# Coexistence of Banks and Non-Banks: Intermediation Functions and Strategies*

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**Abstract**

What is the essence of non-bank financial intermediation? How does it emerge and interact with intermediation performed by banks? To investigate these questions, we develop a *model-based survey*: we classify existing models into different intermediation functions à la Merton (1995) to show that variations of them admit a common modeling structure; then, we extend or reinterpret the resulting models to connect equilibrium strategies to non-bank activities in practice. Particular emphasis is placed on the coexistence of banks and non-banks: how their competition, or the extent of cooperation through contractual arrangements, varies across intermediation functions. Through this approach we speak to a variety of entities such as traditional banks, open-end funds, special purpose vehicles, private credit entities, and fintech lenders. We also discuss innovation, regulation, and market liquidity as drivers of non-bank activities.

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# 1 Introduction

The term non-bank financial institution (NBFI) is used to refer to a range of financial institutions—fintech companies, open-end funds, hedge funds, insurance companies, private debt providers, special purpose vehicles, among others—that provide a wide variety of financial intermediation services. The NBFI sector as a whole has grown at a remarkable pace over the last twenty years, becoming important providers of financial intermediation services worldwide. For example, the left-hand panel of Figure 1 shows that, in recent years, NBFIs' global assets have averaged a growth rate of 9 percent higher than banks'; in turn, the right-hand panel shows that the NBFI share of total global financial assets has increased at the expense of the bank share.

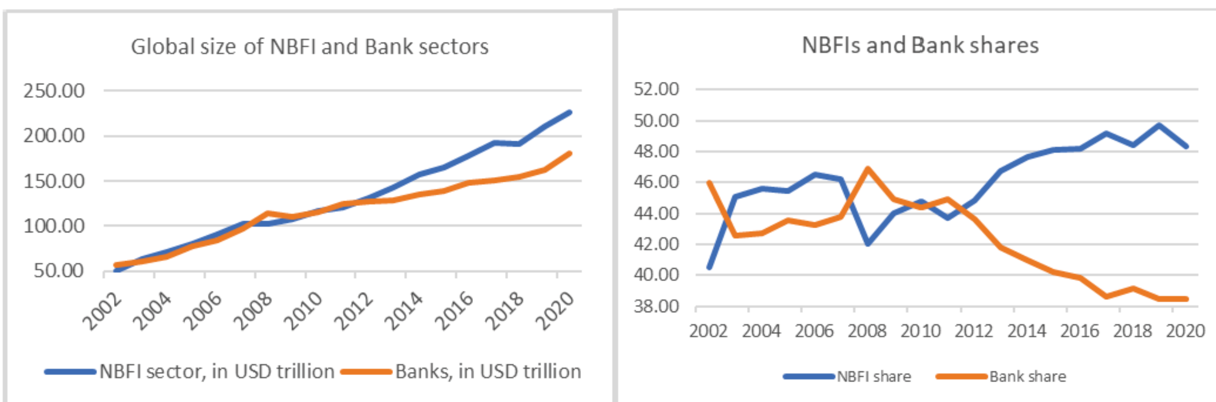


Figure 1: The left panel reports the global size of the NBFI and banking sectors, in trillions of U.S. dollars. The right panel reports the size of the two sectors as a share of aggregate global financial assets, which also includes the assets of central banks and public financial institutions. *Source*: 2021 Global Monitoring Report of Non-Bank Financial Intermediation, Financial Stability Board.

The vast heterogeneity of the NBFI sector is also reflected in a broad literature delving into the specifics of each individual NBFI segment: for instance, Khanna and Mathews (2022) on venture capital investors; Donaldson et al. (2021) on staged financing; Liran et al. (2020) on insurance companies; Gennaioli et al. (2013) on securitized assets; among others. Such an *entity-based approach* to examining NBFIs has merits, as it allows for a deep analysis of the institutional characteristics unique to each segment. But it also has limits. First, by emphasizing specificity, an entity-based approach may miss out on *commonalities* across entity types: for instance, mutual funds are vehicles that facilitate agents' financial investment needs, but if they are structured as open-ended, they also closely resemble banks as providers of deposit-like instruments (see FSB, 2023); likewise, insurance companies sell products to manage risks in specific states of the world, but insurers that sell variable annuities closely resemble mutual funds (Koijen and Yogo, 2021). Second, such an approach is inherently static, as it takes the *current* organizational forms as the starting point of analysis—however, it is widely recognized that the boundaries and activities of both financial sectors and entities morph due to competition, innovation, and regulation.[1] Third, focusing on capturing details of specific entities may make it more difficult to examine the *coexistence* of different types of entities.

In this paper, we move away from organizational forms as the starting point of analysis to better understand the essence of some key forms of non-bank intermediation; draw parallels and conclusions across them; identify the drivers behind their emergence and growth; and further investigate their interaction with banks. Concretely, rather than beginning with entities as the primitive object of study, we take a *function-based approach* to intermediation based on Merton (1995): what intermediaries ultimately do is to carry out, through optimal 'strategies', a set of fundamental 'functions' that are valued in the economy, with the observed organizational forms—the actual entities—only emerging as outcome variables that reflect optimal institutional arrangements given the environment faced. Through our approach, we can speak to a variety of non-bank-driven forms of financial intermediation that are observed in practice, and we can examine the role of key environmental changes across functions—thus providing a more holistic view of the NBFI ecosystem, and without the need for major changes in the modeling toolkit.

Concretely, we examine three intermediation functions where we believe non-banks play a major role. Using the terminology in Merton (1995), these correspond to the *transfer* of resources across time and space; the provision of *safety*; and the management of *incentive* problems. (A fourth function of *pooling* funds to be lent to enterprises is, to varying degrees, implicit in all of them.) To operationalize this approach in an intuitive and familiar way, we leverage important existing work on certain types of NBFIs that we classify according to the function each speaks to. In other words, we integrate existing theories under the umbrella of a set of general intermediation functions.

At a technical level, the novelty of our work lies along three dimensions. First, we show that the models examined admit a simple common structure—such a structure can be cast in the form of a "core game tree"—that can be specialized to each of the functions analyzed.[2] Second, within each function (i.e., within each specialized game tree), we solve

[1] For instance, Cetorelli and Prazad (2024) document the progressive expansion of banks into non-bank activities over the years and, conversely, Gorton and Metrick (2012), and Cetorelli (2014) stress that NBFIs have engaged in activities traditionally performed by banks.

[2] Generic descriptions of this kind are standard in finance. See, for example, Duffie (2001) in asset pricing.

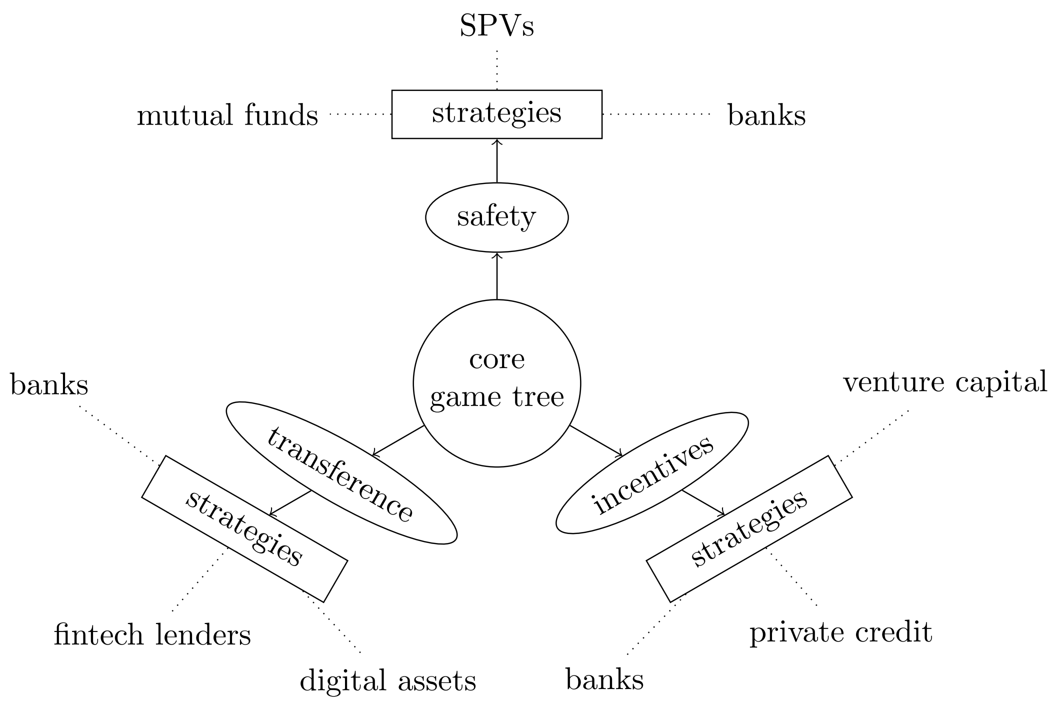


Figure 2: Overview of our approach: we specialize the core tree to functions, from where we derive strategies, that we ultimately map to financial entities. SPV stands for Special Purpose Vehicle.

for intermediaries' optimal strategies: contingency plans that capture how intermediaries fulfill the function in equilibrium given the economic environment faced. Third, we map all identified equilibrium strategies to entity types that resemble their closest analogs in the real world. Figure 2 provides a schematic illustration of our approach, as we go from a common analytical structure (the core game tree at the center) to each separate function (second layer) and, through the identification of optimal strategies (third layer), ending in real-world NBFI types. Moreover, we are able to identify economic *drivers* of the emergence—and growth—of each equilibrium strategy (and thus of the corresponding entities).

At a conceptual level, this approach allows us to reinterpret, modify, and even extend existing models to rationalize observed trends in the NBFI ecosystem, and characterize some aspects of its potential evolution. Particular emphasis is given to the question of *coexistence between banks and non-banks*: that is, how the competitive-cooperative relationship between such entities plays out across different functions. This is particularly important because any study of a non-entity (i.e., a non-bank) is inherently linked to the existence of an original, primitive, entity (i.e., a bank).

**Functions analyzed and findings** Section 2 revisits the functions introduced by Merton (1995) and lays out the core tree that we specialize throughout the analysis. We then begin our analysis in Section 3 by presenting a version of the warehouse banking model developed by Donaldson et al. (2018). This is a good starting point from a historical perspective because it speaks to the role of financial intermediaries in their early stages: institutions where commodities could be stored either for future production or consumption, thus fulfilling the first of Merton's functions, the transfer of resources across space and time.

More importantly, this form of proto-banking has great conceptual value when it comes to more modern non-banks. Indeed, the optimal strategy that emerges here incorporates a variety of characteristics that we see nowadays in certain non-banks—albeit in a more specialized form—while also uncovering key *drivers* that have fueled the development of such entities. In the latter category, the availability of superior technology for storage was key for the emergence of this form of intermediation. But this was not enough, because repayment problems stemming from the non-pledgeability of assets had to be controlled; in turn, interbank markets facilitated the management of such incentives, ultimately yielding superior outcomes. In other words, the role of *innovation* was a key driver of this strategy, in that it provided a notion of *safety* to investors; but inevitably *incentive problems* emerged, which could be counteracted through the presence of *liquid markets*. Thus, this early form of intermediation in fact had great complexity, featuring key factors that are present in more modern (and specialized) versions of non-banks, and that will transpire throughout our subsequent analysis—to which we also add the important role of government regulation.[3]

Section 4 examines the provision of safe assets by intermediaries as demanded by investors. Here, we build on the model by Hanson et al. (2015) which examines the coexistence of intermediaries who, to generate safe liabilities, can use two types of strategies: (i) hold to maturity assets that are backed by government insurance or (ii) liquidate the assets backing their claims in the secondary market at an early stage. By virtue of the role government insurance plays, the first strategy can naturally map to modern banking institutions, while the early liquidation strategy can be associated with mutual funds, among others.

A key takeaway from our analysis in this section is that the lines between these two types of strategies and the players involved in them have blurred over time. Concretely, we provide examples of governmental actions that have favored secondary market liquidity, thereby (indirectly) supporting the profitability of non-bank business models that rely on early liquidation. Conversely, we discuss the role of banks in providing de facto insurance

[3] Given how banks look today, the proto-"bank" that emerges in equilibrium in this model is perhaps closer to *non*-banks. More generally, the optimal strategy that arises here can be implemented by a variety of entities that we could currently identify as either banks or non-banks.

to non-banks through the provision of credit lines, thus facilitating certain non-banks the ability to pursue strategies that hold assets to maturity.

In Section 5, we augment the previous model to encompass *securitization* as a third safe strategy: pooling and tranching as a way to eliminate idiosyncratic risk and provide payments with certainty to those holding senior tranches of the resulting security—those payments that accrue in bad states of the world, which can be non-trivial due to the pooling at play. Absent mechanical costs to implement this strategy, securitization dominates the insurance-based counterpart. Its comparison with the early liquidation strategy, however, is more subtle: it depends not only on the liquidity of secondary markets, but also on the type of uncertainty that investors can face. Indeed, by enriching the model of uncertainty used by Hanson et al. (2015), we can show that securitization is favored when the economy perceived to have limited downside risk across states of the world—such as before the Great Financial Crisis (GFC)—while early liquidation strategies can be more profitable when these downsides exhibit more variability—post GFC, for example. Indeed, if such states are not distinguishable early on, firesale discounts may be less pronounced because they price the possibility of being in a good, but slowly unfolding, state of the world. Thus, we can provide a new explanation for the rapid growth and subsequent decline of securitization that is based on changes in perceived *macroeconomic conditions*—another manifestation of intermediation being dynamic and mutable, with specific entities bound to wax and wane over time.

Finally, Section 6 examines the incentive management function through the lens of the staged-financing model of Donaldson et al. (2021). In their setup, intermediaries provide funds to enterprises that cannot start their businesses otherwise, but entrepreneurs need to be incentivized to make their ventures succeed. A key insight there is that high funding costs can endow an intermediary with a strategic advantage: the threat of discontinuing funding becomes more credible, and such a threat can discipline entrepreneurs into exerting effort.

We perform two exercises in a version of their model that suits our needs. First, we obtain a simple *coexistence* result through the use of a mixed-strategy equilibrium in its population-interpretation form. In the game constructed, ex ante homogeneous intermediaries choose between high and low funding costs, while ex ante homogeneous entrepreneurs choose between projects with high and low agency costs: the weights in the mixed-strategy profile capture the (stable) fraction of agents choosing either strategy when encounters are random but dictated by the masses of agents that select themselves into the strategies—just like in more sophisticated random search model models. In other words, banks and non-banks emerge from purely competitive forces in this setup.

Our second exercise obtains an important result of a more cooperative flavor: a contractual arrangement between banks and non-banks that is mutually beneficial. Concretely, we identify parameters such that intermediaries operating with low funding costs—"banks"—find it profitable to lend funds to those operating with high funding costs—"non-banks"—who in turn channel funds to projects with high agency costs: in other words, a vertical relationship can arise, with banks helping non-banks in segments that neither banks nor non-banks individually would be willing to serve absent this relationship. We link this form of interconnection to two phenomena in practice. First, we argue that it resembles contractual arrangements observed in certain segments of the private credit market and, more generally, that is consistent with Acharya et al. (2024) who document a strong reliance on banks by non-banks in obtaining funding. Second, we examine the role of *interest rate regime switches* in favoring the competitive or cooperative forces just described: for example, reductions in interest rates can make the environment more competitive by both undermining banks' ability to manage risky projects *and* steering investors searching for yield towards funding non-banks.

