategy be zero. This condition implies that $\frac{p\left(\hat{e}^{-i}\right)}{\mathbb{E}_{\hat{e}^{-i}}\left[R\right]}=\frac{p\left(\hat{e}^{i}\right)}{\mathbb{E}_{\hat{e}^{i}}\left[R\right]}$. As a result, the price function can be rewritten as:

$$p\left(\hat{e}\right)\equiv q\mathbb{E}_{\hat{e}}\left[R\right]$$

This pricing rule eliminates arbitrage opportunities, ensuring that such trades do not occur in equilibrium. Consequently, bankers do not allocate additional resources to secondary market trading. This further implies that $q\mathbb{E}_{\hat{e}}\left[R\right]s=q\mathbb{E}_{\hat{e}^{m}}\left[R\right]b$, and given that the safe collateral must equal the promised one, it follows that $s=\hat{s}$ and $b=\hat{b}$.

Proof to lemma 4.3

Under commitment (proven in Lemma (4.1) and Lemma (4.2), the optimal trade strategy is determined as if jointly with the debt level, before the screening decision. The Langrangian of the problem is given by

$$\begin{aligned}\mathcal{L}\ =&\mathbb{E}_{e^{i}}\left[R\right]-c\left(e^{i}\right)-1-\left(\mathbb{E}_{e^{i}}\left[R\right]-p\left(\hat{e}^{i}\right)\right)s+\left(\mathbb{E}\left[P\left(\hat{e}^{m}\right)\right]-p\left(\hat{e}^{m}\right)\right)b-(1-q^{s})d\\&-\mu\left[d-\underline{R}\times(1-s)-P_{b}\left(\hat{e}^{m}\right)b\right]\end{aligned}$$

The Kuhn-tucker conditions are given by

$$\begin{aligned}d:&\qquad -1+q^{s}-\mu\leq 0\\s:&\quad -\mathbb{E}_{e^{i}}\left[R\right]+p\left(\hat{e}^{i}\right)-\left(\frac{\partial p\left(\hat{e}^{i}\right)}{\partial\hat{e}^{i}}\right)\times\left(-\frac{\partial\hat{e}^{i}}{\partial s}\right)s-\mu\underline{R}\lesseqgtr 0\\b:&\qquad \mathbb{E}\left[P\left(\hat{e}^{m}\right)\right]+\mu P_{b}\left(\hat{e}^{m}\right)-p(\hat{e}^{m})\leq 0\\&\mu\geq 0\text{ and }\mu\left[d-\underline{R}\times(1-\hat{s})-P_{b}(\hat{e})\hat{b}\right]=0\end{aligned}$$

Second order conditions hold. The first-order condition for debt holds with equality when $q^s \geq 1$, and this condition prevails in equilibrium since all agents would prefer to invest in safe assets otherwise. Then, the Lagrangian multiplier of the safe collateral constraint, $\mu = q^s - 1$. When $q^s = 1$, the safe collateral constraint is not binding and bankers are indifferent with the amount of debt issuance. When $q^s > 1$, the safe collateral constraint is binding, and the amount of safe collateral delimits the amount of debt issuance.

Bankers optimally set $s = 0$ when $p\left(\hat{e}^i\right) \leq \mathbb{E}_{e^i}\left[R\right]$, and $s > 0$ if:

$$p(\hat{e}) \geq \mathbb{E}_{e^i}\left[R\right] + (q^s - 1)\underline{R} + \left(\frac{\partial p\left(\hat{e}^i\right)}{\partial \hat{e}^i}\right) \times \left(-\frac{\partial \hat{e}^i}{\partial s}\right) s$$

The price must be higher than its expected return to cover the direct and indirect cost of selling risky financial claims on their project; this is, the direct negative effect on the safe collateral (only when $\mu > 0$), and the negative indirect effect on the price due to the moral hazard problem. When the latter equation holds with equality, s is determined by that equation, otherwise $s = 1$.