Finally, in Section 7, we conclude by discussing our work's broad takeaways and how it can be leveraged going forward: in the policy domain, for instance, towards assessing the hypothetical expansion of the role of central banks as lenders of last resort; in financial stability, towards assessing systemic risk from amplification effects of interlinked or competing intermediation strategies; and in research, towards a fuller understanding of how banks and non-banks both compete and cooperate in a variety of industries.

**Related literature** The functional approach introduced by Merton (1995) is revisited in Section 2—see also Merton and Bodie (1995). Hanson et al. (2015) implicitly follow this approach by assuming an ex ante homogeneous group of financial intermediaries who select themselves into different intermediary strategies. In the policy domain, this functional perspective is at the heart of the *congruent principle of financial regulation* proposed by Metrick and Tarullo (2021), who argue that economically similar activities should be regulated similarly regardless of "legal form, chartering identity, or business model". Likewise, the Financial Stability Board (FSB) has highlighted the advantages of this approach in its monitoring reports, further arguing that the entity-based approach complicates "the evaluation of regulations that do or should apply to" NBFIs (FSB, 2013). In a similar vein, the Nobel committee for the Economics Prize of 2022 opined that "As changes in technology and regulation lead to new types of institutions entering financial markets, competing with or even replacing traditional banks, these new actors still perform the same fundamental functions and are subject to the same underlying fragilities" (Economic Sciences Prize Committee, 2022). Other important surveys on financial intermediation that instead follow an entity approach are Bhattacharya and Thakor (1993) and Gorton and Winton (2003).[4]

Regarding our findings, alternative explanations for the growth of securitization include regulatory arbitrage (Schneider et al., 2023), reduced bank charter value from non-bank competition (Gorton and Metrick, 2012), and the neglected risk hypothesis (Gennaioli et al., 2015) around the financial crisis; instead, we focus on the type of long-term uncertainty faced by investors. On the growth of market-based early liquidation strategies, the rise of money market mutual funds (MMMFs) in the US in the 1970s is usually attributed to banks being unable to offer sufficiently high deposit rates due to regulatory restrictions when nominal interest rates were rising; instead, we highlight the liquidity of money market instruments and the development of a national market for residential mortgages. Our finding that innovations favor non-banks is consistent with recent evidence by Lerner et al. (2023) based on financial patents granted between 2000 and 2018 showing that information technology firms have innovated more than banks. Finally, on the rapid growth of private credit, Fritsch et al. (2022) point to a greater availability of capital while Erel and Inozemtsev (2024) emphasize the role of regulatory factors; instead, we argue that banks may play an important role in this growth, and that both banks and non-banks can engage in similar forms of relationship lending (see also Jang, 2024).

Finally, our analysis places special emphasis on the question of coexistence between banks and non-banks: how they both compete *and* collaborate via contractual arrangements. By comparison, the literature emphasizes one versus the other. With regard to private credit provision, Hanson et al. (2024) emphasize competition between banks and private credit firms, stating that "banks play no role whatsoever with respect to loans made by private credit funds and BDCs [Business Development Corporations]." On the other hand, Acharya et al. (2024) document how banks provide credit lines to private credit firms, which our model captures. Xu (2025) shows how both banks and non-banks benefit from these funding relationships, and thereby make the system more resilient. Other papers allow for the coexistence between banks and specific types of NBFIs, such as conglomerates (e.g., Bond, 2004), shadow banks (e.g., Hanson et al., 2015), and venture capitalists (e.g., Ueda, 2004).

[4] Allen and Santomero (1996) provide a critique of theories of intermediation and state that "Institutions have come and gone, evolved and changed, but functional needs persist while packaged differently and delivered in substantially different ways."

# 2 Functions and Strategies and the Core Game Tree Approach

The traditional approach to examining financial intermediation consists of grouping entities (e.g., banks, broker-dealers, finance companies) into "sectors" that are assumed to carry on similar types of activities over time. Unfortunately, the boundaries between organizational entities and activities is fluid (e.g., Borio et al., 2022) with different entities sometimes providing similar services. For example, modern banks are increasingly engaged in a variety of services usually perceived as "non-bank" activities, such as underwriting loan issuances, warehousing and servicing the loans, and providing insurance. Likewise, non-bank entities have been engaging in bank-type strategies: for example, money market funds provide uninsured deposits, while private credit firms lend to corporations.

With increasingly blurred boundaries, the organizational approach to financial intermediation becomes less effective as a tool for understanding the evolution of financial institutions: this is because it takes the *institution or legal form* of entities as the primitive object of study. This limitation is accentuated by the fact that a financial intermediary may provide an array of complex services (e.g., Bhattacharya and Thakor, 1993) which limits one's ability to precisely identify entities with defined activities. Instead, a *functional* perspective that considers economic functions fulfilling a primitive need is more appropriate as a unit of analysis. This is a point made by Merton (1995), who argues that financial/economic functions tend to be more stable than financial institutions, with the observed entities simply reflecting the best institutional structures to carry out those functions given economic conditions (e.g., competitive landscape, current technology, regulatory environment).

This view is permeating regulatory domains too, precisely in the context of NBFIs: the Financial Stability Board (FSB) has highlighted the advantages of this approach in its monitoring reports, arguing that the entity-based approach complicates "the evaluation of regulations that do or should apply to" NBFIs (FSB, 2013).

## 2.1 Merton's Functional Approach Revisited

Merton (1995) identifies six core functions that financial intermediaries perform—we list them below, highlighting in boldface the terminology that we adopt when referring to them. Concretely, a financial system provides:

1. A way to transfer resources over time and across space, or **transference**.

2. A way to manage uncertainty and control risk, or **safety**.

3. A way to deal with incentive problems arising from asymmetric information and moral hazard, or **incentive management**.

4. A way to pool of funds to undertake large-scale enterprises, or **investment**.

5. A way to exchange goods and services, or **payment systems**.

6. A way to coordinate decentralized decision-making across the economy, or **price information**.

In what follows, we examine stylized models depicting and analyzing optimal strategies to fulfill functions 1–4. We choose to focus on this subset of Merton's functions because they are more closely related to what is usually understood as core financial intermediation activities: namely, the provision of liquidity and credit services, where non-banks play a central role. On the other hand, payment systems and price information are usually analyzed separately—partly because of their great relevance, and partly because additional modeling tools are usually needed. For these reasons, we have chosen to not focus on these functions.

## 2.2 The Core Game Tree Representation

The provision of credit and liquidity services normally implies decision-making involving risk and uncertainty. Consequently, we propose to represent each intermediation function through a common, core game tree structure. Hence, for each function there will be an "event tree" encoding the economic environment in which agents participate: a representation of how uncertainty and/or decisions associated with an *asset or project* unfold over time. Importantly, while all the trees examined are specialized to capture key features of the function of interest, they all have a simple and common structure. Concretely, up to small variations, they can be represented as three-period trees like in Figure 3.

In the diagram, the variable $P_t$ denotes the agent who moves at time $t \in \{1, 2, 3\}$: examples are a financial intermediary, an entrepreneur who owns a project, or Nature that determines the realization of ex ante uncertain payoffs. The trees can be decision problems, in which case the players are Nature and only one additional agent; or games, in which there at least two agents different from Nature who can make decisions. These trees have a common structure. First, there is an upper branch associated with less uncertain and/or higher payoffs: say, an asset delivers a high payoff early on in the interaction, captured by the 'success' arm of the tree. Second, there is a lower branch where payoffs can be lower and/or less certain, and that may entail other non-trivial choices: for instance, after a project does not succeed at $t = 1$, a financial intermediary may choose to continue providing

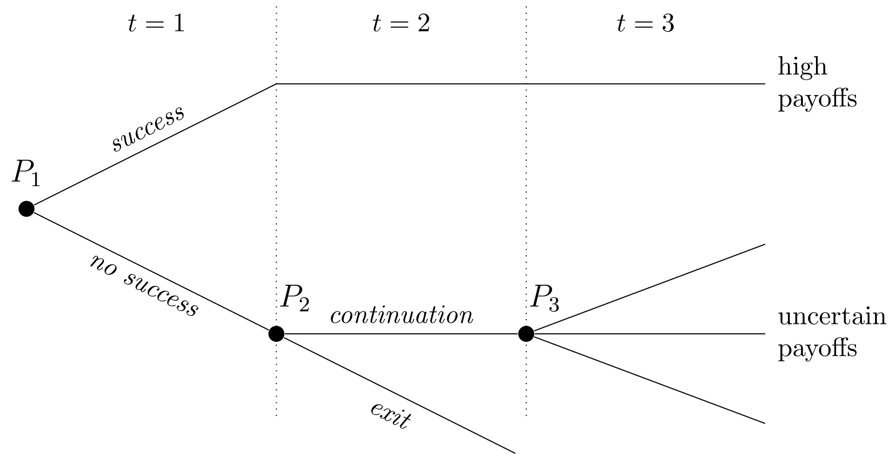


Figure 3: Typical Game Tree

funding (continuation decision) or to irreversibly stop it (exit option). For each function, the associated tree provides concrete meaning to these actions and their corresponding payoffs—the examples to follow will make this clear. Importantly, we note that even when not depicted as explicit players, intermediaries still play a key role through the design of the tree itself: they can influence the economic environment, say, by choosing payoffs that induce desired behavior (see Section 3).

In such a setup, the key outcome variables are the *strategies* chosen by financial intermediaries, understood as contingency plans specifying actions at all suitable decision nodes given the information available. In equilibrium, the strategies of the players other than Nature must maximize expected profits given their counterparties' strategies (in the case of Nature, the probabilities with which payoffs unfold, that are known to our players; hence taken as given). Given equilibrium strategies, we can evaluate their properties vis-á-vis financial activities observed in practice, thus enabling us to establish a link with organizational forms. This closes the loop: from core functions encoding primitive needs, we obtain the strategies that implements these functions; and from these strategies we can move towards the organizational forms that implement their closest analogs, hence fulfilling the primitive needs.[5]

[5]Borio et al. (2022) makes a similar point in the context of regulation: while economic functions may be a solid conceptual basis for financial intermediation, they are too abstract for regulatory purposes. Instead, focusing on activities (here, strategies), is a more natural "entry point" for regulators.

# 3 Provision of Warehousing Services

Warehouse banking is our first application. Warehouses were proto-bank financial institutions that stored goods safely and wrote receipts against them, analogous to custody and deposit-taking in modern banks. In doing so, warehouses facilitated the transfer of resources across time and across space and provided safe storage. In addition, warehouses managed the problem of incentivizing borrowers to repay their debt. Further, the receipts they issued served as private money (Gorton, 2017).[6] Thus, these institutions engaged in all five functions: transfer, safety, investment, incentive management, and payments.

We start with warehouse banking because it is a primitive form of financial intermediation from a historical viewpoint. In its simplicity, the intermediation strategies that emerge as optimal are "organizationally neutral", in the sense that there is no obvious mapping to what one would consider, in a modern sense, either a "bank" or a "non-bank"—thus, this is a natural entry point for our proposed approach. Moreover, it will allow us to identify basic characteristics of such primitive intermediaries that will reappear in our subsequent analysis.

## 3.1 A Model of Warehouse Financing

Consider Figure 4 which depicts a simplification of the warehouse financing model of Donaldson et al. (2018). In the model, there are warehouses ($W$) and farmers ($F$). Farmers can produce a commodity good according to a technology $R(\cdot)$, which is strictly increasing and concave. As an input, they can use their endowment $e > 0$ and borrow funds from the warehouses—for simplicity, if a farmer borrows $B$, it can produce at most $R(e + B)$ units of the good.

There are two frictions in the model. First, entrepreneurs want to consume at a date later than when production takes place. Thus, they must store the good produced. If they store the good privately, there is stochastic depreciation: with probability $\epsilon$, the good is destroyed—this is the 'autarchy' branch along which nature moves to determine the final amount of good available for consumption. The second friction is that output is not pledgeable to warehouses. This means that farmers cannot be forced to repay their debt along the autarchy branch, so they end up consuming the full amount $R(e + B)$.

The advantage of warehouses is that they have a superior storage technology, which is assumed riskless for simplicity. This technology becomes a strategic advantage: if storage

[6] For example, in early modern Europe, goldsmith bankers provided superior safes for storing money and plates in trust while tobacco warehouses were instrumental in the creation of banking and payments in eighteenth-century Virginia, where warehouse receipts were ultimately made legal tender. Later, in the nineteenth century, granaries were doing banking in Chicago.

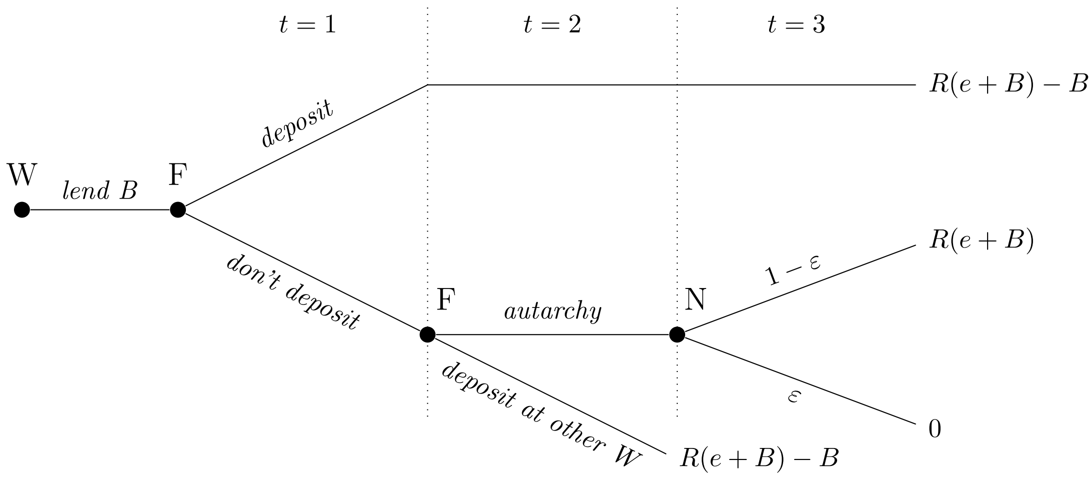


Figure 4: A Model of Warehouse Financing (W: Warehouse, F: Farmer)

with a warehouse occurs, the warehouse takes possession of the asset and thus can enforce repayment, potentially eliminating the pledgeability problem. In this case, the farmer consumes its output net of repayment, or $R(e + B) - B$, which is the payoff in the top branch. We also depict a third possibility (the lowest branch): the farmer could take the deposit from a warehouse, produce with it, and then store the output at a different warehouse. If an inter-bank market exists and debt trades at par, this option yields the same payoff as storing at the original warehouse.

Altogether, to induce storage (which, as just stated, automatically ensures repayment), the warehouse has to make it profitable for farmers to follow this option, or

$$R(e + B) - B \geq (1 - \epsilon)R(e + B).$$

In other words, the farmer's payoff from storing at the warehouse has to be higher than the expected payoff from absconding with the loan and storing the commodity privately. If farmers have all the bargaining power (say, because warehouses are perfectly competitive) the program to be solved is

$$\max_{B \geq 0} \quad R(e + B) - B$$
$$s.t. \quad \epsilon R(e + B) > B.$$

That is, in this equilibrium, warehouses must choose an amount $B$ to loan that maximizes the farmers' utility subject to the incentive constraint that the farmer is willing to deposit at the warehouse. (Note that this constraint is a simplified version of the incentive-compatibility constraint above; the participation constraint for warehouses is trivially satisfied because they make zero profits.)

Let $B^*$ be the solution to this program, and suppose that $R'(e) > 1$ (otherwise, $B^* = 0$). Also, let $B^{fb}$ denote the first-best solution, i.e., $R'(e + B^{fb}) = 1$. If $\epsilon R(e + B^{fb}) > B^{fb}$, the first-best is attained, i.e., $B^* = B^{fb}$. Otherwise, the equilibrium satisfies $B^* < B^{fb}$: that is, credit is constrained to a second-best level due to the incentive problem at play. In this case, an interior equilibrium is characterized by

$$\epsilon R(e + B^*) = B^*,$$

and $B^* = 0$ otherwise.

## 3.2 Discussion: Entities and Drivers

While the model is simple, it still delivers a wealth of insights on both the factors that drive the optimal intermediation strategies and associated entities nowadays. At its core, warehousing is a model that emphasizes the role of *innovation*: at the center of the model is the warehouses' superior storage technology, which improves equilibrium outcomes relative to autarchy by providing a form of *safety* to the farmers. Projecting the model to the present, it is possible to see the role of innovation in technologies affecting the store of value, and the associated mapping from the provision of storage services to specific intermediary types: a) Payment services that currently allow customers to deposit (i.e. store) cash, while also providing payment services (e.g., Venmo); b) specialized firms such as trusts and digital asset entities that provide custodial services to their customers.

The model also highlights how innovation in the space of alternative investment opportunities can conflict with the incentives agents face, ultimately affecting equilibrium outcomes. Concretely, suppose that $\epsilon$ falls, i.e., the *private* storage technology improves. In this case, a large initial loan creates a strong ex-post incentive to skip depositing with the warehouse in favor of simply using private storage and reneging on the repayment (i.e., the incentive constraint becomes tighter). Anticipating this, the warehouse will restrict credit—$B^*$ falls—so that depositing with the warehouse remains profitable.

But the warehouse's ability to focus on private storage as the relevant outside option for the farmer rests on role that the interbank market plays in the model: the more liquid this market, the more likely that warehouses can trade the depositor's debt at par, thereby reducing the depositor's incentives to abscond with the loan and deposit its grain in a different warehouse—i.e., rendering this type of arbitrage irrelevant. In other words, the warehouse's ability to provide both storage and credit services together in the optimal strategy rests heavily on (interbank) *market liquidity.*

Finally, related to the above point, the model emphasizes the importance of *market competition and cooperation.* The fact that warehouses make zero profits can be due to extreme competition among them. But the existence of an interbank market can be seen as a form of cooperation among intermediaries that protects a warehouse that engages in lending with a particular farmer. In other words, innovation *jointly with contractual arrangements* is the key to achieving superior outcomes.[7]

These themes—safety, innovation, incentives, market liquidity, competition and cooperation, as well as the role of governments—will reappear throughout our subsequent analysis.

# 4 Provision of Safe Assets

The demand for safe assets by households has been a key driver of financial intermediation services offered by the private sector. As Gorton (2017) points out, what exactly is understood as a safe asset usually depends on the time horizon at hand. For short horizons, the term is usually attributed to debt instruments that are liquid, or money-like, in that they can be traded with ease (say because the "no-questions-asked" (NQA) principle applies). Typical examples are bank deposits, money market mutual fund (MMMF) shares, commercial paper, federal funds, mutual fund agreements, short-term interbank loans, and US Treasury bills. On the other hand, from a long-term perspective, safety is usually attributed to debt that pays off at par with a high probability at some point, thus acting more as a stable store of value: typical examples are U.S. Treasury notes, agency debt, municipal bonds, private-label securitized AAA debt, and high-grade financial-sector AAA corporate debt.

In the U.S. case, Gorton and Metrick (2012) and Gorton (2017) document that the share of safe liabilities to total assets has been stable at above 30% over the period 1950–2010, with government liabilities falling from approximately 18% in the beginning of the period to only 10% by 2010. The perceived safety of banks—partly stemming from their access to government deposit insurance—made them the main producers of safe claims within the private sector up to the end of the 1970s, and during this time, demand deposits accounted for roughly 70% of the universe of safe assets.

Since then, a steady fall in demand deposits has followed, reaching a low of 30% of total safe assets by 2008. This phenomenon has been accompanied by the rise of MMMFs, money market instruments, and securitization, reflecting the growing role of NBFIs in safe asset

[7] An omitted aspect of our analysis is the source of funds that warehouses use to provide credit. As Donaldson et al. (2018) show, these can be in the form of "fake receipts," or bank notes that are not backed by current output. This form of money is accepted because it is implicitly backed by the credibility of the banks' superior technology ensuring that entrepreneurs will honor their repayments.

provision to households. To illustrate, Figure 5 depicts the evolution of key NBFI-supplied safe assets over the period 1951–2021.[8] There, MMMFs and other mutual funds (MFs) have grown steadily since the late 70s, with federal funds and repurchase agreements (Repos) displaying a stable pattern. As for securitized products, asset-backed securities (ABSs) and government-sponsored enterprise (GSE) securities—among them mortgage-backed securities (MBSs)—soared until the GFC, followed by a decline that has been more acute for ABSs (see Bertaut et al., 2011). Bank deposits have recovered since 2010, but only slightly.

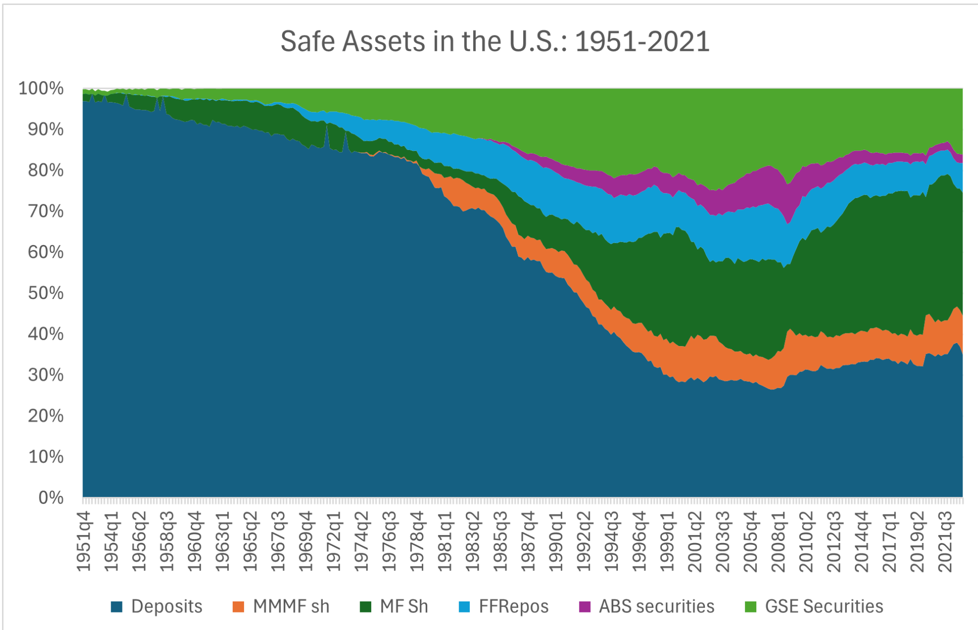


Figure 5: Safe Assets in the U.S. 1950–2021. Source: Flow of funds data.

We note that, in these examples of safe claims, the notion of safety results from an observable attribute of the claims at hand. Thus, such a notion is linked to a property of an *outcome variable*, and not necessarily to a primitive need—i.e., investors' *preference* for safety—which drives the emergence of claims with desired characteristics. Nor do these notions necessarily shed light on the actual strategies that financial intermediaries pursue to provide safety in the specific form demanded by investors, or why investors may prefer certain safe assets over others. Thus, to better understand the factors that favor the dominance of specific safe assets, along with the observed trends, one needs a framework that can (i) accommodate preferences for safety on the investors' side and (ii) entertain the possibility of financial intermediaries adopting different types of safe strategies.

[8] U.S. Treasuries—the quintessential safe asset—has been omitted due to the focus on private institutions. Its connection with NBFI strategies is discussed in section 4.2.

**What comes next** The next two sections develop this idea by leveraging the simple but insightful framework laid out by Hanson et al. (2015). This model—which is another instance of our primitive model and presented in Section 4.1—is used in two tasks. First, in Section 4.2 we deploy the model to understand a number of recent developments in the NBFI ecosystem: we do so by explaining the roles that insurance and (secondary) market liquidity play in supporting the creation of safe claims. A key takeaway is that the boundaries between banks and non-banks suggested in the original work by Hanson et al. (2015) now seem more blurry, reflecting the increased interconnectedness and complexity of the financial system.

Second, in Section 5 we go a step further and extend this setup to encompass securitization as another strategy that is naturally suited to provide safety. Equipped with a unified framework for examining safe strategies, we can compare the profitability of such strategies as a function of primitives: in particular, how the extent of long-term uncertainty faced by investors favors one strategy over the others. This allows us to explain when investors may prefer safe assets in a short-term sense (e.g., money-like) over their long-term counterparts (e.g., store of value), and vice-versa, without resorting to time-preference considerations.

## 4.1 The Hanson et al. (2015) Model of Safe Assets

Using the core game tree representation, we start by leveraging the framework laid out by Hanson et al. (2015): investors pay a premium for liabilities that exhibit a "safety buffer"—a non-trivial payoff that can be guaranteed irrespective of the economic conditions—while intermediaries have flexibility over issuing safe claims by means of strategies that resemble those followed by banks and NBFIs in practice.

**Model basics** A risky asset induces a game tree as depicted in Figure 6. The moves in this tree are determined by two players: nature (N) and a financial intermediary (I). There are three periods. At time 1, nature moves and determines whether the asset has a high payoff with certainty in the last period—a *good news* event that occurs with probability $p$, in which case the intermediary has no relevant actions to take. If this event does not arise—a *pessimistic news* event that occurs with probability $(1-p)$—the uncertainty about the asset will resolve at $t = 3$. In this case, the asset's payoffs can be $R$, $z$, and 0, in decreasing order and with corresponding probabilities $q$, $1-q-\epsilon$, and $\epsilon$.

After pessimistic news, the intermediary has to decide whether to hold the asset to maturity or not. The authors consider two types of strategies. First, in an *insurance-backed* strategy (IB) a financial intermediary (i) holds the asset until maturity in all events and (ii) purchases insurance from the government that covers $z$ if the asset yields a zero payoff. This strategy effectively lowers the worst-state probability $\epsilon$ to zero, but requires an upfront

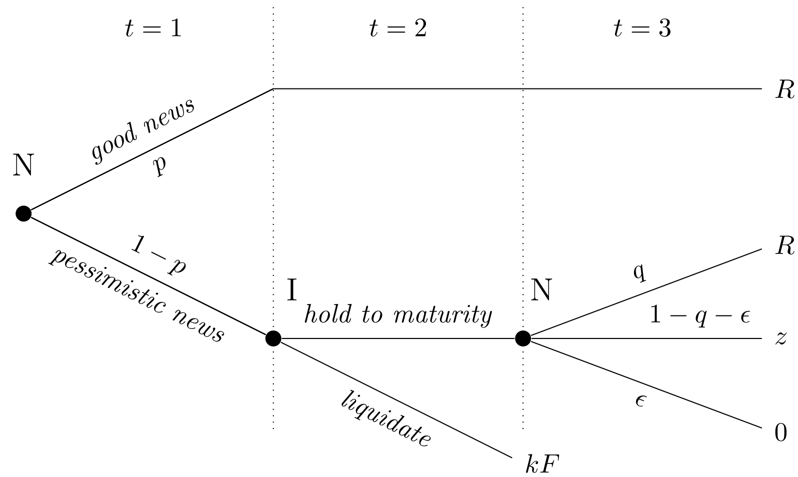


Figure 6: Safe Assets I. N: Nature, I: Intermediary

payment: $(1-p)\epsilon z$, which is the fair value of the government's expected outlay from a time-zero perspective.

A financial intermediary may be willing to purchase insurance because investors are willing to pay a premium for safety: riskless payouts are valued at $\beta+\gamma$ per dollar, where $\beta$ is the financial intermediary's discount rate and $\gamma$ is the safety premium paid by investors. Letting $V^{IB}$ denote the quantity of funds that the intermediary can raise with this strategy, it is easy to see that

$$\begin{aligned} V^{IB} &= \underbrace{(\beta+\gamma)z}_{\text{safe debt}} - \underbrace{\beta(1-p)\epsilon z}_{\text{insurance costs}} + \beta \underbrace{[p+(1-p)q](R-z)}_{\text{equity}} \\ &= \underbrace{\gamma z}_{\text{safety premium}} + \beta \underbrace{[pR+(1-p)F]}_{\text{expected cash flow}} \end{aligned} \tag{1}$$

where $F := qR + (1-q-\epsilon)z$ is the expected value of the asset conditional on pessimistic news. Expression (1) reflects that the bank can raise funds equal to the value of the asset held until maturity plus the safety premium component $\gamma z$.

The second strategy examined is *early liquidation* (EL). In this strategy, the intermediary does not purchase government insurance: instead, the intermediary (or the investors) liquidates the underlying asset following pessimistic news. When this occurs, a payoff of $kF$ is obtained, where $k<1$ is a liquidity discount—say, because the collateral is sold with a haircut in a secondary market. The important thing to note is that the payoff $kF$ is realized with certainty at the moment that liquidation takes place, so the intermediary can use this payoff to generate a safe claim. Concretely, it is easy to see that the intermediary can raise funds that amount to

$$V^{EL} = (\beta + \gamma)kF + \beta p[R - kF] = \underbrace{\gamma kF}_{\text{premium}} + \beta \underbrace{[pR + (1-p)kF]}_{\text{expected cash flows}}. \tag{2}$$

Observe that since the asset is not held until maturity in this case, the factor $k < 1$ accompanying $F$ implies that the 'expected cash flows' component of this strategy no longer coincides with the asset's expected cash flow present in the IB strategy.[9]

**Coexistence between banks and non-banks** Any equilibrium featuring a non-trivial sorting of intermediaries across strategies entails indifference between the two associated payoffs $V^{IB} = V^{EL}$. To this end, let $\mu \in [0,1]$ denote the mass of intermediaries that choose the non-bank strategy. The authors assume that the firesale discount is a function $k(\mu; \varphi) \in [0,1]$ satisfying $\partial k/\partial \mu < 0$, and where $\varphi > 0$ is an illiquidity parameter such that $\partial^2 k/\partial \mu \partial \varphi \leq 0$: in other words, if more NBFIs sell, the fire sale is stronger, and this effect is more pronounced as $\varphi$ grows. As the authors show, given $\varphi > 0$, it is easy to find conditions ensuring that there is a unique $\mu^* \in (0,1)$ such that $V^{IB} = V^{EL}$.