Bankers will invest in the market portfolio if the following holds:

$$p\left(\hat{e}^m\right) \leq \mathbb{E}\left[P\left(\hat{e}^m\right)\right] + (q^s - 1)P_b\left(\hat{e}^m\right)$$

Hence, the price could be lower than the expected return of the claim when $\mu > 0$ as the market portfolio relaxes the binding safe collateral constraint.

In equilibrium, the price in the securities market $p(e)$ is such that $s = b$. In addition, in a symmetric equilibrium $e = e^i = e^{-i}$. Hence:

$$p\left(e^m\right) = \mathbb{E}_{\hat{e}^m}\left[R\right] + (q^s - 1)P_b\left(e^m\right)$$

Otherwise, if the price is smaller then $b > 0$ and $s = 0$ (in equilibrium $e^i = e^{-i} = \hat{e}^i$), and if the price is bigger then $b = 0$ and $s > 0$. Combining with lemma 4.2, which states that $p(e) = q\mathbb{E}_{\hat{e}^m}\left[R\right]$, the equilibrium market discount factor:

$$q \;=\; q^s \kappa\left(\hat{e}^m\right) \;+\; \left(1 - \kappa\left(e^m\right)\right)$$

where $\kappa\left(\hat{e}^m\right) \equiv \frac{P_b(\hat{e}^m)}{\mathbb{E}[P(\hat{e}^m)]}$, where $\hat{e}^m$ captures the collective effort level, which is taken as given by bankers.

Proof to lemma 4.4

In equilibrium, the prices of safe claims, q^s, must ensure that the demand equates the supply.

Demand by savers: savers invest all their resources into safe claims. Hence, $w = q^s d^d$. Hence, the demand as a function of the price, $d^d = \frac{w}{q^s}$, where $\frac{\partial d^d}{\partial q^s} < 0$.

Supply by bankers: In a symmetric equilibrium $e = e^i = e^{-i}$, and taking the equilibrium condition in the securities market $s = b$ into account, the safe collateral constraint can be written as $d \leq \underline{R}(1-s) + P_b(e)s$. Bankers' supply schedule change with the price range:

(i) If $q^s < 1$, bankers do not have incentives to issue safe debt as they make a loss doing so. Hence, $d^* = 0$ and $s^* = 0$. Then, inside equity $k^* = 1$ and screening effort is set at the efficient level $e^* = e^o$.

(ii) If $q^s = 1$, the safe collateral constraint is not binding and $s^* = 0$. The supply is elastic up to the point $\underline{R}$. Then, inside equity $k^* = 1 - d^* \in [0,1]$ and screening effort is set at the efficient level $e^* = e^o$.

(iii) If $q^s > 1$, then the safe collateral constraint is binding, $d = \underline{R}(1-s) + P_b(e)s$, where s is determined:

$$\mathcal{H} = (q^s - 1)\left(P_b(e) - \underline{R} - \kappa(e)\frac{\pi_b^2\left(\overline{R} - \underline{R}\right)^2 s}{c''(e)}\right) - \left(\frac{\pi_b^2\left(\overline{R} - \underline{R}\right)^2 s}{c''(e)}\right) = 0$$

where $e = e^*(s)$ determined in equation (9).

Then, the supply of safe claims, $d^s = \underline{R}(1-s) + P_b(e)s$, as a function of q^s :

$$\frac{dd^s}{dq^s} = \left[\frac{\partial d^s}{\partial s} + \frac{\partial d^s}{\partial e}\frac{\partial e}{\partial s}\right]\frac{ds}{dq^s} = \left[P_b(e) - \underline{R} - \frac{\partial P_b(e)}{\partial e}s\left(-\frac{\partial e^*(e)}{\partial s}\right)\right]\frac{ds}{dq^s}$$

where $\frac{ds}{dq^s} = -\frac{\mathcal{H}_{q^s}}{\mathcal{H}_s + \mathcal{H}_e\frac{\partial e^*}{\partial s}} > 0$ since