## 4.2 Discussion: Entities, Drivers, and Modern Forms of Coexistence

In this section, we first map the model's strategies to real-world entities and then discuss two key features of the strategies examined: the role of liquid secondary markets and the availability of government insurance as *drivers* of the EL and IB strategies, respectively. We conclude with a discussion on how the lines between these two strategies have blurried, partly reflecting new forms of cooperation between banks and non-banks.

**From strategies to entities** As indicated by Hanson et al. (2015), the IB strategy resembles that of a traditional bank that holds loans to maturity (instead of selling or collaterizing them) with deposits that are backed by government insurance. However, we may alternatively interpret the insurance as provided by a private entity such as a bank (via a credit line) to an NBFI, in which case the IB strategy features an NBFI holding the risky asset to maturity. Later in this section we provide several examples of this situation: non-bank mortgage lenders, REITs, private credit, and private equity firms.

On the other hand, the EL strategy resembles the business models of asset managers that allow investors to redeem their shares on demand. In practice, if liquidity buffers are

[9] Expressions (1) and (2) are verbatim from Hanson et al. (2015).

sufficient, the asset manager may hold the asset (e.g., a fixed-income instrument) to maturity and pay investors from the resulting cash flow. If not, they meet redemptions by selling the asset in the secondary markets. Another view of the EL strategy is that it involves collateralized borrowing rather than an outright sale (i.e, a repo). The asset-holder pledges the asset and receives a one-period loan of $F$ minus a haircut that is a fraction $k$ of $F$. At the end of the final period, the asset is returned to the holder. This strategy may be mapped to asset managers (who use the repo for temporary funding) and many other entities such as a Special Purpose Vehicle (SPV) (to be covered in section 5). Importantly, as discussed in Pozsar (2011), the US shadow banking system is heavily funded by repos based on Treasury securities.

Let us now turn to discussing key drivers behind the EL and IB strategies.

**Market liquidity** As the authors argue, when secondary markets are more liquid, (i.e., the illiquidity parameter $\varphi$ is lower), non-banks are a larger share in equilibrium (i.e., $\mu$ is higher). In line with the model, improved market liquidity has indeed supported the rise of NBFI-supplied safe assets in practice. Merton (1995) argues that changes in the structure of the financial system due to newly designed securities and technology advances have contributed to enhanced market liquidity. A notable example that he cites is that more liquid markets for money instruments such as commercial paper facilitated the development of MMMFs that compete with banks for demand deposits. Another example is the development of a national secondary mortgage market that facilitated the purchase of residential mortgages by mutual funds and pension funds.

Authorities have promoted policies that increase market liquidity, for assets such as *mortgages* and *Treasuries*. In the first, non-bank mortgage lenders have been increasingly originating loans which are underwritten by GSEs. One effect of GSE underwriting is that the market for mortgage collateral becomes liquid, which facilitates the trading of MBSs in secondary markets (i.e., a decrease in $\varphi$ mediated by the government, that increases $k$ in the model). For example, Vickery and Wright (2013) discuss the liquidity of the To-Be-Announced (TBA), or forward MBS, market, where two parties agree upon a price for delivering a pool of agency MBS at a specified future date. The liquidity of the TBA market is facilitated by the GSEs' standardization of loan criteria (that limits variations in the characteristics of mortgage borrowers and properties) and pooling criteria (that limits variation in mortgage loan rates and loan ages).

Regarding Treasuries, it is well-recognized that the U.S. government has historically played a key role in enhancing and supporting Treasury market liquidity: for instance, Menand and Younger (2023) argue that Treasury market liquidity "was actively constructed by government officials." In this regard, one notable example discussed by Garbade (2007) is the adoption of a more regularized program of issuance by the Treasury in the early 1980s. As the author argues, this change in debt-management practice reduced "the element of surprise in Treasury offering announcements, facilitating investor planning, and decreasing Treasury borrowing costs," thus improving market liquidity.

While issued by a government, Treasury bills (or more broadly, short-term government guaranteed instruments) are central to the private sector's ability to issue safe liabilities: financial institutions fund their investments, liquidity, and collateral management using Treasury bills and repos, and hence these securities at the heart of the US shadow banking system (Pozsar, 2011). Further, the demand for safe assets generates demand for longer-term Treasury notes (for example, to use as collateral for short-term repos). Altogether, the liquidity of the Treasury market is then key to the functioning of NBFIs.

**Government Insurance and the Safety Premium** In the model, households pay a premium $\gamma$ per dollar of safe deposits. In equilibrium, when this parameter increases, then the fire sale discount must rise (so the share of risky assets held by non-banks must rise too) to compensate. In other words, absent government insurance, higher provision of safe assets by non-banks requires them to hold larger positions in the risky asset. Given $\gamma$, the *amount* of safety premium is proportional to the deposit amount. This amount is equal to the government insurance purchased for IB strategies, and the secondary market value of the risky asset (which is correlated with market liquidity) for EL strategies.[10] Thus, for non-bank strategies, the provision of safe claims is intimately related to the liquidity of the market.

Historically, banks may have had an advantage in providing such insurance, given their benefits from government-provided deposit insurance. Currently, however, a wide variety of NBFI entities — such as non-bank mortgage lenders, REITs, private credit and private equity firms — might undertake market-based insurance strategies. In particular, banks may provide credit insurance to non-banks, as we explore below.

**Modern forms of coexistence** As mentioned previously, the boundaries between the EL and IB strategies, as well as their drivers, have become much less clear over time. First, governments have increasingly promoted market liquidity for assets that are core to the economy, effectively supporting the implementation of EL strategies adopted by NBFIs. Second, certain NBFIs have been gradually adopting business models that resemble the IB

[10] Christensen and Mirkov (2021) show how asset purchases by the European Central Bank reduced the amount of safe assets in the euro area and thereby affected the safety premium of Swiss government bonds.

strategy, in that (i) the assets involved are more likely to be held to maturity, and (ii) forms of insurance are at play: most notably in the form of credit lines offered by banks.

Acharya et al. (2024) shed light on the significant dependence of NBFIs on bank funding: using Flow of Funds data, they show, for instance, that for equity real estate investment trusts (or REITs, to be discussed shortly) 25% of their liabilities correspond to bank funding. Importantly, the authors note that the data likely understates these dependencies because it does not include undrawn bank commitments to NBFIs in the form of credit lines, or loans that can be drawn on demand.

This form of bank credit to NBFIs is becoming more and more prevalent. For example, in the private credit market, private credit funds make loans—typically secured or relatively senior in the borrowers' capital structure—to medium- and small-sized businesses. Banks have been active in providing lines of credit to these funds, some belonging to asset managers. In the mortgage market, non-bank mortgage lenders obtain most of their debt funding from banks that originate loans in the same markets, but this lending materializes at high rates to ameliorate competition (Jiang, 2023). A final example relates to the provision of subprime auto loans. Following losses during the GFC, major banks pulled out of this market and, instead, they now lend to NBFIs such as private equity firms who, in turn, make auto loans to subprime borrowers.[11]

These examples share two salient features: there are credit lines involved, and the loans made by NBFIs are riskier than those made by banks. This has two implications. First, the presence of credit lines implies that a form of insurance by banks is at play, a phenomenon that is is well-recognized in the literature: such commitments may allow non-financial entities to counteract adverse shocks that would threaten the continuation of profitable businesses that have difficulties in raising external finance, as noted by Holmström and Tirole (1998) and Kashyap et al. (2002) among others. Second, because of the riskier nature of these loans, secondary markets for the underlying loans sometimes simply do not exist, which means the assets are typically held to maturity (or a refinancing event happens) due to the absence of secondary markets; see Cai and Haque (2024). Put together, these examples reflect that non-banks are gradually implementing strategies that resemble those followed by banks in the model. What is also noteworthy in the private credit example is that asset management companies are pursuing these strategies: that is, precisely those NBFIs that one would associate more closely with the early liquidation strategy.

Anticipating our revisitation of private credit in Section 6, we pose this question: from

[11] In a typical transaction, NBFIs post the loans it makes as collateral for the bank loan while the bank's credit line would be equal to the collateral value minus a haircut. See https://www.wsj.com/articles/big-banks-find-a-back-door-to-finance-subprime-loans-1523352601.

a competitive perspective (as in the mortgage example just described), why would a bank fund an NBFI that will coexist in the same lending market? Before then, our goal will be to incorporate securitization within the previous framework as a third "safe" strategy.

# 5 Safe Assets II: A Securitization Strategy

Securitization is another prominent way through which safer payoffs can be provided. The key features of this practice are the reduction in idiosyncratic risk when *pooling* a large number of related risky assets, and the subsequent *tranching* of the underlying cash flows to guarantee minimum payouts to investors holding "senior" (i.e., safe) components of the debt issued.

To shed light on the comparative advantage of securitization vis-a-vis the two strategies previously examined in section 5.1, we first reintepret the Hanson et al. (2015) model from the previous section to encompass securitization as a third intermediation strategy. Later, in section 5.3, we generalize this model to accommodate richer forms of uncertainty. Through this exercise, we will uncover that the a priori advantage of securitization is sensitive to the extent of long-term uncertainty faced by economic agents, enabling us to link macroeconomic conditions to the dominance of different safe strategies.

## 5.1 Encompassing Securitization

We will view securitization as a strategy that *holds assets to maturity*—this will result from our setup by excluding the possibility of residual idiosyncratic risk, or of aggregate risk that leads to complete value destruction, as will become clear soon.[12] Consequently, we reconsider Figure 6 but ignore the "liquidation" branch, and with two additional twists. First, we interpret news realizations as observable states of the world: 'good news' now refers to an observable "good" ('$g$') state of the world that realizes with probability $p$ (in which case the asset pays $R$ with probability 1), while pessimistic news reflects a bad ('$b$') state of the world—in which case the asset is a lottery as in the lower half of the tree. Equipped with these assumptions, note that the asset's expected payoffs conditional on each state of the world satisfy

$$\mathbb{E}[\text{asset}|g] = R > \mathbb{E}[\text{asset}|b] = qR + (1 - q - \epsilon)z = F.$$

[12]In practice, these risks lead to insurance indeed playing a key role in the structuring of SPVs. See Cetorelli and Peristiani (2012) for formal insurance in the form of *ancillary enhancements* that protects investors from default and other risks. Gorton and Souleles (2007) instead discuss forms of "implicit recourse" by banks that step in to rescue their sponsored SPVs.

The second change is that idiosyncratic risk can be fully diversified: there is a family of i.i.d. random variables $(\mathcal{A}_i)_{i\in[0,1]}$ representing assets with realizations as in the tree. Letting $\omega \in \{g, b\}$ denote the state of the world, and $\mathbb{1}_{(\cdot)}$ the indicator function, the law of large numbers (LLN) allows us to conclude that pooling this family of assets results in an *ex-post* payoff of

$$\int_0^1 \mathcal{A}_i di = \mathbb{E}[\mathcal{A}_i|g]\mathbb{1}_{\omega=g} + \mathbb{E}[\mathcal{A}_i|b]\mathbb{1}_{\omega=b} = R\mathbb{1}_{\omega=g} + F\mathbb{1}_{\omega=b}.$$

In other words, pooling leads to a payoff of $R$ *with certainty* if the state is good, and a payoff of $F$ *with certainty* if the state is bad—investors are exposed to aggregate risk only.

But this means that this strategy can guarantee a payoff of $F > 0$ irrespective of the state of the world, so it can be used to create a safe asset in a long-term sense (i.e., when held until maturity). Using the tools from the previous section, it is then easy to see that the total amount of funds raised by this strategy, $V^S$, is given by

$$V^S = (\beta + \gamma)F + \beta p[R - F] = \underbrace{\gamma F}_{\text{premium}} + \beta \underbrace{[pR + (1-p)F]}_{\text{expected cash flows}}.$$

From here, securitization is a dominant strategy: it is strictly better than traditional banking because the money premium is higher ($F > z$), while the expected cash flow components coincide; and it is strictly better than the early liquidation strategy unless secondary markets are perfectly liquid, i.e., $k \equiv 1$ (in which case they are equally profitable). In particular, relative to the *EL* mutual fund-like strategy, the power of securitization stems from its ability to generate high payoffs precisely in those events where intermediaries would want to sell off the assets underlying their liabilities.

## 5.2 Discussion: Entities and Drivers

In this section, we first map the strategy studied to real-world entities. Then, we discuss three drivers behind the growth of securitization: securitization costs, secondary market liquidity, and macroeconomic factors.

**From strategies to entities** The securitization strategy is naturally mapped to various entities. The most common types are the special purpose entities (SPEs) or SPVs, widely used in structured finance. An SPV is a legally protected entity (typically organized in the form of a trust) created by a firm ("the sponsor") that transfers assets to the SPV for a specific purpose. The securitization process involves the sponsor pooling receivables and selling them to the SPV; the cash flows are then tranched into ABS, the most senior of which are rated and sold in the market: in the model, the payouts of the senior (i.e., safe, or AAA-rated) and the junior (i.e., equity-like) tranches correspond to $F$ and $R - F$, respectively. In practice, the pools revolve over time, ending with a final amortization period when payments from receivables are used to pay down the tranche principal amounts (Gorton and Souleles, 2007)—in our model, the ABS are held to maturity and, at the end of the final period, the tranche investors are paid according to the realized cash flows.

Let us now turn to discussing some key drivers behind securitization.

**Costs of Securitization** The costs associated with setting up structured vehicles are unmodeled but easy to incorporate. Historically, these costs have often been associated with accounting, legal and regulatory uncertainty, and have eased over time to induce intermediaries to follow this strategy. For instance, accounting innovations clarified whether the transfer of receivables to SPVs could be counted as a sale rather than as a secured loan; legal innovations permitted new legal organizational forms—in particular, business trusts—that made SPVs bankruptcy-remote and ensured that a new SPV did not need to be set up every time a new pool of loans had to be secured; and in the regulatory sphere, the Delaware Business Trust Act (1988) provided statutory recognition of the limited liability of SPVs.[13] The growth in GSE securities that is observed in Figure 5 is consistent with this view: legal and technological innovations effectively lowered the costs of issuing residential MBSs underwritten by GSEs; and this happened precisely at a time when the market for mortgages (the underlying collateral) was relatively illiquid. We will expand on this and other examples at the end of the section.

**Secondary market (il)liquidity** While secondary market liquidity does not affect the securitization strategy directly, it does so indirectly as the alternative EL strategy is relatively less attractive when markets are illiquid. The markets for residential mortgages and for corporate loans help illustrate how cost-reducing innovation and market liquidity have shaped the relative attractiveness of securitization.