$$\mathcal{H}_s < 0, \mathcal{H}_{q^s} > 0, \mathcal{H}_e\frac{\partial e^e}{\partial s} = (q^s - 1)\left(\frac{\partial P_b(e)}{\partial e} - \frac{\partial \kappa(e)}{\partial e}\mathbb{E}_e[R]\underbrace{\frac{\pi_b^2\left(\overline{R} - \underline{R}\right)^2 s}{c''(e)\mathbb{E}_e[R]}}_{\text{from FOC} <1}\right)\frac{\partial e^e}{\partial s} < 0$$

The term in brackets in $\frac{dd^s}{dq^s}$ is positive or negative depending on:

$$(q^s - 1)(1 - \kappa(e)\pi_b) \lesseqgtr \pi_b$$

If the condition holds with $<$ then $\frac{dd^s}{dq^s} > 0$, and if $>$ then $\frac{dd^s}{dq^s} < 0$.

Proof to Proposition 1.

If $q^s = 1$, then the demand for safe assets $d = w$. In this scenario, bankers lack incentives to diversify their asset portfolios, thus, $s^* = 0$. Consequently , $q^s = 1$ can prevail in equilibrium only if bankers' safe collateral without diversification, is sufficient to meet the demand at that price. This condition is satisfied when $w \le \underline{R}$. Otherwise, $q^s > 1$ must hold.

Proof to Proposition 2.

$$\mathcal{L}^{sp} \quad = Wd + (1 - W)\left[\mathbb{E}_{e^*}\left[R\right] - c(e^*) - d\right] - \mu^{sp}\left[d - \underline{R} \times (1 - s) - P_b(e^*)\, b\right]$$

The Kuhn-tucker conditions are given by

$$\begin{aligned}
d: & \qquad W - (1 - W) - \mu^{sp} \le 0 \\
s: & \quad \mu^{sp}\left(P_b(e) - \underline{R} - \frac{\partial P_b(e)}{\partial e}s\left(-\frac{\partial e^*}{\partial s}\right)\right) - (1 - W)\frac{\partial\left(\mathbb{E}_{e^*}\left[R\right] - c(e^*)\right)}{\partial e}\left(-\frac{\partial e^*}{\partial s}\right) \lesseqgtr 0 \\
& \qquad \mu^{sp} \ge 0 \text{ and } \mu^{sp}\left[d - \underline{R} \times (1 - s) - P_b(e)\, b\right] = 0
\end{aligned}$$

Hence, when the constraint is binding, $\mu^{sp} > 0$:

$$\begin{aligned}
&\left(\frac{W - (1 - W)}{(1 - W)}\right)\left(P_b(e) - \underline{R} - \kappa(e)\frac{\partial \mathbb{E}_e\left[R\right]}{\partial e}\left(-\frac{\partial e^*}{\partial s}\right)\right) - \frac{\partial\left(\mathbb{E}_{e^*}\left[R\right] - c(e^*)\right)}{\partial e}\left(-\frac{\partial e^*}{\partial s}\right) \\
&- \underbrace{\left(\frac{W - (1 - W)}{(1 - W)}\right)\left(\frac{\partial P_b(e)}{\partial e}s - \kappa(e)\frac{\partial \mathbb{E}_e\left[R\right]}{\partial e}\right)\left(-\frac{\partial e^*}{\partial s}\right)}_{\equiv \phi > 0} = 0
\end{aligned}$$

Since $\phi > 0$, a wedge arises between the social cost and the private cost of diversification. Specifically, bankers underestimate the cost of diversification, leading to a diversification level that exceeds the social optimum , $s^{SP} < s^*$. As a result, the screening effort exerted by bankers is suboptimal, $e^*\left(s^{SP}\right) > e^*(s^*)$. The effect of on d depends on which of the opposing effects dominates.

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