In the first case, the whole-loan market for trading unsecuritized mortgages was relatively illiquid in the U.S. in the 1970s (an initial low value of $k$ in the model). The first residential mortgage-backed securities (RMBS) were issued around that time, and expanded robustly in the 1980s and 1990s. Their growth was facilitated by innovations such as collateralized mortgage obligations (CMO)—issued by Fannie Mae in 1983 to address prepayment risk—and the Real Estate Mortgage Investment Conduit (REMIC), an SPV that simplified tax treatment and allowed investors to choose more or less credit risk—these innovations

[13] See Gorton and Souleles (2007) for more on these topics.

effectively lowered the costs of implementing securitization strategies. Furthermore, RMBSs were issued by various GSEs and were backed by pools of "conforming" mortgages required to meet certain requirements for size, credit scores, loan-to-value ratios, and documentation. As GSEs guaranteed the timely payment of principal and interest on the underlying loans, investors bore little credit risk. In a similar vein, the securitization of commercial mortgages through the Commercial Mortgage-Backed Securities (CMBS) market, created in the early 1990s, increased liquidity in the commercial real estate market (Buchak et al., 2024).

Regarding corporate loans, securitizations were introduced to, in part, ameliorate the inherent illiquidity of the corporate loan market, thus enabling investors to trade credit risk more efficiently. One such security is the collateralized loan obligation (CLO) that invests mainly in pools of leveraged loans—bank loans to highly leveraged, below-investment-grade firms with high debt service costs relative to earnings. Unlike other forms of securitizations such as collateralized debt obligations (CDOs), CLOs have continued to thrive after the GFC, with about 50% of leveraged loans securitized as CLOs in 2019. The bottom line is, consistent with our analysis, market illiquidity coupled with a reduction in implementation costs favored the growth of these securitized products.

**Macroeconomic conditions** The time-series of securitizations exhibits considerable variation across time. For example, Figure 5 showed that securitizations were prominent prior to the GFC during a period of low interest rates; they then exhibited a sharp increase in the lead-up to the financial crisis around 2006–2008; and finally, they went into a period of decline after the crisis. These trends suggest that, macroeconomic conditions, partly through the associated perceptions of risk, can have a material impact on the demand and supply of assets perceived to be safe. We investigate this idea in more detail next.

## 5.3 A Richer Model and A Macroeconomic Interpretation

**Potentially indistinguishable states** The dominance of a securitization strategy depends on the underlying uncertainty. To make this point—while at the same time providing insights on factors that influence the power of this strategy—we consider the model of uncertainty depicted in Figure 7, which is an enriched version of the previous setup.

In the figure, nature moves first to determine one of two possible states of the world: good with probability $\pi$ or bad with probability $1 - \pi$. Conditional on the state of the world, the top and bottom continuation trees have the exact same structure as in the previous model. In particular, we return to the interpretation of observable optimistic and pessimistic news and assume that $1 > p_g \geq p_b$ , $q_g \geq q_b$ and $\epsilon_g \leq \epsilon_b$, i.e., higher payoffs are weakly more likely in state $g$ than state $b$. The main difference relative to Section 5.1 is that the observation of

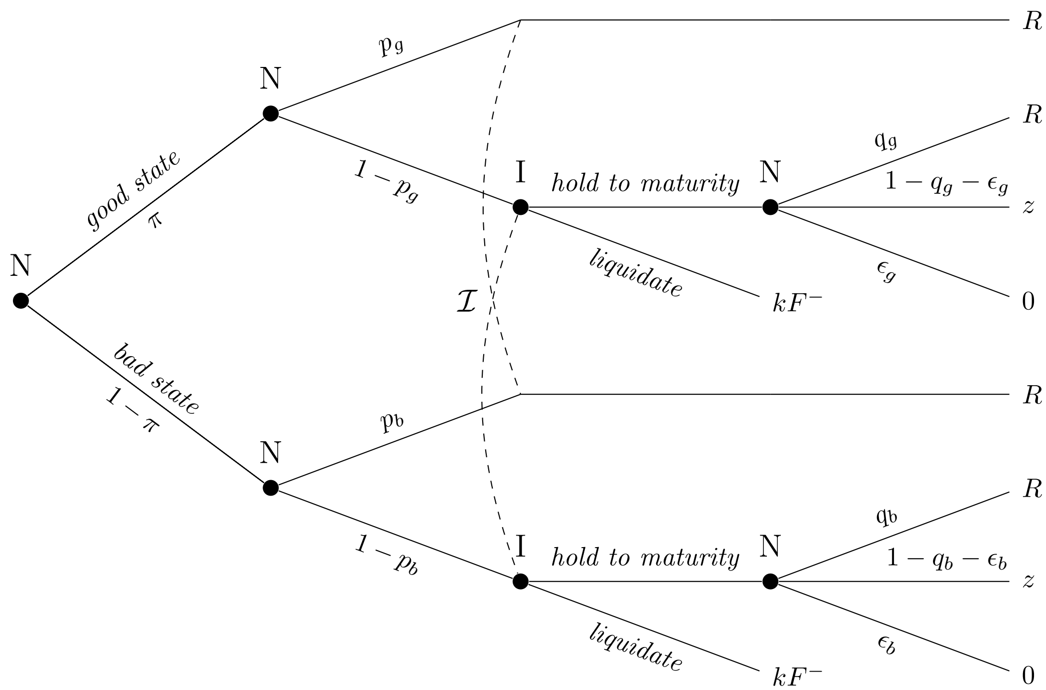


Figure 7: Generalized model. N denotes Nature, I is for Intermediary, and $\mathcal{I}$ stands for Intermediary and Investors. $F^-$ is the asset's expected payoff conditional on bad news.

news need not reveal which state of the world has realized: as long as the probabilities are non-trivial, good news and pessimistic news can in principle be attributed to either state, which is represented by the dashed curves encoding the uncertainty faced by intermediaries and investors (the whole set of which is denoted by $\mathcal{I}$ in the graph).[14]

The next results displays the payoffs for the three strategies under consideration. To this end, let $F^\omega$ denote the asset's expected payoff conditional on state $\omega = g, b$. Likewise, we use $F^-$ to denote the asset's expected payoff conditional on bad news realizing, which happens with probability $1 - p_\omega$ if $\omega \in \{b, g\}$ is the realized state. As before, we assume that a securitization strategy has available a large number of conditionally i.i.d. assets.

**Lemma 1.** *The following amounts can be raised by each of the strategies*

$$\begin{aligned} \textit{insurance-backed}: V^B &= \gamma z + \beta[\pi F^g + (1-\pi)F^b] \\ \textit{early liquidation}: V^{EL} &= \gamma k F^- + \beta[R(\pi p_g + (1-\pi)p_b) + kF^-(1 - \{\pi p_g + (1-\pi)p_b\})] \\ \textit{securitization}: V^S &= \gamma F^b + \beta[\pi F^g + (1-\pi)F^b] \end{aligned}$$

It is clear that securitization dominates the IB strategy: the money-like component is

[14] Do not confuse this convention with the one in game theory attributing information sets to the player that moves in each specific node (which in our case would be Nature).

higher ($F^b > z$), while the expected cash flow components coincide, just as in Section 5.1. Also, the EL strategy continues to dominate IB when secondary markets are perfectly liquid, i.e., $k \equiv 1$: in this case, the cash flow component in $V^{EL}$ becomes $R(\pi p_g + (1-\pi)p_b) + F^-(1 - \{\pi p_g + (1-\pi)p_b\}) = \pi F^g + (1-\pi)F^b$, and so the money premium breaks the tie in favor of the EL strategy ($F^- > z$). Just like in Section 4, this opens up the possibility of indifference between the two strategies.[15]

The comparison between the EL and securitization strategies is more subtle: it will depend on the money-like components $F^-$ and $F^b$, respectively, as well as on the fire-sale discount $k$. The most optimistic case for the EL strategy is when $k \equiv 1$, in which case $V^{EL} > V^S \Leftrightarrow F^- > F^b$: when expected cash flows after pessimistic news are higher than those in the bad state of the world. The latter comparison is non-trivial since it depends on the type of uncertainty at play—we consider two scenarios based on their extent of long-term uncertainty.

**Extent of long-term uncertainty** We say that the economy is in a *growth* environment if $p_g > p_b > 0$, while $q_b = q_g$ and $\epsilon_g = \epsilon_b$: states of the world matter to the extent that they determine how fast projects in the economy succeed, but any downside risk is unaffected. Alternatively, we say that the economy features *long-term uncertainty* if $p_b = 0$: that is, in the bad state of the world, uncertainty about the asset's payoffs can only dissipate at the end of the horizon (or that optimistic news never arise in that state).

**Proposition 1.** *The securitization strategy always dominates EL in a growth environment. By contrast, if there is long-term uncertainty, the EL strategy dominates securitization when* $k \equiv 1$ *(secondary markets are perfectly liquid).*

To understand the first part, note that in a growth environment the downside risk is the same across states: the expected payoffs after pessimistic news are exactly the same. Securitization is then more attractive because the bad state offers the upside of projects that succeed early; meanwhile, early liquidation provides no upside because, again, the asset's expected payoff after pessimistic news is invariant to the state of the world. On the other hand, with long-term uncertainty, the advantage of the securitization strategy vanishes, as early success is not possible in the bad state of the world. In turn, the early liquidation strategy is attractive because the states of the world are indistinguishable: the money premium component—determined by expected payoffs after pessimistic news—pools

[15]In the expressions of the Lemma, the only non-trivial term is the one accompanying $\beta$ in $V^{EL}$: with probability $\pi p_g + (1-\pi)p_b$ (which accounts for a potentially unknown state of the world) there is good news, yielding a return $R$; with complementary probability, the news is bad, and the expected value of the asset is $F^-$, and it is sold at a discount—see the Appendix for the expression of $F^-$.

the good and the bad states in a probabilistic sense. In other words, the early liquidation strategy has the upside of potentially selling the assets in a good state of the world, which limits the intensity of the fire sale discount.

The takeaway is that securitization is expected to dominate in settings with limited downside variability across states of the world: in those environments, there is an *option value to wait* for the possibility of higher returns realizing. By contrast, if the downsides are more pronounced across states, the securitization strategy will be particularly exposed, because it guarantees payoffs based on realizations in those bad states. The early liquidation strategy then acquires an edge, because it offers an *option to exit* at prices that incorporate the possibility of being in high, albeit slowly unfolding, states.

Let us finish with three observations regarding Proposition 1. First, it is an important "possibility result:" securitization *can be dominated*, even when idiosyncratic risks can be completely eliminated and there are no costs to implement the strategy. Second, it speaks to our earlier discussion regarding how the notions of short- versus long-term safety shape the relative attractiveness of certain assets: a growth environment is less uncertain in a long-term sense, thus favoring securitization; conversely, with more long-run uncertainty, the option value of liquidating assets at interim dates grows, and safety in a short-term sense is preferred. Third, the result relates to the *neglected risk hypothesis* of Gennaioli et al. (2015), which is often argued as the reason behind several episodes of market collapse– in our context, this would mean optimistic investors perceiving the growth scenario as the prevailing one when in reality the true state is one of long-term uncertainty. The prediction then is a strong initial demand for securitized products, followed by a flight to safety towards more liquid securities upon the realization that there is more long-term uncertainty than anticipated. Chernenko et al. (2014) finds evidence consistent with this hypothesis precisely in the context of securitization.[16]

# 6 Incentive Management and Credit

Another key function of financial intermediaries is to offer credit to enterprises that need external funds to operate. The purpose of this section is to explore how banks and non-banks coexist in this domain, with an emphasis on how such intermediaries can manage their borrowers' incentive problems. By focusing on credit, the emphasis that sections 4 and 5 placed on the type of liabilities issued by NBFIs will now shift to the asset side. But the liability side will matter too. Concretely, we will show that banks can fund NBFIs to

[16] See also Gennaioli et al. (2012) for a model examining the financial stability implication of intermediaries that cater to investors who demand safe cash flows while neglecting certain risks.

indirectly expand lending to segments that would be too costly for banks to serve otherwise: a *vertical relationship* between banks and non-banks then emerges. This phenomenon of banks acting as a key source of funding for NBFIs, that in turn engage in direct lending, is observed in private credit, which we briefly referenced at the end of Section 4.1.

To proceed, what we need is a framework that allows for potentially heterogeneous intermediaries (e.g., banks and non-banks) as well as lending decisions in the presence of agency problems. To this end, we apply our core game tree structure to develop a simplified version of Donaldson et al. (2021) where banks and non-banks differ in terms of their costs of funding. We accomplish two goals through this simplified model. First, relative to their results, we can establish simple conditions for the coexistence of banks and non-banks that specialize in lending to different types of enterprises (Section 6.1). Second, in line with the evidence coming from private credit, we show that banks can find it profitable to extend lines of credit to NBFIs when funding costs make it prohibitively costly for NBFIs to engage in direct lending (Section 6.3).

## 6.1 A Simple Funding Game

Consider an entrepreneur (he) and a financial intermediary (she). The entrepreneur needs start up funds totaling $K_0$ for a project. If the intermediary provides those funds, the game depicted in Figure 8 takes place (note that the tree preserves the structure from the previous sections):

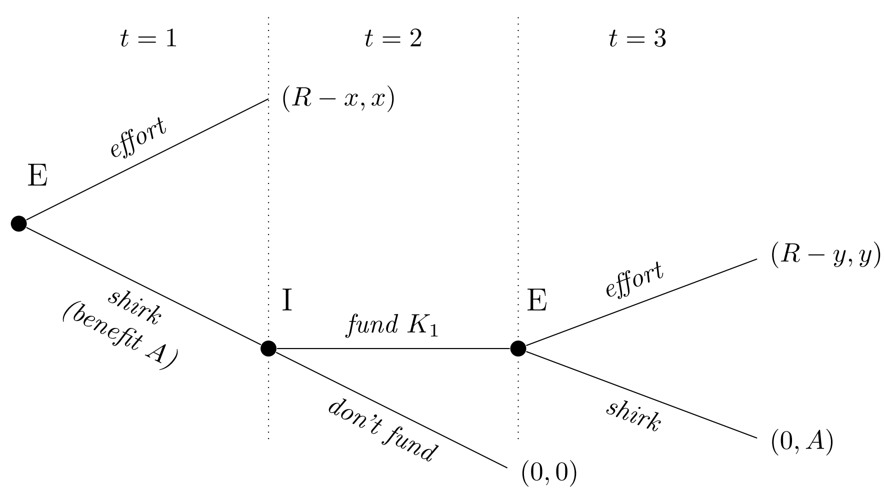


Figure 8: Incentive management function. E: Entrepreneur, I: Intermediary

In the figure, the payoffs depicted correspond to *flow or continuation payoffs* at each of the terminal nodes: previously enjoyed benefits or costs (which are sunk) are not depicted. The story is as follows. After $K_0$ is obtained, the entrepreneur can either exert effort toward the project's success or shirk. The former yields a project return $R$ with certainty, after which the game ends; this is the upper branch of the tree, which displays a payment $x$ from the intermediary to the entrepreneur that will induce effort. Alternatively, the entrepreneur shirks and the project does not succeed, but she obtains a private benefit $A$. The intermediary then needs to decide whether to provide additional funding $K_1$ or simply not fund; in the latter case, the interaction ends and the players' (continuation) payoffs are zero. But if $K_1$ is provided, the interaction repeats: $y$ denotes the payment made by the intermediary to induce effort, while the entrepreneur obtains the (continuation) payoff of $A > 0$ after shirking.

Observe that, to induce effort in the last period, the intermediary optimally sets $y = A$. Suppose that the intermediary's relevant interest rate is $r > 0$. The intermediary will then engage in a second round of funding if and only if the project has non-negative NPV, i.e.,

$$\frac{R - A}{1 + r} - K_1 \geq 0. \tag{3}$$

The tension highlighted by Donaldson et al. (2021) is a standard one: when the previous condition holds, the threat of discontinuing funding after no success in the first period is not credible; but such a threat can be an effective mechanism to discipline the entrepreneur.[17]

To formalize this idea, we follow the authors by assuming that there are only two possible classes of agents that can act as intermediaries, and who differ only in their funding costs $r_B$ and $r_N$, where $r_N > r_B$. We call the low funding cost type a 'bank' and the high funding cost a 'non-bank'— such an interpretation is natural if the lower funding cost is the result of (unmodeled) access to government support, say, in the form of some guarantees on their liabilities.[18] Additionally, there are projects with high and low agency costs, $\bar{A}$ and $\underline{A}$ respectively, where $\bar{A} > \underline{A}$. The credibility problem for the low funding cost type (the banks) is acute, in that we assume that (3) holds for high and low agency cost projects when $r = r_B$; in turn, we assume that non-banks discontinue all projects. Anticipating how the relationship will unfold, Figure 9 illustrates the resulting game depending on the type of intermediary considered.

The credibility problem manifests in a bank being forced to pay $x = 2A$ to induce effort at $t = 1$ (left panel), while a non-bank needs to pay only $x = A$ (right panel). Indeed, by shirking in the presence of a bank, an entrepreneur gains $A$ today but also anticipates a rent of $A$ in the future due to the bank's inability to commit to discontinuing funding.

[17] The idea that adopting a costly technology—in this case, high funding costs—can be used to make a threat credible is a long-standing theme in game theory and industrial organization. See for instance Chapter 23 in Kreps (2019)

[18] While this may seem like an entity-based approach, we later use a population interpretation of Nash equilibria where the intermediary type is not pre-determined: there, ex-ante identical intermediaries self-select into high and low funding costs strategies, which we ex-post label as banks and non-banks.

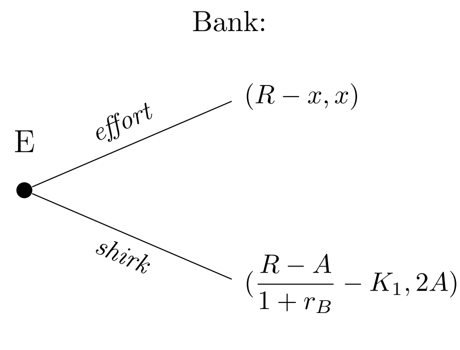


Figure 9: Reduced tree with payoffs summarizing equilibrium play given the continuation game. For simplicity, the entrepreneur is assumed to be patient.

Conversely, a non-bank's credible threat to drop projects down the road reduces the rents that need to be paid today. This opens up the possibility for non-banks having a strategic advantage when it comes to lending to high agency cost projects, despite their ex-ante worse cost structure.

**Proposition 2.** *There exists agency costs $0 < \underline{A} < \bar{A} < R$, interest rates $0 < r_B < r_N$ and start-up costs $K_0, K_1 > 0$ such that:*

1. *Credibility problem: non-banks never continue either type of project, while banks continue both.*
2. *Initial funding: non-banks fund both types of projects, while banks only fund low agency cost projects; in both cases, projects succeed in the first round.*
3. *When facing low agency cost projects, banks make higher profits than non-banks.*

Part 1 means that (3) is satisfied when $A = \bar{A}$ and $r = r_B$, and that it is violated when $A = \underline{A}$ and $r = r_N$. Part 2 can be divided into two. First, if non-banks start high agency cost projects, then they will necessarily start low cost counterparts; obviously, those projects must succeed in the first round. Second, one can find conditions such that banks only fund low agency cost projects by inducing effort in the first round: serving high agency costs projects would require an outlay $2\underline{A}$ that makes these projects unattractive for banks. Finally, the third part states that while a low-cost structure may have a strategic disadvantage—in that it implies paying rents twice as large as those that non-banks would pay—it still has a *direct* advantage with low agency cost projects: despite the larger payouts, the low rates faced yield higher profits than those obtained by non-banks.

**Coexistence between banks and non-banks** Returning to our goal to move away from entities, we depart from the authors' analysis by establishing the coexistence between banks and non-banks via a simultaneous-move game, which is depicted below. In this game, a *generic* intermediary chooses between two types of strategies: a strategy with low funding costs ('bank'), or one featuring high interest rates ('non-bank'). Similarly, a generic entrepreneur chooses between a project with high (HAC) or low (LAC) agency costs. (The $(bank, HAC)$ entry displays trivial payoffs due to banks not funding high agency cost projects.)

*Entrepreneur*

| *Intermediary* | | LAC | HAC |
|---|---|---|---|
| | bank | $\frac{R-2\underline{A}}{1+r_B} - K_0\ ,\ 2\underline{A}$ | $0\ ,\ 0$ |
| | non-bank | $\frac{R-\underline{A}}{1+r_N} - K_0\ ,\ \underline{A}$ | $\frac{R-\bar{A}}{1+r_N} - K_0\ ,\ \bar{A}$ |

Given the previous proposition, (bank, LAC) and (non-bank, HAC) are pure-strategy Nash equilibria of the game: that is, the intermediaries specialize their lending activities. The presence of two such equilibria implies the existence of an equilibrium in mixed strategies: for suitably chosen $a \in (0,1)$ and $b \in (0,1)$, it is optimal for a fraction $a \in (0,1)$ of—small, ex ante identical—intermediaries to become 'banks' when expecting random encounters with entrepreneurs where a fraction $b \in (0,1)$ of the latter possess $LAC$ projects, and vice versa.[19] Put differently, the *population interpretation* of Nash equilibria naturally delivers a coexistence result between banks and non-banks, with the latter holding a strategic advantage in dealing with "riskier" (in an agency-cost sense) projects.

## 6.2 Discussion: Entities and Interest Rates

As in previous sections, we now map the strategies to entities observed in practice, followed by a discussion of drivers of the rise of NBFIs in this area: in this particular case, the importance of interest rates.

[19] Recall that these scalars must make the players indifferent between strategies:

$$\underbrace{a\left[\frac{R-2\underline{A}}{1+r_B} - K_0\right] + (1-a)\times 0}_{\text{I's payoff from } bank} = \underbrace{a\left[\frac{R-\underline{A}}{1+r_N} - K_0\right] + (1-a)\left[\frac{R-\bar{A}}{1+r_N} - K_0\right]}_{\text{I's payoff from } non-bank}, \quad \text{and}$$

$$\underbrace{b\times 2\underline{A} + (1-b)\underline{A}}_{\text{E's payoff from } LAC} = \underbrace{b\times 0 + (1-b)\bar{A}}_{\text{E's payoff from } HAC}\ .$$

**From strategies to entities** The basic model examined may be viewed as a description of *staged financing*: a situation where the funding for a long-term project is provided in stages, contingent on past performance. As noted by Donaldson et al. (2021), intermediaries that carry out these strategies include private equity funds and venture capitalists.

More generally, the growing importance of non-bank intermediaries in lending is manifested in the recent rise of *private credit*, or debt financing by NBFIs without the direct involvement of banks or public capital markets. As one of the fastest growing asset categories in private capital markets, it amounts to $1.4 trillion in assets under management as of Q2 2022,[20] or over 30% of outstanding high-yield bonds, syndicated loans, and private credit combined (Acharya et al., 2024). Private credit firms can carry out the strategies studied when they invest in early-stage firms using venture debt financing, typically through the use of short-maturity term loans.

However, a fundamental difference relative to the setting just studied is that private credit firms tend to rely heavily on bank funding to carry out their lending. Therefore, to study this phenomenon one needs to modify the previous analysis to allow for a profitable vertical relationship between entities that (ex-post) may be categorized as banks and non-banks—this is what we examine in Section 6.3.

**Interest rate regime switches** Given the prominent role that interest rates play in the model, it is natural to contrast the model's predictions across different levels of interest rates. One prediction is that transitions from high-rate regimes to low-rate counterparts would imply a shift from a bank-centric world towards one in which banks and non-banks coexist, albeit in a specialized form: each type of entity caters to a different segment.

Concretely, envision first an environment with "moderately high" rates, understood as the rates $r_B < r_N$ high enough that banks do not suffer from a credibility problem, but not too high so that projects are funded. In this case, banks should be the dominant type of entity in the lending business: just like non-banks, they can credibly commit to harsh penalties if projects underperform; and their lower funding costs give them an edge in attracting both types of projects. As rates fall, however, two phenomena can simultaneously arise. First, banks may find it difficult to fund HAC projects for the same incentive considerations just described. Second, wholesale funding markets can take off as investors begin looking for options that yield higher returns. As non-banks take advantage of these emerging wholesale markets, they start serving the otherwise bank-excluded HAC projects. In other words, reductions in interest rates make the lending market more competitive.

These implications are consistent with the analysis of Sarto and Wang (2023) in the

[20] See Preqin.

mortgage market, where they document that the share of mortgages held by non-banks—a high HAC market segment—increased more in counties where banks were more exposed to lower interest rates, and vice-versa. While they propose a mechanism based on market power, in their setup bank profits are also large in high-interest regimes, partly because banks' monopoly power in the deposit market enables them to sustain large spreads $r_N - r_B$ when interest rates are high. From this perspective then, both settings speak to a similar phenomenon: either due to monopolistic or strategic considerations, competition intensifies as rates fall.

### 6.3 Vertical Relationships: Banks Funding Non-Banks

As already anticipated, a distinguishing feature of private credit is that the intermediaries engaging in this practice tend to rely heavily on bank funding to carry out their lending. Using the same tools from Section 6.1, we now show that such a profitable vertical relationship between entities—that ex-post may be categorized as banks and non-banks—can arise in equilibrium.

Our idea is to construct an extreme scenario in which current market rates for non-banks make the funding of high agency cost projects unattractive, and hence these projects do not receive credit initially. Concretely, consider a tuple $(R, \bar{A}, \underline{A}, r_N, r_B, K_0, K_1)$ as in Proposition 2, also satisfying that $\bar{A} - 2\underline{A} > 0$—an assumption we will discuss shortly. Such a tuple exists because lowering $\underline{A}$ to satisfy this constraint does not conflict with any of the conditions in Proposition 2. As non-bank rates $r_N$ increase while the rest of the parameters remain fixed, there will be a threshold $r_N^\dagger$ such that

$$\frac{R - \bar{A}}{1 + r'_N} - K_0 < 0, \text{ if and only if } \; r'_N > r_N^\dagger, \tag{4}$$

while all other relevant constraints continue to be satisfied (except for the fact that non-banks may cease to fund projects altogether.) Thus, high agency cost projects cease to have positive NPV for non-banks, and only low agency cost ones receive credit (banks having an edge over non-banks because of their higher profits).

Equipped with $(R, \bar{A}, \underline{A}, r'_N, r_B, K_0, K_1)$ where $r'_N$ satisfies (4), we can show that banks optimally continue serving low agency cost projects while inducing non-banks to serve high agency cost counterparts. To establish this result, we continue to assume that initially refusing to provide funds is an irreversible choice (i.e., it is not possible to encounter an entrepreneur with start-up costs of $K_1$), and further assume that a bank has the option to delegate a project to a non-bank, also in an irreversible manner (i.e., it is not possible to steal back an entrepreneur after $K_0$ has been sunk with a different intermediary). For simplicity, suppose that non-banks have no cash.

**Proposition 3.** *Suppose that a bank offers a credit line with limit $K_0$ and repayment interest $r_N^\dagger$ to a non-bank. Then, the non-bank is willing to fund HAC (and a fortiori LAC) projects by drawing down the credit line. Banks in turn find it optimal to fund LAC projects while delegating HAC projects to non-banks.*

The logic is simple. A non-bank is willing to fund an HAC project because the threshold rate $r_N^\dagger$ allows the intermediary break even when doing so. In the process, banks earn a spread ($r_N^\dagger - r_B > 0$) per dollar lent to a non-bank via the credit line, increasing their profits relative to the previous section—note that this is the largest spread that incentivizes non-banks to engage in the type of credit studied. The condition $\bar{A} - 2\underline{A} > 0$ simply ensures that it is profitable for banks to continue serving LAC projects rather than delegating them to non-banks; thus, the intermediaries continue segmenting the market as before.

**Interest rate switches revisited** While in section 6.2 we examined how competition between banks and non-banks intensified as interest rates fall, this model variation sheds light on the flip-side: how a mutually beneficial cooperation between banks and non-banks can be fostered as rates transition from low to high levels. Indeed, as this occurs and non-banks increasingly lose the ability to serve riskier segments, our results indicate that banks can insulate non-banks from their loss, to the extent that there is a mechanism that leads banks' funding rates to respond less strongly to higher rates (as in the deposit market power mechanism proposed by Sarto and Wang, 2023). Thus, one prediction of the model is that this type of regime switch should be accompanied by greater non-bank reliance on bank funding—the mutually advantageous cooperation between banks and non-banks strengthens.

**Private credit revisited** Private credit refers to debt financing by NBFIs without the direct involvement of banks or public capital markets. While private credit financing involves many areas such as transportation equipment, real estate, structured debt assets, and so on, one category of particular importance is *direct lending*: direct credit to firms granted by finance companies and private debt funds. The firms that seek direct lending usually share two key characteristics. First, they are mid-sized—or "middle-market" firms—reporting between \$50 million and \$1 billion in annual revenue. Second, they are usually riskier and unable to borrow directly from banks, which results in higher borrowing rates and fees—for instance, the gross yields that investors are required to pay private debt funds are more than twice those of syndicated bank loans.[21] See Erel et al. (2024), Chernenko et al. (2022), and Block et al. (2023) for more on this topic.

What is noteworthy is that while banks have over time stepped back from providing direct credit to middle-market borrowers (Chernenko et al., 2022), they continue to finance them *indirectly* by lending to NBFIs. For example, Acharya et al. (2024) state that "banks have retained indirect loan exposures through senior loans to private credit companies, collateralized loans to mortgage Real Estate Investment Trusts (mortgage REITs, or mREITs), and the generally more senior claims of mortgage-backed securities (MBS) and collateralized loan obligations (CLOs)." They note that, in 2023, REITs were among the largest users of bank credit lines, which were deployed mainly for warehouse financing (i.e., to purchase assets such as property in the case of equity REITs, or mortgages by the so-called mREITs). A particularly interesting example discussed by Acharya et al. (2024) involves the asset management company Blackstone and its Blackstone Private Credit Fund (BCRED) arm, currently the largest private credit fund in the world with over $50 billion of assets. Subsidiaries of BCRED arranged 19 secured credit commitment facilities, worth $23.5 billion in total as of December 2022, with 18 of these 19 facilities provided by 13 banks. The outstanding amounts drawn on these facilities was about $14 billion, or about 50% of BCRED's total debt liabilities.

Our analysis bears many similarities with this recent phenomenon. First, non-banks are engaging in direct lending with firms that are deemed too costly to be served by banks. Second, NBFIs charge lending rates than are substantially greater than those by banks. Third, banks find it profitable to commit funds to NBFIs—in our model, because there are non-trivial spreads that can be arbitraged. Finally, since direct lenders actively monitor and engage in loan restructurings similar to banks (Jang, 2024), they are capable of monitoring and developing expertise in mid-market firms; while unmodeled, this is another force inducing banks to expand markets through NBFIs.

# 7 A Transversal View Across Models and Concluding Remarks

Intermediation entities are dynamic over time and across space. Over time, entities emerge and disappear, change organizational forms, and alter their business and funding models. Across space, entities expand to provide different intermediation services, such as banks providing asset management services. The boundaries delimiting institution types, and their

[21] For example, private debt funds typically charge an annual management fee of about 1.5 percent and a "carried interest" of 15 percent (Erel et al., 2024).

activities, are more often than not an accident of history, driven by institutional and regulatory constraints, with boundaries bound to be crossed and redrawn, as entities adapt and evolve in the strategy space. However, research and policy analysis have focused almost exclusively on the *entity* space, whether banks or non-banks, depending on which set of institutions are considered important at a given time. This approach has constrained policy from moving towards a "similar risk, similar regulation" approach, while research has been slow to identify important trends in financial intermediation.

Responding to these concerns, we propose an approach that starts from the identification of intermediation *functions* that fulfill the basic needs of society (e.g. safety, savings, investments and incentive management). Such functions are more likely to remain constant over time, thus representing a solid foundation on which to build our conceptual framework. Furthermore, this approach is more amenable to identifying the commonalities across activities rather than the specificity in the entities domain.

Borrowing from Merton (1995), we focus on three main intermediation functions directly related to the provision of credit and liquidity services. We start by introducing a core game tree representation that is common to all three functions, thereby emphasizing the underlying unity in alternative ways to service different intermediation functions. Then, we specialize the core game tree to each function and build models in which agents devise *strategies* to optimally serve that function. The equilibrium outcomes in these models depend on economic drivers such as regulation (e.g. in the form of government guarantees), innovation, market competition and liquidity, interest rate regimes and business cycles.

As a final step, we map the equilibrium strategies to real-world entities, thereby completing the conceptual cycle from function and strategies to actions and entities. Since agents may utilize multiple strategies to provide a function, the expanded strategy space along with the ex-post mapping allows us to characterize a rich ecosystem of entities such as banks, mutual funds, special purpose vehicles, issuers of securitized assets, specialty lenders, private debt funds, and business development companies. Importantly, the existence and the role of such entities are derived as optimal outcomes of our models, and not posited ex-ante.

We next discuss the research and policy insights that are unique to our approach, and go beyond those available in the literature. We end with a brief discussion of financial stability issues that are mostly outside the scope of this paper.

**Research insights** A typical entity-based approach may start with the question "Why are banks special?" and then examine how banks and non-banks differ in serving certain functions. In contrast, the function-based approach—which puts all entities on equal footing ex ante—naturally speaks to the coexistence of banks and non-banks: their businesses compete in some situations and cooperate in others. As competitors, banks and non-banks can act as *substitute* entities by providing the same intermediation service but using different strategies. Alternatively, depending on the strategy space, entities can be in a *complementary* relationship, so that their growths are co-dependent. As the relative attractiveness of these strategies depends on their economic drivers, our approach leads to a characterization of how different entity types are likely to evolve as conditions change. Our approach generalizes that in the existing literature, which primarily focuses on competition between banks and non-banks (see, for example, Jiang (2023)), thereby allowing for a more complete welfare analysis.[22] Secondly, while the literature has exclusively focused on credit markets, our method may be applied in other contexts, such as the provision of safe assets.

**Policy insights** The existing literature emphasizes particular institutional and regulatory developments behind the growth of specific entities (e.g. the rise of MMMFs as a response to regulatory restrictions on banks). In our approach, the fungibility of the strategy space lends itself to fresh policy insights. For example, the function-based approach provides a new twist to the debate on whether LoLR benefits should be extended to non-banks. Our analysis in section 6.3 reveals that banks may, in some cases, "rent out" their LoLR benefits to non-banks via a credit line, with novel implications for policy. Consider a reduction in the value of government guarantees to banks that, in the first instance, benefit non-banks such as mutual funds at the expense of banks. However, such reductions may also imply an increase in banks' funding rates, all else equal, and reduce the viability of bank funding of non-bank strategies, potentially forcing the latter to cut back on credit provision.

**Financial stability considerations** Our approach can be seen as trying to uncover factors that shape the profitability of certain financial intermediation strategies during *normal times*. However, other factors that may amplify the negative effects to the economy of maturity transformation, shifts in beliefs, and interconnectedness, can play a key role during crises. While our analysis can implicitly speak to these issues—an element of maturity transformation is embedded in the market illiquidity affecting the EL strategy of section 4.1; shifts in the perception of risk were demonstrated to non-trivially affect the securitization strategy of section 5.3; and a form of interconnection is at play in the vertical relationship arising in the agency model of section 6.3—repurposing the analysis to put financial stability considerations at the center is a natural venue for future work.

[22] For an approach stressing cooperation, see Xu (2025).

# 8 Appendix

*Proof of Lemma 1.* Let us introduce some notation. First, $F^{\omega,-}$ denotes the expected value of the asset after pessimistic news (with prob $1 - p_\omega$) given state $\omega = g, b$. Likewise, $F^\omega$ denotes the expected value of the asset in state $\omega = g, b$. It follows that for $\omega = g, b$:

$$F^{\omega,-} = q_\omega R + (1 - q_\omega - \epsilon_\omega)z$$
$$F^\omega = p_\omega R + (1 - p_\omega)F^{\omega,-}$$

Our assumptions on probabilities yield $F^{g,-} > F^{b,-}$ and $F^g > F^b$, i.e., the good state always generates a higher expected payoff. We now turn to calculating the total funds that each strategy can raise.

**Traditional banking strategy** From a time-0 perspective, the actuarial fair value of insurance now is $\iota(z) := \beta z[\pi(1 - p_g)\epsilon_g + (1 - \pi)(1 - p_b)\epsilon_b]$. Thus, this strategy raises

$$\begin{aligned} V^B &= (\beta + \gamma)z - \iota(z) + \beta(R - z) \underbrace{\{\pi[p_g + (1 - p_g)q_g] + (1 - \pi)[p_b + (1 - p_b)q_b]\}}_{\text{probability of asset paying } R} \\ &= \gamma z + \beta\{\pi[p_g R + (1 - p_g)F^{g,-}] + (1 - \pi)[p_b R + (1 - p_b)F^{b,-}]\} \\ &= \gamma z + \beta[\pi F^g + (1 - \pi)F^b]. \end{aligned} \tag{5}$$

We again obtain a premium term $\gamma z$ plus the expected value of the asset—because it is held until maturity—now averaged across different states of the world.

**Early liquidation strategy** This strategy also admits an almost identical analysis to that in Section 4.1. The only difference is that, upon observing pessimistic news, investors do not know what state they are in. They update their belief about the state using Bayes' rule:

$$\pi^- := \text{Prob}(\omega = g|\text{pessimistic news}) = \frac{(1 - p_g)\pi}{(1 - p_g)\pi + (1 - p_b)(1 - \pi)}.$$

The expected value of the asset conditional on pessimistic news is then given by

$$F^- := \pi^- F^{g,-} + (1 - \pi^-)F^{b,-}.$$

The liquidation value of the asset at time 1 is then $kF^-$. We conclude that this strategy can raise a total amount of funds—deposits plus equity—equal to

$$\begin{aligned} V^R &= (\beta+\gamma)kF^- + \beta(R - kF^-)\underbrace{[\pi p_g + (1-\pi)p_b]}_{\text{prob. optimistic news}} \\ &= \gamma kF^- + \beta\underbrace{[R(\pi p_g + (1-\pi)p_b) + kF^-(1 - \{\pi p_g + (1-\pi)p_b\})]}_{\text{expected cash flows}} \end{aligned} \tag{6}$$

**Securitization** As before, we assume that there is a continuum of assets with payoffs as in the diagram, with total mass 1. Conditional on the state of the world, the assets are independent random variables, and they are pooled to generate an ABS. The latter's ex-post payoff is given by

$$F^g \mathbb{1}_{\omega=g} + F^b \mathbb{1}_{\omega=b}.$$

(Recall that by the LLN, pooling delivers the expected value of the asset conditional on the underlying state of the world.)

Since $0 < F^b < F^g$, the ABS can always offer $F^b$ with certainty in the senior tranche, while $F^g - F^b$ in the junior counterpart, albeit with probability $\pi$. Thus, the securitization strategy yields:

$$V^S = (\beta+\gamma)F^b + \beta\pi[F^g - F^b] = \gamma F^b + \beta[\pi F^g + (1-\pi)F^b].$$

This concludes the proof.

□

*Proof of Proposition 1:* Assume $k \equiv 1$. In this case, $V^{EL} > V^S \Leftrightarrow F^- > F^b$. Furthermore,

$$\begin{aligned} F^b &= F^{b,-} + p_b[R - F^{b,-}], \text{ while} \\ F^- &= F^{b,-} + \pi^-[F^{g,-} - F^{b,-}], \end{aligned} \tag{7}$$

where $F^{\omega,-}$, $\omega \in \{g, b\}$ was defined in the proof of Lemma 1, and $\pi^-$ (defined in the same proof) corresponds to the probability of a good state conditional on pessimistic news being observed.

Using these expressions, we conclude that $F^- > F^b$ is equivalent to

$$\pi^-[F^{g,-} - F^{b,-}] > p_b[R - F^{b,-}]. \tag{8}$$

Since in a *growth* environment $p_g > p_b > 0$, while $q_b = q_g$ and $\epsilon_g = \epsilon_b$, we conclude that $F^{g,-} = F^{b,-}$. Thus, $F^b > F^-$ due to the left-hand side of (8) vanishing. On the other hand, with *long-term uncertainty* $p_b = 0$, and so the right-hand of (8) now vanishes. If either $q_g \geq q_b$ or $\epsilon_b \geq \epsilon_g$ are strict, we have that $F^{g,-} > F^{b,-}$, which yields $F^- > F^b$—the early liquidation strategy is better than securitization.

*Proof of Proposition 2.* Fix $R > 0$ in what follows. Consider the following conditions:

$$\frac{R - \underline{A}}{1 + r_N} < K_1 \quad \text{(non-banks never continue projects)} \tag{9}$$

$$\frac{R - \bar{A}}{1 + r_N} > K_0 \quad \text{(non-banks start both projects)} \tag{10}$$

$$\frac{R - \underline{A}}{1 + r_B} > K_1 \quad \text{(banks continue both projects)} \tag{11}$$

$$\frac{R - 2\bar{A}}{1 + r_B} < K_0 \quad \text{(banks do not start HAC set up to succeed early)} \tag{12}$$

$$\frac{R - 2\underline{A}}{1 + r_B} > K_0 \quad \text{(LACs that succeed early are profitable for banks)} \tag{13}$$

$$\frac{R - 2\underline{A}}{1 + r_B} > \frac{R - \underline{A}}{1 + r_N} \quad \text{(banks make higher profits from LACs than non-banks)} \tag{14}$$

Set $\underline{A} = 0$ in the above. In this case, (14) always holds as long as $r_B < r_N$. Also, if (10) holds, then $\frac{R}{1+r_B} - K_0 > 0$, so (13) holds. Now, putting (10) and (11) together yields:

$$\frac{R - \bar{A}}{1 + r_N} > K_0 > \frac{R - 2\bar{A}}{1 + r_B}.$$

While (9) and (11) read

$$\frac{R - \bar{A}}{1 + r_B} > K_1 > \frac{R}{1 + r_N}.$$

Choosing $\bar{A} = R/2$, in the latter display, we obtain

$$\begin{aligned} \frac{R}{2(1 + r_B)} > &K_1 > \frac{R}{(1 + r_N)} \\ &\Rightarrow r_B < \frac{r_N - 1}{2}. \end{aligned} \tag{15}$$

In turn, the two-sided inequality for $K_0$ becomes

$$\frac{R}{2(1 + r_N)} > K_0 > 0. \tag{16}$$

We need two additional conditions. First, banks prefer to funds LAC projects that succeed in the first round rather than saving agency costs and inducing success in the last round:

$$R - 2\underline{A} > \frac{R - \underline{A}}{1 + r_B} - K_1.$$

Note that this condition is always satisfied at $\underline{A} = 0$ as long as $K_1 > 0$.

Second, we impose that banks find HAC projects unprofitable when saving on effort costs in the first round (so, jointly with (12), banks effectively never fund them):

$$-K_0 - \frac{K_1}{1 + r_B} + \frac{R - \bar{A}}{(1 + r_B)^2} < 0 \Leftrightarrow K_0 > \frac{1}{1 + r_B}\left[\frac{R - \bar{A}}{(1 + r_B)} - K_1\right]$$

Setting $\bar{A} = R/2$, the condition becomes

$$K_0 > \frac{1}{1 + r_B}\left[\frac{R}{2(1 + r_B)} - K_1\right].$$

Choosing $r_B$ and $r_N$ satisfying (15) enable us to pick $K_1 = \frac{R}{2(1+r_B)} - \epsilon$, with $\epsilon > 0$ small so that (15) continues to hold. Plugging this in the last expression, and considering (16), we obtain

$$\frac{R}{2(1 + r_N)} > K_0 > \frac{\epsilon}{1 + r_B}.$$

Letting $\epsilon$ be sufficiently small, there is $K_0$ such that both inequalities hold. By continuity, all inequalities hold for $\underline{A} > 0$ (so LAC projects have agency problems) and $\overline{A}$ close to $R/2$.

**Alternative argument** The previous proof requires checking that a bank does not want to delay success for HAC projects either: essentially burning $K_0$ and skipping agency costs $\bar{A}$ at $t = 1$, to induce success at $t = 2$. Indeed, this strategy can be more profitable than inducing success at $t = 1$ because, when $\bar{A} = R/2$:

$$\begin{aligned} -K_0 - \frac{K_1}{1 + r_B} + \frac{R - \bar{A}}{(1 + r_B)^2} &> -K_0 + \frac{R - 2\bar{A}}{1 + r_B} \\ \Leftrightarrow -\frac{K_1}{1 + r_B} + \frac{R}{2(1 + r_B)^2} &> 0 \end{aligned} \tag{17}$$

which is true because banks would continue HAC projects. The reason for this is that agency costs $\bar{A}$ are just too large.

Instead, consider $\bar{A} = R/4$. The two-sided inequality for $K_0$ (16) then becomes

$$\frac{3R}{4(1+r_N)} > K_0 > \frac{R}{2(1+r_B)} \Rightarrow r_N < \frac{3}{2}r_B + \frac{1}{2}.$$

On the other hand, the two-sided condition for $K_1$ becomes (after setting $\underline{A} = 0$):

$$\frac{3R}{4(1+r_B)} > K_1 > \frac{R}{1+r_N} \Rightarrow r_N > \frac{4}{3}r_B + \frac{1}{3}.$$

Given any $r_B > 0$ then, we obtain a non-trivial interval for values $r_N > r_B$:

$$r_N \in \left(\frac{4}{3}r_B + \frac{1}{3}, \frac{3}{2}r_B + \frac{1}{2}\right).$$

Now, the constraint that banks prefer LAC projects that succeed earlier than those that succeed later is the same, and hence continues to hold. Now we check that banks prefer HAC projects to succeed earlier than in the second period:

$$\begin{aligned} -K_0 - \frac{K_1}{1+r_B} + \frac{R-\bar{A}}{(1+r_B)^2} &< -K_0 + \frac{R-2\bar{A}}{1+r_B} \\ \Leftrightarrow -K_1 + \frac{3R}{4(1+r_B)} &< \frac{R}{2} \\ \Leftrightarrow K_1 &> \frac{R}{2}\frac{1-2r_B}{2(1+r_B)}. \end{aligned} \tag{18}$$

So, $r_B > 1/2$ makes this constraint always true. In other words, if $\bar{A} = R/4$ and $r_B > 1/2$, we can pick $r_N \in \left(\frac{4}{3}r_B + \frac{1}{3}, \frac{3}{2}r_B + \frac{1}{2}\right)$ such that

$$I_0 := \left(\frac{R}{2(1+r_B)}, \frac{3R}{4(1+r_N)}\right) \quad \text{and} \quad I_1 := \left(\frac{R}{1+r_N}, \frac{3R}{4(1+r_B)}\right) \tag{19}$$

are non-empty intervals. Choosing $K_0 \in I_0$ and $K_1 \in I_1$, there exists $\underline{A} > 0$ such that all the inequalities hold and (bank, LAC) and (non-bank, HAC) are pure-strategy Nash equilibria and these projects are always induced to succeed in $t = 1$.

□

*Proof of Proposition 3.* Consider a tuple $(R, \bar{A}, \underline{A}, r'_N, r_B, K_0, K_1)$ as stated in the paragraph before the proposition. Concretely, start first with $(R, \bar{A}, \underline{A}, r_N, r_B, K_0, K_1)$ as in Proposition 2, but also satisfying $\overline{A} - 2\underline{A} > 0$: this is possible by continuity of the latter constraint in $\underline{A}$ around zero. Now, define $r_N^\dagger > r_N$ as

$$\frac{R - \bar{A}}{1 + r'_N} - K_0 = 0. \tag{20}$$

Equipped with this, we replace $r_N$ by $r'_N > r_N^\dagger$ in the previous tuple, and so non-banks do not want to start HAC projects at the rate $r'_N$. This is the starting point of our economy. Importantly, it is easy to conclude from inspection of the proof of Proposition 2 that the only additional constraint that can possibly be violated—if $r'_N$ is sufficiently large—is (10): non-banks may cease to be willing to start LAC projects. But the rest hold.

In this case then, the bank faces the same credibility problem as in the baseline model when accepting to fund an HAC project—thus, directly managing these projects in unprofitable for banks. Instead, delegating to a non-bank in an irreversible manner, complemented with access to a credit line at rate $r_N^\dagger$, the bank earns a positive profit of $K_0(r_N^\dagger - r_B) > 0$: the initial loan $K_0$ times the spread. One way to implement the previous commitment to delegating the project is via conditioning future access to the credit line (i.e., the additional take up of funds) on repayment of the current loan (i.e., on the current project's success)—this explains why the credit line is capped at $K_0$ in the statement of the result.

This means that delegating an HAC project is a profitable option for the bank. Also, the non-bank is willing to take on managing an HAC project with the support of the credit line by construction, as this yields a profit of $R - \bar{A} - K_0 \times (1 + r_N^\dagger) = 0$ in time-1 dollars for non-banks. Now, because HAC projects are profitable for non-banks, so are LAC projects; meanwhile, the profits that banks make from funding LAC projects are the same as before, i.e., $\frac{R-2\underline{A}}{1+r_B} - K_0 > 0$. We need to check, however, that banks do not find it profitable to delegate LAC projects too. This condition reads:

$$\underbrace{\frac{R - 2\underline{A}}{1 + r_B} - K_0}_{\text{bank's profits from funding LACs}} > \underbrace{-K_0 + \frac{K_0(1 + r_N^\dagger)}{1 + r_B}}_{\text{profits from delegating LAC}}$$
$$\Leftrightarrow R - 2\underline{A} > K_0(1 + r_N^\dagger)$$

Using that $r_N^\dagger$ satisfies $K_0(1 + r_N^\dagger) = R - \bar{A}$, the condition reduces to

$$R - 2\underline{A} - (R - \bar{A}) > 0 \Leftrightarrow \bar{A} - 2\underline{A} > 0$$

which is satisfied by assumption. This concludes the proof.

□

# References

**Acharya, Viral V., Nicola Cetorelli, and Bruce Tuckman**, "Where Do Banks End and NBFIs Begin?," *NBER Working Paper 32316*, 2024.

**Allen, Franklin and Anthony M. Santomero**, "The Theory of Financial Intermediation," *Journal of Banking and Finance*, 1996, *21*, 1461±1485.

**Bertaut, Carol C., Laurie DeMarco, Steven B. Kamin, and Ralph Tryon**, "Abs Inflows to the United States and the Global Financial Crisis," *Journal of International Economics*, 2011, *88*, 219–34.

**Bhattacharya, Sudipto and Anjan V. Thakor**, "Contemporary Banking Theory," *Journal of Financial Intermediation*, 1993, *3*, 2–50.

**Block, Jorn Hendrich, Young Soo Jang, Steven Neil Kaplan, and Anna Schulze**, "A Survey of Private Debt Funds," *NBER Working Paper No w30868*, 2023.

**Bond, Philip**, "Bank and Nonbank Financial Intermediation," *Journal of Finance*, 2004, *59* (6), 2489–2529.

**Borio, Claudio, Stijn Claessens, and Nikola Tarashev**, "Entity-based vs activity-based regulation: a framework and applications to traditional firms and big techs," *Financial Stability Institute Occasional Paper No. 19*, 2022, *August.*

**Buchak, Greg, Gregor Matvos, Tomasz Piskorski, and Amit Seru**, "The Secular Decline of Bank Balance Sheet Lending," *NBER Working Paper 32176*, 2024.

**Cai, Fang and Sharjil Haque**, "Private Credit: Characteristics and Risks," *FEDS Notes*, 2024, *https://doi.org/10.17016/2380-7172.3462.*

**Cetorelli, Nicola**, "Hybrid Intermediaries," *Federal Reserve Bank of New York Staff Report*, 2014, *December.*

– **and Saketh Prazad**, "The Nonbank Footprint of Banks," *FRB of New York Staff Report No. 1118*, 2024. Available at SSRN https://ssrn.com/abstract=4965069 or http://dx.doi.org/10.2139/ssrn.4965069.

– **and Stavros Peristiani**, "The role of banks in asset securitization," 2012.

**Chernenko, Sergey, Isil Erel, and Robert Prilmeier**, "Why Do Firms Borrow Directly from Nonbanks?," *The Review of Financial Studies*, 2022, *35* (11), 4902–4947.

– **, Samuel Gregory Hanson, and Adi Sunderam**, "The Rise and Fall of Demand for Securitizations," *NBER Working Paper No 20777*, 2014.

**Christensen, Jens H. E. and Nikola Mirkov**, "Exploring the Safety Premium of Safe Assets," *Federal Reserve Bank of San Frisco Economic Letter*, 2021, *13* (May), 1–5.

**Donaldson, Jason Roderick, Giorgia Piacentino, and Anjan Thakor**, "Warehouse banking," *Journal of Financial Economics*, 2018, *129* (2), 250–267.

**– , – , and –** , "Intermediation Variety," *Journal of Finance*, 2021, *76* (6), 3103–3152.

**Duffie, Darrell**, "Dynamic Asset Pricing Theory:," *Third Edition, Princeton University Press*, 2001.

**Economic Sciences Prize Committee**, "Financial intermediation and the economy," *Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2022, The Royal Swedish Academy of Sciences*, 2022. The Committee for the Prize in Economic Sciences in Memory of Alfred Nobel.

**Erel, Isil and Eduard Inozemtsev**, "Evolution of Debt Financing toward Less-Regulated Financial Intermediaries in the United States," *Working Paper*, 2024. Available at SSRN: https://ssrn.com/abstract=4151880 or http://dx.doi.org/10.2139/ssrn.4151880.

– **, Thomas Flanagan, and Michael S. Weisbach**, "Risk-Adjusting the Returns to Private Debt Funds," *NBER Working Paper No. 32278*, 2024.

**Fritsch, Laura, Wayne Lim, Alexander Montag, Martin C. Schmalz, and Martin C. Schmalz**, "Direct Lending: Evidence from European and U.S. Markets," *Journal of Alternative Investments*, 2022, *Forthcoming.*

**FSB**, "Strengthening Oversight and Regulation of Shadow Banking," *Financial Stability Board*, 2013, *August.*

– , "Global Monitoring Report on Non-Bank Financial Intermediation 2023," *Financial Stability Board*, 2023, *December.*

**Garbade, Kenneth**, "The Emergence of 'Regular and Predictable' as a Treasury Debt Management Strategy," *Economic Policy Review*, 2007, *13* (1).

**Gennaioli, N., A Shleifer, and R.W. Vishny**, "Neglected Risks, financial innovation, and financial fragility," *Journal of Financial Economics*, 2012, *104* (3), 452–468.

– , – , and – , "Neglected Risks: The Psychology of Financial Crises," *American Economic Review*, 2015, *105* (5), 310–14.

**Gennaioli, Nicola, Andrei Shleifer, and Robert W. Vishny**, "A Model of Shadow Banking," *Journal of Finance*, 2013, *68* (4), 1331–1363.

**Gorton, Gary**, "The History and Economics of Safe Assets," *Annual Review of Economics*, 2017, *9*, 547–586.

– **and Andrew Metrick**, "Securitized banking and the run on repo," *Journal of Financial Economics*, 2012, *104* (2), 425–451.

– **and Nicholas S. Souleles**, "Special Purpose Vehicles and Securitization," *in The Risks of Financial Institutions*, 2007. Mark Carey and René M. Stulz, editors.

**Gorton, Gary B. and Andrew Winton**, "Financial Intermediation," *in Handbook of the Economics of Finance*, 2003, *1*, 431–552.

**Hanson, Samuel, Andrei Shleifer, Jeremy C Stein, and Robert W Vishny**, "Banks as patient fixed-income investors," *Journal of Financial Economics*, 2015, *117* (3), 449–469.

– **, Victoria Ivashina, Laura Nicolae, Andrei Shleifer, Jeremy C Stein, and Daniel K. Tarullo**, "The Evolution of Banking in the 21st Century: Evidence and Regulatory Implications," *Brookings Papers on Economic Activity*, 2024, *BPEA Conference Draft.*

**Holmström, Bengt and Jean Tirole**, "Private and public supply of liquidity," *Journal of political Economy*, 1998, *106* (1), 1–40.

**Jang, Young Soo**, "Are Direct Lenders More Like Banks or Arm's-Length Investors?," *Working Paper*, 2024. Available at SSRN: https://ssrn.com/abstract=4529656 or https://dx.doi.org/10.2139/ssrn.4529656.

**Jiang, Erica Xuewei**, "Financing Competitors: Shadow Banks' Funding and Mortgage Market Competition," *The Review of Financial Studies*, 2023, *36* (10), 3861–3905.

**Kashyap, Anil K., Raghuram Rajan, and Jeremy C. Stein**, "Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-taking," *Journal of Finance*, 2002, *57* (1), 33–73.

**Khanna, Naveen and Richmond D. Mathews**, "Skill versus Reliability in Venture Capital," *Journal of Financial Economics*, 2022, *145* (2), 41–63.

**Koijen, Ralph S. J. and Motohiro Yogo**, "The evolution from life insurance to financial engineering," *The Geneva Risk and Insurance Review*, 2021, *46* (2), 89–111.

**Kreps, David M**, *Microeconomics for managers*, Princeton University Press, 2019.

**Lerner, Josh, Amit Seru, Nick Short, and Yuan Sun**, "Financial Innovation in the 21st Century: Evidence from U.S. Patents," *NBER Working Paper 28980*, 2023.

**Liran, Einav, Amy Finkelstein, and Jonathan Levin**, "Beyond Testing: Empirical Models of Insurance Markets," *Annual Review of Economics*, 2020, *2*, 311–36.

**Menand, Lev and Josh Younger**, "Money and the Public Debt: Treasury Market Liquidity as a Legal Phenomenon," *Working Paper*, 2023, (1). Available at https://ssrn.com/abstract=4567016.

**Merton, Robert**, "A functional perspective of financial intermediation," *Financial Management*, 1995, *24* (2), 23–41.

**Merton, Robert C. and Zvi Bodie**, "A Conceptual Framework for Analyzing the Financial Environment," *Chap. 1 in The Global Financial System: A Functional Perspective, By D. B. Crane, K. A. Froot, Scott P. Mason, André Perold, R. C. Merton, Z. Bodie, E. R. Sirri, and P. Tufano*, 1995, p. 3–31.

**Metrick, Andrew and Daniel K. Tarullo**, "Congruent Financial Regulation," *Brookings Papers on Economic Activity*, 2021.

**Pozsar, Zoltan**, "Institutional Cash Pools and the Triffin Dilemma of the U.S. Banking System," *IMF Working Paper No. 2011/190*, 2011.

**Sarto, Andrés and Olivier Wang**, "The Secular Decline in Interest Rates and the Rise of Shadow Banks," *Working Paper*, 2023. Available at SSRN https://ssrn.com/abstract=4248374 or http://dx.doi.org/10.2139/ssrn.4248374.

**Schneider, Thomas, Philip E. Strahan, and Jun Yang**, "Banking in the United States," *in Oxford Handbook of Banking Fourth Edition*, 2023, *Forthcoming.*

**Ueda, Masako**, "Banks versus Venture Capital: Project Evaluation, Screening, and Expropriation," *Journal of Finance*, 2004, *59* (2), 601–621.

**Vickery, James Ian and Joshua Wright**, "TBA Trading and Liquidity in the Agency MBS Market," *Economic Policy Review*, 2013, *19* (1).

**Xu, Chi**, "The Value of Contingent Liquidity from Banks to Nonbank Financiers," *Working Paper*, 2025. Available at SSRN: https://ssrn.com/abstract=5084953 or http://dx.doi.org/10.2139/ssrn.5084953.